

Measuring Pubertal Development:
A Comparison of Different Scales and Different Sources

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INTRODUCTION

The measurement of puberty is a critical component of many studies of adolescent development. Changing body features have been theoretically and empirically linked to attitudes and behavior. In addition, it is often necessary to get information about bodily changes without a physician's examination - especially when attempting to study large numbers of adolescents from non-clinical populations. Self-reports and parent-reports of pubertal development are often necessary. It is critical, then, that researchers know how self-reports and parent-reports of pubertal change are related to doctors' assessments of that change. It is also important to know how such agreement varies across different measures.

Fairly good agreement between children's and doctors' ratings of pubertal development using photographs or pencil drawings of the five Tanner stages has been reported (Duke, Litt, & Gross, 1980; Morris & Udry, 1980); reported agreement was higher in the study using photographs (Duke et al., 1980). Girls in these studies ranged in age from 9 to 16; boys from 11 to 18. Results were not broken down by age, however.

Brooks-Gunn, Warren, Rosso, and Gargiulo (1987) explored the relationships among child, parent, and doctor assessments of pubertal development in 11-13 year old girls. These investigators compared girls' and parents' reports on a) pictorial representations of the Tanner stages and b) the Pubertal Development Scale (PDS) (Petersen, Crockett, Tobin-Richards, & Boxer, 1985) to doctors' ratings of Tanner stage. Both mothers and daughters were in close, although not exact, agreement with doctors when pubertal classifications were made. Girls were rated as more pubertally mature when using the PDS than when using the Tanner pictures.

The present study extends previous work in four ways:

- 1) Reports of boys, their parents, and their doctors on the Pubertal Development Scale are examined as well as the reports for girls;

- 2) Doctors completed the PDS as well as parents and children, allowing comparisons between children, parents, and doctors on the same measure;

- 3) Children range in age from 8 to 13, thereby including earlier stages of puberty than in all but the Duke et al. study; degree of agreement between respondents on the PDS is broken down by age groups;

4) This study reports more detailed information about how child, parent, and doctor reports of puberty differ from one another;

5) Child and parent agreement on Tanner schematic drawings is reported for both boys and girls. Comparisons between Tanner schematics and the PDS are also made for both sexes.

METHODS

STUDY 1. Several local pediatricians cooperated in recruiting participants for this study. When children between the ages of 8 and 13 came in for physicals, they and the accompanying parent were presented with a letter describing the study, and copies of the questionnaires they would fill out. If the child and / or the parent agreed to participate, the doctor, parent and child filled out a Pubertal Development Scale (Petersen et al., 1985). Due to doctors' concern over the assessment of "body hair", the "body hair" item was replaced with two items: one asking about growth of "pubic hair" and one about "underarm hair"¹. In addition to completing the PDS, doctors recorded the Tanner stage they would assign to that child in their own records on the PDS form. Completed forms were collected by the doctors, who returned them to us.

Data were collected for 45 girls and 33 boys. The girls ranged in age from 8 to 13 years; the boys ranged in age from 8 to 15 years, although all but two boys were between 8 and 12 years. Most (89% for girls and 70% for boys) of the participating parents were mothers.

STUDY 2. Children and parents in this study were participants in a larger study of hormones and behavior at adolescence. Subjects were recruited through local pediatricians, orthodontists, and girl scout troupes, who provided names and addresses of families with early adolescent children. These families were sent a letter describing the study, and asked to return a postcard indicating whether or not they wished to participate. In an interview in the subject's home, the early adolescent and his/her parents (separately) completed the Pubertal Development Scale as well as ratings on schematic drawings of the Tanner stages (breast and pubic hair development for girls; genital and pubic hair development for boys).

¹Correlations between reports of pubic and underarm hair ranged from .43 to .72. In all cases where disagreements occurred, pubic hair was said to be more advanced in growth than underarm hair.

Information was obtained for thirty-two girls (aged 10 to 11) and 28 boys (aged 11 to 13). Again, in most cases, mothers were the parent reporting on their child's development. For girls, 81% of the parent reports were completed by mothers, 3% by fathers, and 16% by both. For boys, 64% of the parent reports were completed by mothers, 29% by fathers, and 7% by both.

PUBERTAL STAGE RATINGS

1. PDS: MEAN PUBERTY SCORE

A mean pubertal score was calculated for each subject in both studies, according to the method suggested by Petersen et al. (1985). For girls, scores on items concerning growth spurt, breast development, body hair development¹, and skin changes were averaged. For boys, scores on items concerning growth spurt, body hair development, skin changes, voice changes, and facial hair were averaged².

2. PDS: DERIVED TANNER STAGE

A derived Tanner classification was also computed for each subject in both studies, according to the Petersen et al. (1985) algorithm. For boys, this classification was based on degree of voice change, body hair growth, and facial hair growth. For girls, this classification was based on menarcheal status, breast development, and body hair growth.

3. DOCTOR ASSIGNED TANNER STAGES

In Study 1, doctors were asked to assign a Tanner stage to each child examined.

4. SCHEMATIC DRAWINGS OF TANNER STAGES

In Study 2, early adolescents rated themselves using drawings of the Tanner stages. Girls rated themselves on stages of breast and pubic hair development; boys rated themselves on stages of genital and pubic hair development. Parents rated their adolescent using the same drawings. Tanner picture scores for each individual index of puberty were used, as well as a mean pubertal rating that averaged responses on the two sets of pictures for each child.

¹In Study 1, the item measuring body hair was specifically worded as "pubic hair".

²Facial hair was not included in the composites for boys in Study 2.

5. PDS: INDIVIDUAL ITEMS

In Study 2, ratings on individual items regarding breast (for girls) and body hair (for girls and boys) development from the PDS are compared directly to ratings on the corresponding Tanner drawings.

RESULTS

STUDY 1

AGREEMENT BETWEEN CHILDREN, PARENTS AND DOCTORS

FOR GIRLS:

- Correlations between child, parent, and doctor PDS reports ranged from .70 to .80. (See Table 1).

- Agreement between child and doctor was lowest for 10 year olds and highest for 11-13 year olds. Parent-doctor agreement varied by measure of puberty used. For 10 year olds, parents were in better agreement with doctors if a limited set of indices was used (derived Tanner Stage); for 11-13 year olds there was better agreement on a broader set of indices (mean pubertal score). (See Table 2).

- For 8 to 10 year olds, parents were in closer agreement with the doctor than the child; for 11-13 year old girls, child report was in as good or better agreement with doctors than parent report. (See Table 2).

- Where differences occurred, 8-9 year old girls rated themselves as less mature than parents and doctors rated them; 10-13 year old girls rated themselves as more mature than parents and doctors. (See Figures 1 and 2). Where parents differed from doctors, they were equally likely to rate 8-10 year old girls as more or less advanced than the doctors; for 11-13 year old girls, parents more often rated their child as less advanced than doctors did. (See Figure 3).

FOR BOYS:

- Correlations between child, parent, and doctor PDS reports ranged from .46 to .77, although only one correlation exceeded .60. (See Table 1).

- Agreement between child and doctor was better at younger ages; agreement between parent and doctor was better for older boys. (See Table 2).

- Child-doctor agreement was always as good or better than parent-doctor agreement. (See Table 2).

- Where differences occurred, boys of all ages rated themselves as more mature than doctors or parents rated them. (See Figures 4 and 5). Differences between parents and doctors went in both directions. (See Figure 6).

CORRESPONDENCE BETWEEN DERIVED TANNER STAGE (PDS) AND TANNER STAGE ASSIGNED BY DOCTOR:

FOR GIRLS:

- Correlations were best for 8-9 year olds and best for doctors' own ratings on the PDS. Correspondence between self- and parent- reported PDS stage and doctors' assignments were only moderate for girls 10 and older; they were particularly low for parents of 11 to 13 year olds. (See Table 3).

- The PDS resulted in more advanced classification than Tanner rating assigned by doctor. (See Figure 7). The same pattern occurred within all age groups, and for all respondents.

FOR BOYS:

- Moderate correlations emerged for boys (.61 to .78). Self-report correlated more highly with doctor assignment than parent report. (See Table 4).

- Where differences occurred, they occurred in both directions for doctor and parent reports. In other words, stage ratings on the PDS were just as likely to be one more mature or one less mature than Tanner stage ratings assigned by doctors. Boys themselves, however, classified themselves as further along in development using the PDS as compared to doctors' assigned stage. (See Figure 8).

STUDY 2

AGREEMENT BETWEEN CHILDREN AND PARENTS ON TANNER SCHEMATICS

FOR GIRLS:

- Correlations between child and parent ranged from .66 to .81. The correlation on the mean of the two Tanner pictures was highest, but may have hidden differences on ratings of specific indices. (See Table 5).

- Where differences occurred, girls rated themselves as more advanced than parents rated them. (See Figure 9).

FOR BOYS:

- Correlations between child and parent ranged from .31 to .48. (See Table 5).

- Where differences occurred, boys rated themselves as more advanced than parents rated them, sometimes by 3 stages. (See Figure 10).

AGREEMENT BETWEEN TANNER SCHEMATICS AND THE PDS

FOR GIRLS:

- Correlations between the two scales ranged from .41 to .63 for girls own report. Parents rated more consistently across the scales (.63 to .84). (See Table 6).

- Where differences occurred, girls were rated as more advanced using the PDS. (See Figures 11 and 12).

FOR BOYS:

- Correlations between the two scales ranged from .08 to .57 for boys' own report, with the best correlation between the "body hair" item on the PDS and the Tanner pubic hair picture. As with girls, parents rated more consistently than their sons across the two scales (.54 to .72). (See Table 6).

- Where differences occurred, boys were rated as more advanced using the Tanner pictures. (See Figures 13 and 14).

DISCUSSION

Agreement between child, parent, and doctor on scales of pubertal development is generally better for girls than boys. This is true across pairs of respondents and across scales. This difference has not been reported before, and may be particularly true for boys in the early stages of puberty. Other studies (Duke et al., 1980; Morris & Udry, 1980) that have sample boys have used a broad age range. As Brooks-Gunn et al. (1987) point out, large age ranges might result in inflated correlations given the strong relationship between age and pubertal development.

Girls agree least with doctors at age 10; boys agree least at ages 11-12. For each sex, these are the ages when initial pubertal changes are most likely to be taking place. Initial pubertal changes may be the hardest for the child and / or the doctor to assess.

Parents' reports of a child's pubertal development more closely approximate an "objective" report (using doctor as the standard) than the child's own self-report IF that child is a girl and IF the girl is young (8-9 years old). Brooks-Gunn et al. (1987), in a sample of 11-13 year old girls, reported agreement between mothers and doctors that was just as high as agreement between girls and doctors. In this study, mothers of 11-13 year old girls were good assessors of the girls' development if multiple indices were used in the pubertal composite. However, 11-13 year old girls were equally as good or better raters of their own pubertal status than their parents.

At all ages, boys agree more closely with doctors about their pubertal status than their parents do. Since the majority of parents in Study 1 were mothers, this may reflect that fact that mothers do not know much about their

sons' physical development. Fathers might be better raters of sons. However, it may also indicate that boys' pubertal development is simply hard to rate.

Although girls are in fairly high agreement with parents and doctors, differences that occur are systematic by age. Eight to nine year old girls say they are less developed than parents or doctors do. Perhaps parents and doctors notice the very first, very subtle, signs of puberty before the child does. Once pubertal signs are noticeable by the girl (ages 10 and older) girls tend to rate themselves as more mature than parents and doctors rate them.

Boys systematically rate themselves as more mature than parents or doctors rate them. This may have to do with the fact that pubertal changes (e.g. more muscular build) for boys are societally valued; thus, puberty is something boys want to approach. It may also reflect difficulty identifying and classifying pubertal changes for boys.

Doctors' ratings on the PDS are in fairly high agreement with their Tanner stage assignments, especially for young (8-9 years) girls. For older girls, the PDS more often results in ratings that are more advanced (for all respondents) than the doctors' Tanner classification.

Boys' self-ratings on the PDS are more advanced than the Tanner stage assigned to them by doctors, but differences between doctor and parent PDS reports and assigned Tanner stage are not systematic. This suggests that for boys (unlike for girls) the PDS does not systematically result in more mature classifications; rather, boys tend to rate themselves as more mature than parents and doctors whatever comparison measure is used.

Child - parent correlations on Tanner schematic drawings are in the range of those reported by other authors (Brooks-Gunn et al., 1987; Duke et al., 1980; Morris & Udry, 1980) for girls but not for boys. As explained above, the lower correlations for boys may be due to the more restricted age range used in this sample, an age range in which pubertal change may also be particularly difficult to describe.

Using the Tanner schematics, both girls and boys tend to rate themselves as more mature than parents rate them.

The PDS and Tanner schematics may give very similar information if parents are the respondents. For girls' self-report, Tanner schematic ratings may be more accurate reflections of actual pubertal growth given the findings that ratings on the PDS in Study I (for all respondents) resulted in

more mature pubertal classifications than a doctors' Tanner stage assignment. Since girls rate themselves as less advanced on the schematic drawings than on the PDS, the schematic ratings may be closer to a doctors' assessment. Brooks-Gunn et al. (1987) also found that girls' rated themselves as more advanced on the PDS than on Tanner pictures, and that girls' self-ratings on Tanner pictures correlated more highly with doctors' Tanner staging than girls' self-ratings on the PDS.

For boys, unlike for girls, Tanner pictures may be less accurate reflections of pubertal development than the PDS. In Study 1, boys consistently tended to rate themselves as more advanced on the PDS than doctors and parents. In Study 2, boys rated themselves as more advance on the Tanner pictures than on the PDS. Potentially, then, the Tanner drawings result in extreme "overestimations" of development for boys.

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- Duke, P.M., Litt, I.F., & Gross, R.T. (1980). Adolescents' self-assessment of sexual maturation. Pediatrics, 66(6), 918-920.
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STUDY 1

Table 1

Correlations between Pubertal Composites Derived from
Child, Parent, and Doctor Report on the Pubertal Development Scale: Results
for All Children

	N	Mean Puberty Score	N	Derived "Tanner Stage"
Girls:				
Child : Doctor	40	.72	43	.75
Parent : Doctor	42	.76	42	.80
Parent : Child	39	.75	42	.72
Boys:				
Child : Doctor	30	.60	30	.54
Parent : Doctor	28	.54	28	.46
Parent : Child	26	.77	26	.60

STUDY I

Table 2

Correlations between Pubertal Composites Derived from
Child, Parent, and Doctor Report on the Pubertal Development Scale: Results
by Age Group

	Mean Puberty Score			Derived "Tanner Stage"		
	8-9	10	11-13	8-9	10	11-13
Girls:						
Age:	8-9	10	11-13	8-9	10	11-13
Child : Doctor	.68(15)	.54(16)	.88(9)	.71(17)	.67(16)	.90(10)
Parent : Doctor	.90(17)	.44(16)	.89(9)	.78(17)	.85(16)	.56(9)
Parent : Child	.68(14)	.75(17)	.82(8)	.70(16)	.68(17)	.75(9)
Boys:						
Age:	8-10	11-12		8-10	11-12	
Child : Doctor	.92(6)	.72(22)		.79(6)	.58(22)	
Parent : Doctor	.42(6)	.68(20)		.25(6)	.58(20)	
Parent : Child	.47(6)	.77(18)		.32(6)	.67(18)	

STUDY 1

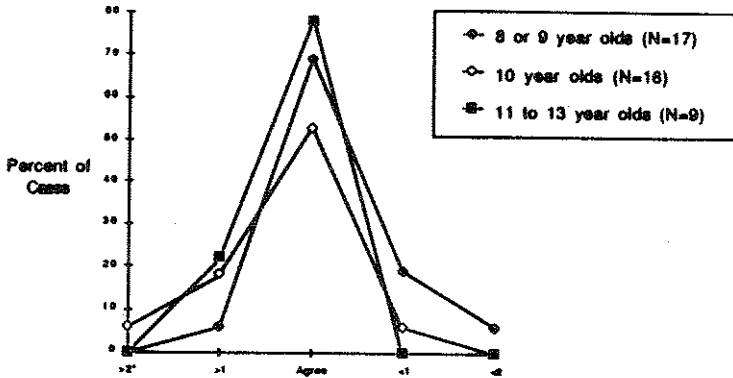


Figure 1. Agreement between Girls and Parents on Derived Tanner Stage from the PDS: Results by Age Group

*Child rates child's development as 2 stages higher than the parent.

STUDY 1

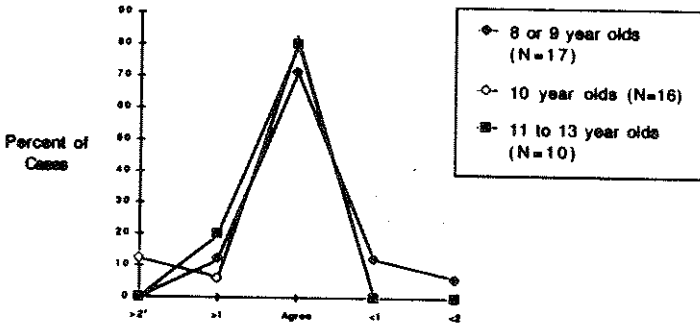


Figure 2. Agreement between Girls and Doctors on Derived Tanner Stage from the PDS: Results by Age Group

*Child rates child's development as 2 stages higher than the doctor.

STUDY 1

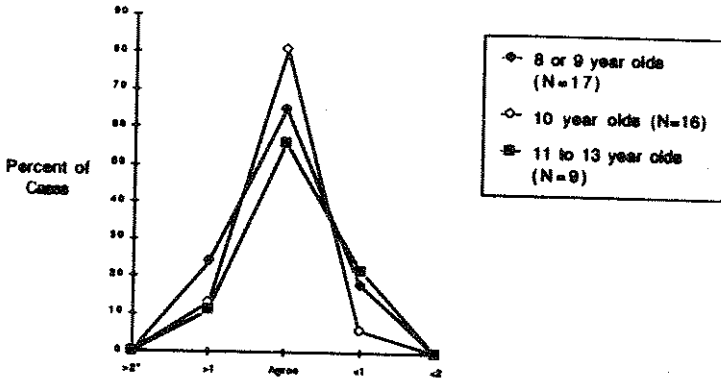


Figure 3. Agreement between Parents and Doctors on Derived Tanner Stage from the PDS: Results for Girls by Age Group

*Parent rates child's development as 2 stages higher than the doctor.

STUDY 1

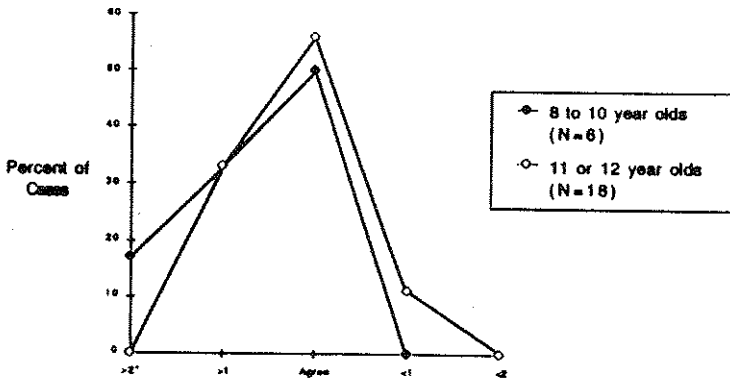


Figure 4. Agreement between Boys and Parents on Derived Tanner Stage from the PDS: Results by Age Group

*Child rates child's development as 2 stages higher than the parent.

STUDY 1

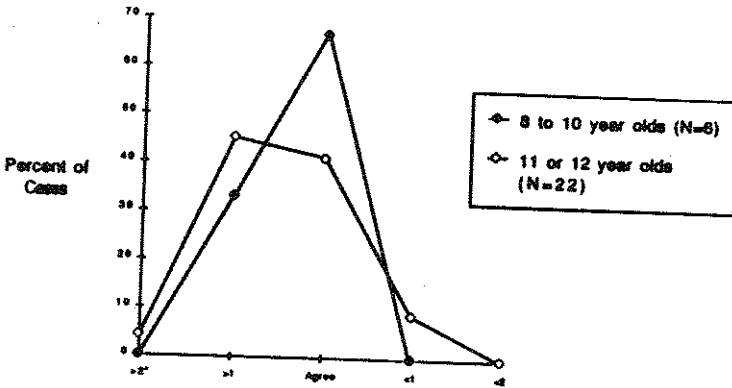


Figure 5. Agreement between Boys and Doctors on Derived Tanner Stage from the PDS: Results by Age Group

*Child rates child's development as 2 stages higher than the doctor.

STUDY 1

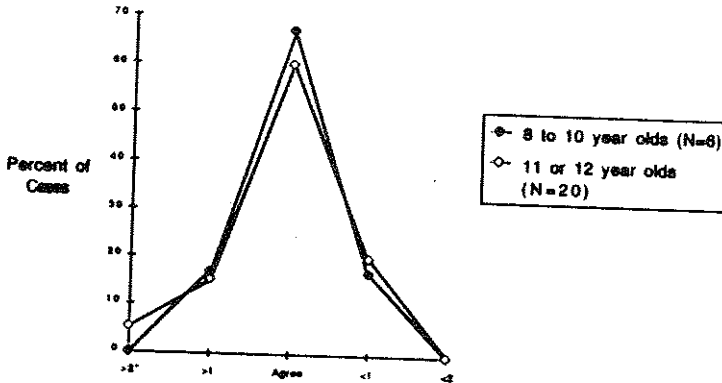


Figure 6. Agreement between Parents and Doctors on Derived Tanner Stage from the PDS: Results for Boys by Age Group

*Parent rates child's development as 2 stages higher than the doctor.

STUDY 1

Table 3

Correlations between PDS Derived Tanner Categories and Tanner Stages
Assigned by Physician for Girls

	All Girls		8 to 9 yr olds		10 yr olds		11 to 13 yr olds	
	r	N	r	N	r	N	r	N
Doctor PDS :								
Tanner Stage	.83	(33)	.91	(15)	.67	(11)	.76	(7)
Child PDS :								
Tanner Stage	.71	(32)	.78	(14)	.52	(11)	.60	(7)
Parent PDS :								
Tanner Stage	.70	(32)	.78	(14)	.65	(11)	.30	(7)

STUDY 1

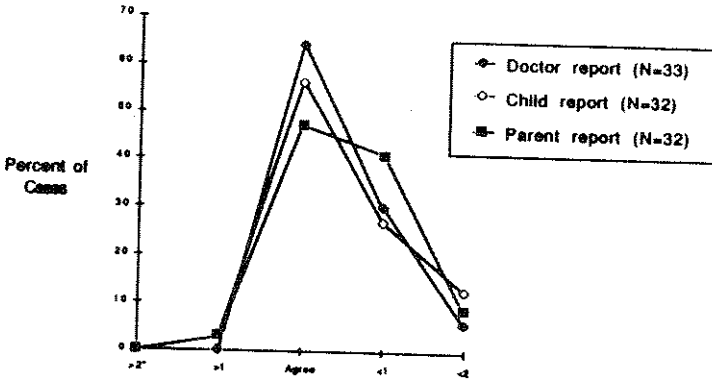


Figure 7. Agreement between Derived Tanner Stage from the PDS and Doctors' Tanner Stage Assignments: Results for Girls

*Tanner assignment rates child's development as 2 stages higher than the PDS.

STUDY I

Table 4

Correlations between PDS Derived Tanner Categories and Tanner Stages Assigned by Physician for Boys

	All Boys		8 to 10 year olds		11 to 12 year olds	
	r	N	r	N	r	N
Doctor PDS :						
Tanner Stage	.78	(26)	1.00	(4)	.67	(21)
Child PDS :						
Tanner Stage	.72	(24)	1.00	(4)	.78	(19)
Parent PDS :						
Tanner Stage	.61	(23)	1.00	(4)	.66	(18)

STUDY 1

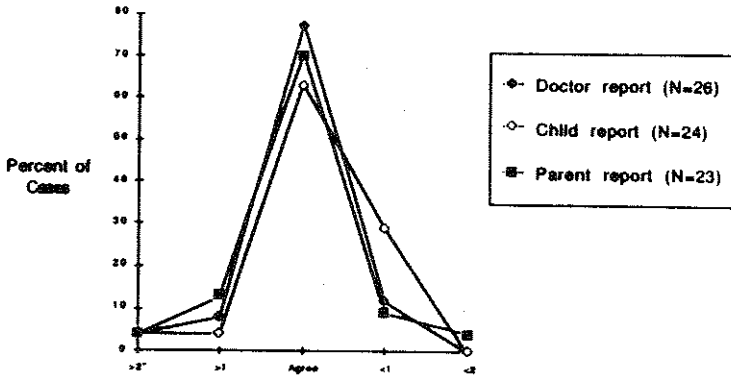


Figure 8. Agreement between Derived Tanner Stage from the PDS and Doctors' Tanner Assignments: Results for Boys

*Tanner assignment rates child's development as 2 stages higher than the PDS.

STUDY 2

Table 5

Correlations between Child and Parent
on Schematic Tanner Drawings

	Girls		Boys	
	r	N	r	N
Pubic Hair Drawing	.69	(29)	.43	(20)
Breast / Genital Drawing	.66	(31)	.31	(22)
Mean of Pubic Hair and Breast / Genital Drawing	.81	(29)	.48	(19)

STUDY 2

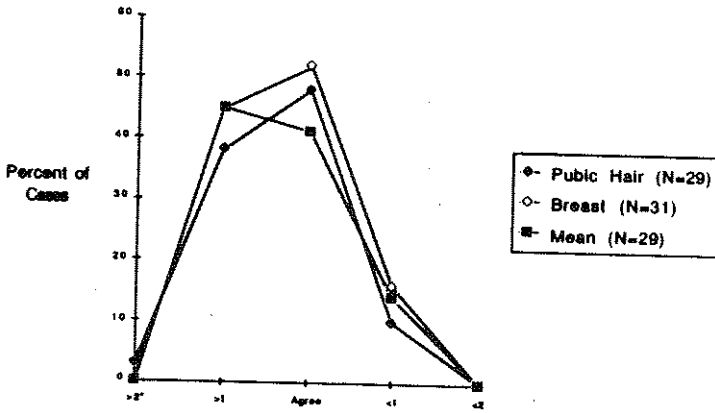


Figure 9. Agreement between Girls and Parents on Tanner Schematic Drawings

*Child rates child's development as 2 stages higher than the parent.

STUDY 2

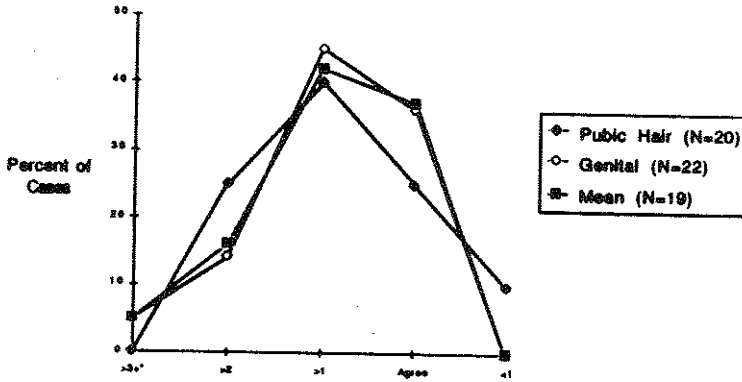


Figure 10. Agreement between boys and parents on Tanner Schematic Drawings

*Child rates child's development as 3 or more stages higher than the parent.

STUDY 2

Table 6

Correlations between Items and Derived Tanner Composites from the Pubertal Development Scale and Ratings on Schematic Tanner Drawings

	Girls		Boys	
Child Report:				
PDS Body Hair Item: Pubic Hair Drawing	.41	(32)	.57	(27)
PDS Composite: Pubic Hair Drawing	.62	(32)	.13	(27)
PDS Breast Item: Breast Drawing	.63	(32)	N.A.	N.A.
PDS Composite: Breast / Genital Drawing	.44	(32)	.08	(26)
PDS Composite: Mean of Pubic Hair and Breast / Genital Drawings	.59	(32)	.12	(26)
Parent Report:				
PDS Body Hair Item: Pubic Hair Drawing	.84	(29)	.68	(21)
PDS Composite: Pubic Hair Drawing	.80	(29)	.72	(21)
PDS Breast Item: Breast Drawing	.73	(31)	N.A.	N.A.
PDS Composite: Breast / Genital Drawings	.63	(31)	.54	(24)
PDS Composite: Mean of Pubic Hair and Breast / Genital Drawings	.79	(29)	.72	(21)

STUDY 2

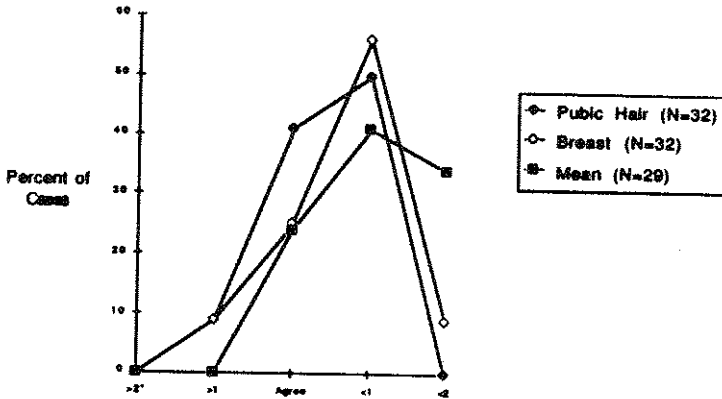


Figure 11. Agreement between Derived Tanner Stage from the PDS and Tanner Schematic Ratings: Results for Girls' Self-Report

*Tanner Picture rates child's development as 2 stages higher than the PDS.

STUDY 2

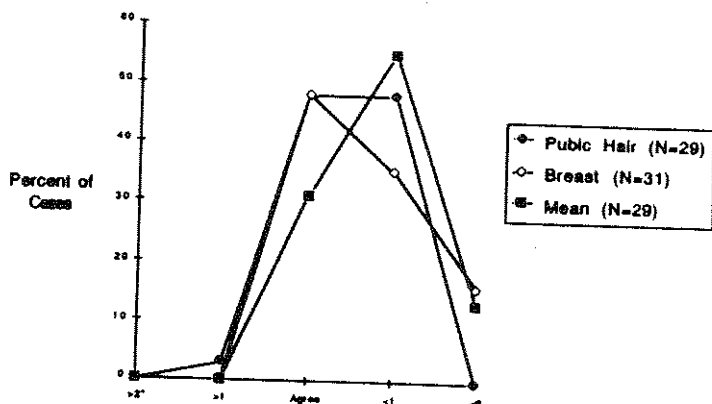


Figure 12. Agreement between Derived Tanner Stage from the PDS and Tanner Schematic Ratings: Results for Parents of Girls

*Tanner Picture rates child's development as 2 stages higher than the PDS.

STUDY 2

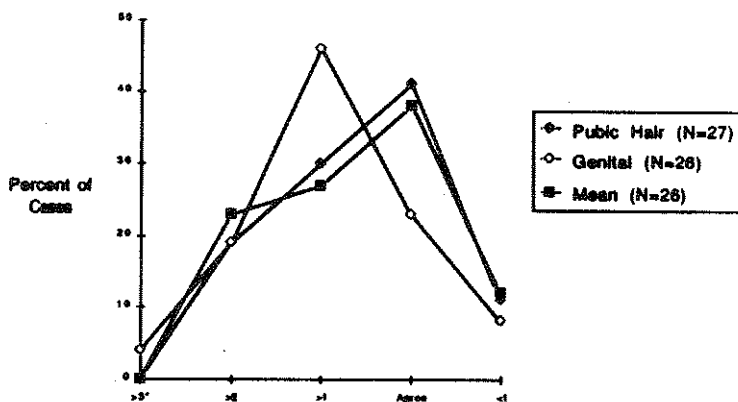


Figure 13. Agreement between Derived Tanner Stage from the PDS and Tanner Schematic Ratings: Results for Boys' Self-Reports

*Tanner Picture rates child's development as 3 stages higher than the PDS.

STUDY 2

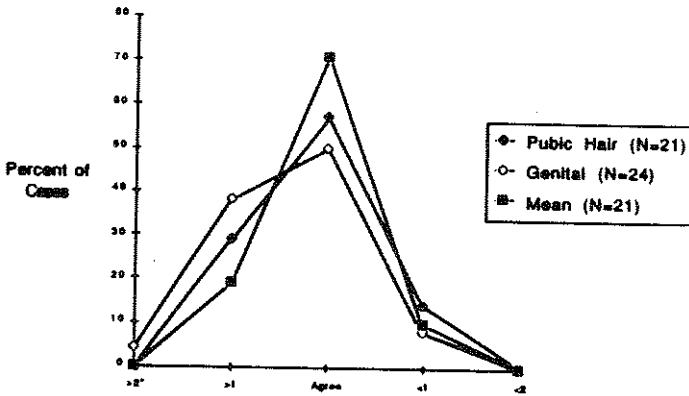


Figure 14. Agreement between Derived Tanner Stage from the PDS and Tanner Schematic Ratings: Results for Parents of Boys

*Tanner Picture rates child's development as 2 stages higher than the PDS.