Validation of a Self-Administered Instrument to Assess Stage of Adolescent Development[1]

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Drawings were made from Tanner's photographs illustrating five stages of development each for male genitalia, testicular size, male pubic hair, female breasts, and female pubic hair. Forty-seven females and forty-eight males aged 12-16 years indicated on questionnaires which stage they were most like, and answered other questions related to their physical development. Afterwards they were examined by physicians who had not seen their answers. Pearson correlation coefficients were 0.6 or above for the physician's observations compared with the adolescents' answers for the drawings, with the exception of testicular size. Answers to questions concerning amount of underarm hair and general development also yielded high correlations.

INTRODUCTION

Tanner's stages of maturity are well known to pediatricians as standards for assessing pubertal development. Photographs published by Tanner (1975) illustrate five stages of development each for (1) male genitalia, (2) male pubic hair, (3) female breasts, and (4) female pubic hair.

The present authors wanted to use Tanner's stages as biological bench-marks against which to examine the development of heterosexual behavior in normal adolescents, but wanted to avoid performance of physical examinations on every subject. Familiar with previous experiments on the use of self-assessment instruments by adolescents (Alexiou, *et al.*, 1969; Brown *et al.*, 1975), we could discover no such applications of Tanner's standards.

We therefore had drawings made from Tanner's photographs, added some explanatory information and instructions, and prepared a short series of questions designed to supplement the self-comparisons with the drawings. Before relying on self-rated measures in a study where the measures would define a key variable, we deemed it essential to determine the validity of the self-ratings. We now report the results of our validation study, expecting that an instrument making possible the assessment of pubertal stage by self-rating will have value for other investigators.

METHOD

Separate instruments were assembled for males and females. Adjacent to the drawings illustrating Tanner's stages of development of breasts and pubic hair, or pubic hair and male genitalia (with a separate series representing increase in testicular size), instructions request the adolescent to "choose the drawing closest to your stage of development." Written descriptions amplify the drawings (see Figures 1-5).

One question asked, "How much underarm hair do you have now"? Answers were multiple choice, from "None at all" to "As much... as I will probably ever have." Other questions were quite similar and concerned hair on face, around nipples, on abdomen, and on legs (depending on sex of respondent). Additional questions were asked to amplify the adolescents' answers, such as "How often do you shave?" and "Do the clothes you wore last year still fit?" (Since the latter questions could not be validated by an examiner they are not dealt with further in this paper.) In this report physicians' observations are compared with adolescents' answers to the same questions. A final question answered by both adolescent and examiner (concerning the adolescent) was, "Imagine that the numbers below stand for seven equal stages of sexual development (your physical development) from childhood to adulthood. Please circle the stage which best stands for your stage of sexual development." A scale with numbers 1-7 and three points — childhood at 1, adolescence at 4, and adulthood at 7 — was given.

Six physicians, including author NMM, carried out the examinations. Five are pediatricians; one sees children in his family medicine practice. Four of the physicians enlisted participants from their private practices; two recruited adolescents attending a community clinic.

The procedure was as follows: When a student in grades 7-12 accompanied by a parent or guardian came for a routine health checkup (usually a "camp physical" or "school physical") the study was explained to adult and child, and both

THE DRAWINGS ON THIS PAGE SHOW DIFFERENT STAGES OF DEVELOPMENT OF THE BREASTS. A FEMALE PASSES THROUGH EACH OF THE FIVE STAGES SHOWN BY THESE SETS OF DRAWINGS. PLEASE LOOK AT EACH SET OF DRAWINGS AND READ THE SENTENCES UNDER THE DRAWING. THEN CHOOSE THE SET OF DRAWINGS CLOSEST TO YOUR STAGE OF BREAST DEVELOPMENT AND MARK IT 1. THEN CHOOSE THE DRAWING THAT IS THE NEXT CLOSEST AND MARK IT 2.

1. DRAWING A   2. DRAWING B   3. DRAWING C   4. DRAWING D   5. DRAWING E

Areola
Nipple
Breast

THE NIPPLE IS RAISED A LITTLE IN THIS STAGE. THE REST OF THE BREAST IS STILL FLAT.

THIS IS THE BREAST BUD STAGE. IN THIS STAGE THE NIPPLE IS RAISED MORE THAN IN STAGE 1. THE BREAST IS A SMALL MOUND. THE AREOLA IS LARGER THAN IN STAGE 1.

THE AREOLA AND THE BREAST ARE BOTH LARGER THAN IN STAGE 2. THE AREOLA DOES NOT STICK OUT AWAY FROM THE BREAST.

THE AREOLA AND THE NIPPLE MAKE UP A MOUND THAT STICKS UP ABOVE THE SHAPE OF THE BREAST. (NOTE: THIS STAGE MAY NOT HAPPEN AT ALL FOR SOME GIRLS. SOME GIRLS DEVELOP FROM STAGE 3 TO STAGE 5, WITH NO STAGE 4.)

THIS IS THE MATURE ADULT STAGE. THE BREASTS ARE FULLY DEVELOPED. ONLY THE NIPPLE STICKS OUT IN THIS STAGE. THE AREOLA HAS MOVED BACK TO THE GENERAL SHAPE OF THE BREAST.

Fig. 1

THE DRAWINGS ON THIS PAGE SHOW DIFFERENT AMOUNTS OF FEMALE PUBIC HAIR. A GIRL PASSES THROUGH EACH OF THE FIVE STAGES SHOWN BY THESE DRAWINGS. PLEASE LOOK AT EACH DRAWING AND READ THE SENTENCES UNDER THE DRAWINGS. THEN CHOOSE THE DRAWING CLOSEST TO YOUR STAGE OF HAIR DEVELOPMENT AND MARK IT 1. THEN CHOOSE THE DRAWING THAT IS NEXT CLOSEST AND MARK IT 2.
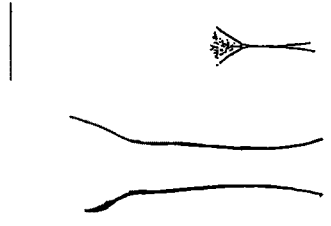
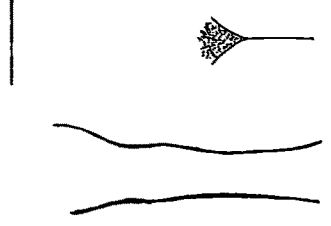1. DRAWING A   2. DRAWING B   3. DRAWING C   4. DRAWING D   5. DRAWING E

THERE IS NO PUBIC HAIR.
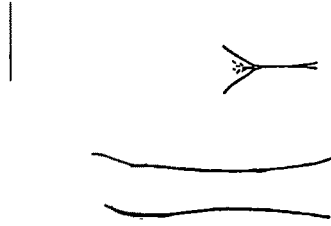
THERE IS A LITTLE LONG, LIGHTLY COLORED HAIR. THIS HAIR MAY BE STRAIGHT OR A LITTLE CURLY.

THE HAIR IS DARKER IN THIS STAGE. IT IS COARSER AND MORE CURLED. IT HAS SPREAD OUT AND THINLY COLVERS A LARGER AREA.

THE HAIR IS NOW AS DARK, CURLY, AND COARSE AS THAT OF AN ADULT FEMALE. HOWEVER, THE AREA THAT THE HAIR COVERS IS NOT AS LARGE AS THAT OF AN ADULT FEMALE. THE HAIR HAS NOT SPREAD OUT TO THE THIGHS.
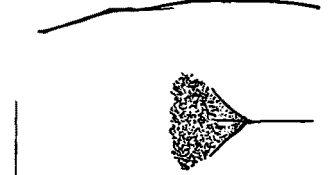
THE HAIR NOW IS LIKE THAT OF AN ADULT FEMALE. IT ALSO COVERS THE SAME AREA AS THAT OF THE ADULT FEMALE. THE HAIR USUALLY FORMS A TRIANGULAR (▽) PATTERN AS IT SPREADS OUT TO THE THIGHS.

Fig. 2

THE DRAWINGS ON THIS PAGE SHOW DIFFERENT AMOUNTS OF MALE PUBIC HAIR. A BOY PASSES THROUGH EACH OF THE FIVE STAGES SHOWN BY THESE DRAWINGS. PLEASE LOOK AT EACH DRAWING AND READ THE SENTENCES UNDER THE DRAWING. THEN CHOOSE THE DRAWING CLOSEST TO YOUR STAGE OF YOUR HAIR DEVELOPMENT. MARK A 1 ON THE LINE ABOVE THAT DRAWING. THEN CHOOSE THE DRAWING THAT IS NEXT CLOSEST TO YOUR STAGE OF HAIR DEVELOPMENT AND MARK IT A 2. IN CHOOSING THE RIGHT PICTURE, LOOK ONLY AT THE PUBIC HAIR, AND NOT AT THE SIZE OF THE TESTES, SCROTUM, AND PENIS.
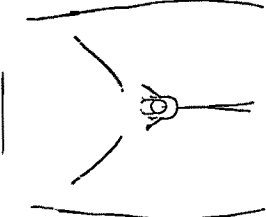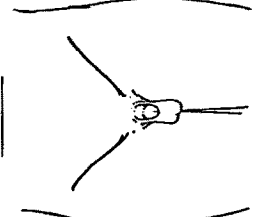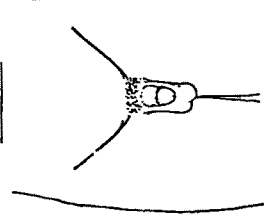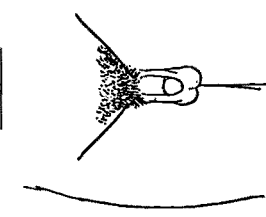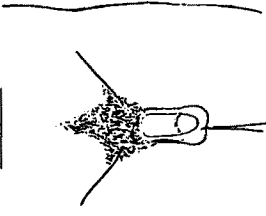
1. DRAWING A

2. DRAWING B

3. DRAWING C

4. DRAWING D

5. DRAWING E

THERE IS NO PUBIC HAIR AT ALL.

THERE IS A LITTLE SOFT, LONG, LIGHTLY COLORED HAIR. MOST OF THE HAIR IS AT THE BASE OF THE PENIS. THIS HAIR MAY BE STRAIGHT OR A LITTLE CURLY.

THE HAIR IS DARKER IN THIS STAGE. IT IS COARSER AND MORE CURLED. IT HAS SPREAD OUT AND THINLY COVERS A SOMEWHAT LARGER AREA.

THE HAIR IS NOW AS DARK, CURLY, AND COARSE AS THAT OF AN ADULT MALE. HOWEVER, THE AREA THAT THE HAIR COVERS IS NOT AS LARGE AS THAT OF AN ADULT MALE. THE HAIR HAS NOT SPREAD OUT TO THE THIGHS.

THE HAIR HAS SPREAD OUT TO THE THIGHS. THE HAIR IS NOW LIKE THAT OF AN ADULT MALE. IT COVERS THE SAME AREA AS THAT OF AN ADULT MALE.

Fig. 3

THE DRAWINGS OF THIS PAGE SHOW DIFFERENT STAGES OF DEVELOPMENT OF THE TESTES, SCROTUM, AND PENIS. A BOY PASSES THROUGH EACH OF THE FIVE STAGES SHOWN BY THESE DRAWINGS. PLEASE LOOK AT EACH OF THE DRAWINGS AND READ THE SENTENCES UNDER THE DRAWING. THEN CHOOSE THE DRAWING CLOSEST TO YOUR STAGE OF DEVELOPMENT. MARK A "1" ON THE LINE ABOVE THAT DRAWING. THEN CHOOSE THE DRAWING THAT IS NEXT CLOSEST TO YOUR STAGE OF DEVELOPMENT AND MARK IT "2". IN CHOOSING THE RIGHT PICTURE, LOOK ONLY AT THE STAGE OF DEVELOPMENT, NOT AT PUBIC HAIR.

1. DRAWING A   2. DRAWING B   3. DRAWING C   4. DRAWING D   5. DRAWING E

PENIS
SCROTUM
GLANS (HEAD)
TESTES
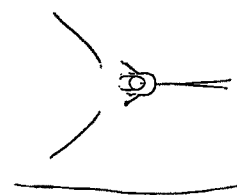
THE TESTES, SCROTUM, AND PENIS ARE ABOUT THE SAME SIZE AND SHAPE AS THEY WERE WHEN YOU WERE A CHILD.
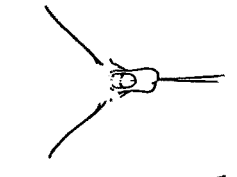
THE TESTES AND SCROTUM HAVE GOTTEN A LITTLE LARGER. THE SKIN OF THE SCROTUM HAS CHANGED. THE SCROTUM, THE SACK HOLDING THE TESTES, HAS LOWERED A BIT. THE PENIS HAS GOTTEN ONLY A LITTLE LARGER.
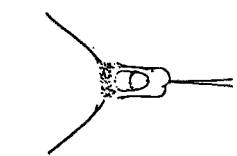
THE PENIS HAS GROWN MAINLY IN LENGTH. THE TESTES AND SCROTUM HAVE GROWN AND DROPPED LOWER THAN IN STAGE 2.
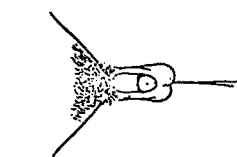
THE PENIS HAS GROWN EVEN LARGER. IT IS WIDER. THE GLANS (THE HEAD OF THE PENIS) IS BIGGER. THE SCROTUM IS DARKER THAN BEFORE. IT IS BIGGER BECAUSE THE TESTES HAVE GOTTEN BIGGER.

THE PENIS, SCROTUM, AND TESTES ARE THE SIZE AND SHAPE OF THAT OF AN ADULT MALE.

Fig. 4

As a male adolescent develops, the testes become larger and heavier than
they were when he was a child. Below are 5 drawings indicating testes
size. Please mark a *1* by the size that is closest to your size and a *2*
by the drawing that is next closest to your size.

1. _____

2. _____

3._____

4._____

5. _____
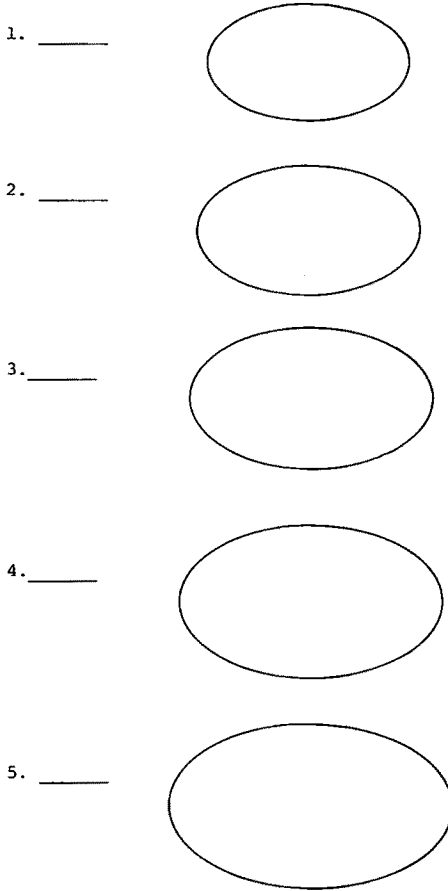
Fig. 5. (Reduced 30% for reproduction.)

were asked to sign a consent form if they were willing for the adolescent to par-
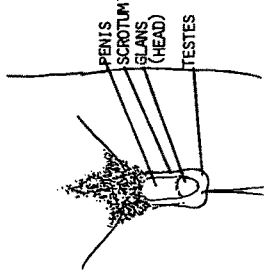ticipate. The child was then given the sex-appropriate questionnaire to fill out,
a private place in which to work on it, and an envelope in which to put it when
completed. The child was assured that no one in the office was going to look at
his/her answers, and that the information, when studied, would not be connected
with his/her name. After turning in the envelope to the doctor's assistant, the
child was completely examined by the physician. The physician independently
marked his/her identical questionnaire immediately after the examination.

The consent forms were filed separately from the completed questionnaires, which were anonymous to all investigators. The questionnaires, which were validated in Lake County, Illinois, were mailed to Chapel Hill, North Carolina, for data analysis.

RESULTS

Forty-seven females and 48 males participated. Age distributions are shown in Table I. Stages of maturity were fairly widely distributed, so that the correlations obtained were clearly not artifacts of ceiling effects. (see Table II). Whites, Blacks, adolescents with Spanish surnames, and a wide spectrum of socioeconomic backgrounds were included.

For multiple choice items, Pearson correlation coefficients are displayed for answers given by physicians and male adolescents in Table III. Adolescent male estimates of genital development, genital hair, underarm hair, and position on the scale of general development correlate in the range of 0.60 with physician observation. Adolescent male estimates of abdominal and facial hair correlate with physician observations somewhat less well (in the 0.30s). Estimates of testicular size based on adolescent recall and physician palpation do not agree at all, despite the fact that each correlates moderately well with some of the other group's answers. Analysis of physicians' testicular size estimates versus physicians' other observations yields correlations of 0.60-0.76 for individual items, all very significant. Comparison of adolescents' testicular size estimates with their other answers gives uniformly low correlations (some as low as 0.07) with marginal or low significance. This suggests that physicians were more accurate in their estimates. One cannot rule out the possibility, however, that physicians, but not students, were influenced in their estimates of testicular size by other developmental signs.

Pearson correlation coefficients are displayed for answers given by physicians and female adolescents in Table IV. Female estimates of breast and hair development, with the exception of facial hair, correlate with physician observa-

Table I. Frequency Distribution of Participants by Age

Age (years)	Girls (N = 47)	Boys (N = 48)
12	12	10
13	14	17
14	10	13
15	7	8
16	4	0

Table II. Girls' Breast Development

		Physician rating			
		2	3	4	5	Total
Adolescent rating	1	1	0	0	0	1
	2	2	1	2	0	5
	3	1	6	8	0	15
	4	0	3	11	5	19
	5	0	1	1	5	7
Total		4	11	22	10	47

Table III. Pearson Correlation Coefficients for Physicians' Observations Compared with Male Adolescents' Estimates of Various Characteristics

Characteristic	Coefficient (R)	Number of cases (N)[a]
Genital development	0.59[b]	(45)
Genital hair distribution	0.63[b]	(43)
Testicular size	0.18	(46)
Amount of underarm hair	0.68[b]	(43)
Amount of hair around nipple	0.13	(44)
Amount of hair on abdomen	0.32[b]	(43)
Amount of facial hair	0.37[b]	(45)
Position on scale of general adolescent development	0.57[b]	(46)

[a] Missing data account for N being less than 48 in the various correlations.
[b] $p \leqslant 0.05$.

Table IV. Pearson Correlation Coefficients for Physicians' Observations Compared with Female Adolescents' Estimates of Various Characteristics

Characteristic	Coefficient (R)	Number of cases (N)[a]
Breast development	0.63[b]	(47)
Genital hair distribution	0.81[b]	(47)
Amount of underarm hair	0.74[b]	(45)
Amount of facial hair	0.25	(46)
Amount of leg hair	0.44[b]	(44)
Position on scale of general adolescent development	0.52[b]	(39)

[a] Missing data reduce the N in correlations where the number of cases given is less than 47.
[b] $p \leqslant 0.05$.

tions at a level equal to or higher than that for males. The best female correlation was 0.81 for genital hair distribution. For leg hair, the lowest significant correlation, the value was 0.44.

DISCUSSION AND CONCLUSIONS

The degrees of correlation found for female breast, male genital (aside from testicular size), and genital hair development displayed in drawings plus answers to certain questions provide confidence that adolescent self-ratings of these characteristics will provide a meaningful biological context against which to consider behavior in new studies which desire to integrate sociological, psychological, and physiological factors. Actually, it might be possible to improve the levels of correlation. Adolescents who participated were not forewarned that physical development questions would be asked until immediately before they filled out the questionnaire, and it was not suggested that they privately look at themselves. In subsequent utilization of the self-rating items, if the methodology called for contacts in the student's home the student could be sent to a private room where he/she could examine himself/herself in order to provide greater accuracy in his/her answers. If the methodology called for answering the questions in a public place such as a classroom, the need for informed consent ahead of time might provide an opportunity to suggest self-examination before coming to participate.

ACKNOWLEDGMENTS

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Brown, S. S., Lieberman, E. J., and Miller, W. G. (1975). Young adults as partners and planners: A preliminary report on the antecedents of responsible family formation. Paper presented at the annual meeting of the American Public Health Association, Chicago, November 16-20.
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