

NIPPLE DEVELOPMENT IN FEMALE PUBERTY*

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Sexual development scores are used in evaluating the sexual maturation of adolescents. The visual Tanner scoring system evaluates the development of genitalia and pubic hair in males, and breast development and pubic hair development in females¹. Besides the visual system, an objective criteria, the orchidometer, is used to measure genital development in males². However, at present, there are no objective devices available which can be used to determine breast maturation of girls³. To determine the sexual maturation of girls, the five stage classification of breast maturation and pubic hair development is used, but some ambiguity between breast stages 4 and 5 has been found¹⁻⁴. The aim of this study is to determine the characteristics of nipple size in the different sexual stages of girls and to find measurable criteria between the five stages, especially stages 4 and 5.

Material and Methods

Two hundred and thirty girls aged between 11 and 17 years, with no history of endocrinological or severe somatic problems who were seen at the Adolescence Unit of the Hacettepe University Children's Hospital were evaluated. Breast and pubic hair maturation was staged by Tanner's criteria. Masters and Johnson⁵ mention that cold, tactile or psychic stimulation may lead to areolar engorgement which may mimic the areolar mound of breast stage 4, and that some changes in the diameter of the base of the nipple may also occur. To circumvent these problems, breast staging was assessed prior to breast palpation. The diameter of the areola and only the plateau portion of the erect nipple were measured by the same observer using a plastic ruler. Nipple diameter was compared to the breast and pubic hair stages and menstrual status. Menstrual status was calculated as the number of months subsequent to menarche by recall. For comparison, their results were categorized into four menstrual age groupings: premenstrual or length of time postmenarche. M(-): premenstrual period; M+1: postmenarche of one year or less; M+2: postmenarche of one-two years; M+3: postmenarche of more than two years.

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Results

Tables I, II and III show the nipple size of adolescent girls with respect to breast size (B), pubic hair (PH), and menstrual (M) status.

Table I: Nipple Diameter Versus Breast Development

<u>Stage</u>	<u>Number of children</u>	<u>Nipple size (mm)±SD</u>
B 1	18	1.80±0.87
B 2	45	4.24±2.18
B 3	59	5.93±2.07
B 4	59	7.10±2.28
B 5	49	8.67±2.70
B 1 vs B 2	p<0.001	
B 2 vs B 3	p<0.001	
B 3 vs B 4	p<0.001	
B 4 vs B 5	p<0.01	

Table II: Nipple Diameter Versus Pubic Hair Stages

<u>Stage</u>	<u>Number of children</u>	<u>Nipple size (mm)±SD</u>
PH 1	13	1.67±0.63
PH 2	47	4.36±2.03
PH 3	56	6.16±2.13
PH 4	58	6.95±2.20
PH 5	56	8.55±2.63
PH 1 vs PH 2	P<0.001	
PH 2 vs PH 3	p<0.001	
PH 3 vs PH 4	p<0.05	
PH 4 vs PH 5	p<0.001	

Table III: Nipple Diameter Versus Menstrual Status

<u>Menstrual status</u>	<u>Number of children</u>	<u>Nipple size (mm)±SD</u>
M(-)	79	4.22±2.16
M +1	62	6.57±2.26
M +2	40	7.23±2.39
M +3	49	8.48±2.60

M(-) vs M +1 $p < 0.001$

M +1 vs M +2 $p > 0.05$

M +2 vs M +3 $p < 0.05$

Statistical analysis was performed using Student's *t* test in which the breast stage, pubic hair stage and menstrual status groups were compared with respect to their previous groups⁶. Significant increments in nipple diameter were noted between stages B1, B2, B3, B4 and B5 but the differences between stages B1, B2, B3, and B4 were more significant ($p < 0.001$) than the difference between B4 and B5 ($p < 0.01$). With respect to pubic hair stages, the differences between PH1, PH2, PH3, PH4 and PH5 from their previous stages were also statistically significant. The differences between PH1 and PH2, PH2 and PH3 and PH4 and PH5 were more significant ($p < 0.001$) than the difference between the PH3 and PH4 stages ($p < 0.05$). The nipple diameter was significantly greater in M+1 with respect to M(-) ($p < 0.001$), and in M+3 with respect to M+2 ($p < 0.05$). There was no statistically significant difference in the nipple diameters between groups M+1 and M+2 ($p > 0.05$).

Discussion

The five stage classification of breast development as described by Tanner is widely used today. These stages are found by determining the breast bud and evaluating the shape of the areola and nipples¹. In the studies carried out by Reynolds and Wines⁷ and by Tanner¹, there is significant ambiguity between stages B4 and B5. In the former study, a secondary areola mound was absent in eight out of thirty-two girls, while seven others only had slight Tanner stage B4 development⁷. Tanner's experience was similar, and he also noted that in many girls the areola mound stage often persisted into adulthood¹.

In the semi-longitudinal study performed by Roche et al³, areola development was compared to chronological age, pubic hair stage, age of peak height velocity, age of menarche and subcutaneous fat thickness. Although they found increasing areola size with pubertal progression, it was concluded that areola size was not

significantly related to any of the factors studied. This lack of correlation, they noted indicated that genetic factors were the primary determinants of areolar size. Rohn^{4,8} performed two studies about nipple diameters in prepubertal and pubertal children. The results of these studies and our study are illustrated in Tables IV and V.

Table IV: Nipple Diameter Versus Breast Stage: Comparison of Other Studies

Stage	Nipple size (mm) \pm SD		
	Rohn's cross-sectional Study ⁴	Rohn's longitudinal Study ⁸	Hacettepe study
B 1	2.89 \pm 0.81	3.00 \pm 0.77	1.80 \pm 0.87
B 2	3.28 \pm 0.89	3.37 \pm 0.96	4.24 \pm 2.18
B 3	4.07 \pm 1.32	4.72 \pm 1.40	5.93 \pm 2.07
B 4	7.74 \pm 1.64	7.25 \pm 1.46	7.10 \pm 2.28
B 5	9.94 \pm 1.38	9.41 \pm 1.45	8.67 \pm 2.70

Table V: Nipple Diameter Versus Pubic Hair Stage: Comparison of Other Studies

Stage	Nipple size (mm) \pm SD		
	Rohn's cross-sectional study ⁴	Rohn's longitudinal study ⁸	Hacettepe study
PH 1	2.95 \pm 1.02	3.14 \pm 1.31	1.67 \pm 0.63
PH 2	3.32 \pm 0.91	3.69 \pm 1.34	4.36 \pm 2.03
PH 3	4.11 \pm 1.54	4.44 \pm 1.17	6.16 \pm 2.13
PH 4	7.15 \pm 1.81	6.54 \pm 1.47	6.95 \pm 2.20
PH 5	9.66 \pm 1.59	8.98 \pm 1.56	8.55 \pm 2.63

In our study there was a significant increment in nipple diameters in all breast and pubic hair stages with respect to the previous stages. In a cross-sectional study Rohn⁴ found minimal development from Tanner stages PH 1 to PH 3 and B 1 to B 3, but found a significant increment from B 4 to B 5, and from PH 4 to PH 5. He discovered that the greatest growth in papilla diameter occurred after stages B 3 or PH 3. In his longitudinal study, he again found minimal nipple development from Stages B 1 to B 3, and from PH 1 to PH 3 and confirmed the results of his previous cross-sectional study⁸. With respect to menstrual status, Rohn⁴⁻⁸ found the greatest growth in nipple diameter to be near menarche (from two years premenarche to one year post-menarche). In our study, the greatest growth in nipple diameter occurred between the M(-) and M(+1) periods (premenstrually and one year postmenarche). Rohn⁴⁻⁸ significantly concluded that his data

demonstrate that nipple size increases the distinction between stages B 4 and B 5, and that B 4 is associated with a nipple diameter of 7 to 7.5 mm and that B 5 is associated with a nipple diameter of 9 mm or greater. In our study, the mean value of nipple diameter in B 4 was 7.10 mm and in B 5 it was 8.67 mm. We discovered that there was a greater increase in nipple diameter from B 1 to B 2 (2.44 mm) and from PH 1 to PH 2 (2.69 mm). This indicates the effect of increasing estrogen in B 2 and PH 2 which results in nipple growth. Increments in nipple size in each pubertal stage may also demonstrate the hormonal effect but it is our opinion that the role of race, nutrition and genetics in nipple size cannot be overlooked. We believe that more cross-sectional and longitudinal studies from different parts of the world may narrow the wide range of differences and help in assigning specific measurements for nipple size to the currently used Tanner breast stages.

Summary

Nipple diameters of 230 girls aged between 11-17 were calculated with the aim of finding measurable criteria for breast development during female puberty. There was a significant increment in nipple diameters in each breast and public hair stage with respect to the previous stages. The maximum increment was found to be from B 1 to B 2 (2.44 mm), and from PH 1 to PH 2 (2.69 mm). With respect to menstrual status, the greatest growth in nipple diameter occurred from the premenstrual period (M(-)) to one year postmenarche (M +1) (2.35 mm). These results are compared with other studies in the literature, and it was concluded that increments in nipple size in each pubertal stage is related to the hormonal status as well as to race, nutrition and genetics. More longitudinal and cross-sectional data are needed in order to find a measurable criteria for the Tanner breast stages.

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