National Estimates of the Timing of Sexual Maturation and Racial Differences Among US Children

Shumei S. Sun, PhD*; Christine M. Schubert, MS*; William Cameron Chumlea, PhD*; Alex F. Roche, MD, PhD, DSc*; Howard E. Kulin, PhD‡; Peter A. Lee, PhD‡; John H. Himes, PhD§; and Alan S. Ryan, PhD‖

ABSTRACT. *Objective.* **To provide clinically meaningful, normative reference data that describe the timing of sexual maturity indicators among a national sample of US children and to determine the degree of racial/ethnic differences in these estimates for each maturity indicator.**

Methods. **Tanner staging assessment of sexual maturity indicators was recorded from 4263 non-Hispanic white, black, and Mexican American girls and boys aged 8.00 to 19.00 years as part of the Third National Health and Nutrition Examination Survey (NHANES III) conducted between 1988 and 1994. NHANES III followed a complex, stratified, multistage probability cluster design. SUDAAN was used to calculate the mean age and standard error for each maturity stage and the proportion of entry into a maturity stage and to incorporate the sampling weight and design effects of the NHANES III complex sampling design. Probit analysis and median age at entry into a maturity stage and its fiducial limits were calculated using SAS 8.2.**

Results. **Reference data for age at entry for maturity stages are presented in tabular and graphical format. Non-Hispanic black girls had an earlier sexual development for pubic hair and breast development either by median age at entry for a stage or for the mean age for a stage than Mexican American or non-Hispanic white girls. There were few to no significant differences between the Mexican American and non-Hispanic white girls. Non-Hispanic black boys also had earlier median and mean ages for sexual maturity stages than the non-Hispanic white and Mexican American boys.**

Conclusion. **Non-Hispanic black girls and boys mature early, but US children completed their sexual development at approximately the same ages. The present reference data for the timing of sexual maturation are recommended for the interpretation of assessments of sexual maturity in US children.** *Pediatrics* **2002;110:911–919;** ***sexual maturity, Tanner stages, age at onset, secondary sex characteristics, race.***

ABBREVIATIONS. NHES, National Health Examination Survey; HHANES, Hispanic Health and Nutrition Examination Survey; NHANES III, Third National Health and Nutrition Examination Survey.

From *The Lifespan Health Research Center Departments of Community Health, Pediatrics, and Mathematics and Statistics, Wright State University, School of Medicine, Dayton, Ohio; ‡Pennsylvania State College of Medicine, Hershey Medical Center, Hershey, Pennsylvania; §School of Public Health, University of Minnesota, Minneapolis, Minnesota; and ‖Ross Products Division of Abbott Laboratories, Columbus, Ohio.

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Reprint requests to (S.S.S.) Lifespan Health Research Center, Department of Community Health, Wright State University School of Medicine, 3171 Research Blvd, Kettering, OH 45420. E-mail: shumei.sun@wright.edu

Assessment of the onset and progression of sexual maturation are important in pediatrics because this information has immediate clinical application in the interpretation of endocrine and growth status.[1–4] Criteria describing the stages of sexual maturity indicators in boys and girls are well established.[5–7] Sexual maturity assessments are meaningful, however, when the age of a child who is entering a stage or the age of a child who is already in a stage can be compared with suitable reference data for sexual maturity stages in normal healthy peers. Normative references for sexual maturity levels of current US children have been few, and most are outdated or limited because of the composition and ages of the samples involved.[8,9] Recent concern about the possible early onset of puberty in US children[9–11] has highlighted the need for current normative national reference data to facilitate the interpretation of sexual maturity assessments.

Sexual maturity status of US children from nationally representative samples is available. The timing of sexual maturity of non-Hispanic white and black children from the National Health Examination Survey (NHES) was documented >20 years ago, when earlier maturation in non-Hispanic black girls than white girls was noted.[3,4] Sexual maturity data for Mexican American children from the Hispanic Health and Nutrition Examination Survey (HHANES) were reported approximately a decade ago.[12] However, these NHES and HHANES data were from children only as young as 12.00 and 10.00 years, respectively, and neither of these is young enough to provide estimates of early sexual maturation.[13]

Recently, sexual maturity data were collected from a national probability sample of US children aged 8.00 to 19.00 years as part of the Third National Health and Nutrition Examination Survey (NHANES III) conducted from 1988 to 1994. Information on the prevalence of sexual development of boys using these NHANES III data has been reported,[11] including estimates of the median ages of transition from one Tanner stage to the next. The aims of the present analysis were 1) to estimate the median age at entry for a stage in tabular format, the ages at which 25%, 50%, and 75% of children transitioned

from stage 1 to stage 2 in graphical format, and the mean age for being in a stage for each sexual maturity indicator in the NHANES III for non-Hispanic white, black, and Mexican American girls and boys and 2) to determine racial/ethnic differences in these estimates for each maturity indicator. Median age at entry for a stage is the age when 50% of the children entered that stage. The mean age for being in a stage is the average ages for all children in that stage at the time of examination. It is anticipated that median age at entry would be earlier than the mean age for being in a stage. These results provide clinically meaningful, normative reference data that describe the timing of sexual maturity indicators among a national sample of US children.

METHODS

Sample

The data are from the NHANES III conducted by the National Center for Health Statistics between 1988 and 1994.[14,15] NHANES III used a complex, stratified, multistage probability cluster design to obtain representative samples of the noninstitutionalized US civilian population.[16,17] Like other national health surveys, the NHANES III sample represented the total US civilian noninstitutionalized population that was 2 months old or older at the time the data were collected.[14] Assessment of sexual maturity indicators were recorded from 4263 children aged 8.00 to 19.00 years. The number of children in each age, gender, and racial/ethnic-specific group used in this analysis is presented in Table 1. In NHANES III, there was intentional oversampling of those aged 8.00 to 19.00 years and of Mexican Americans and non-Hispanic blacks to increase the reliability of estimates for these groups.

Sexual Maturity Stages

Sexual maturity of each child was assessed by physicians during the NHANES III physical examination. These physicians received special standardized training. Written descriptions and photographs describing the stages of the sexual maturity indicators used during training were available for reference in the examination centers. The details of this training are documented.[14]

Sexual maturity stages based on the recommendations of Tanner[6,7] were assigned to each maturity indicator, ie, pubic hair in each gender, breast development in girls, and genital development (penis, testes, and scrotum) in boys. Each maturity indicator has 5 stages that can be assigned from stage 1, representing immaturity, to stage 5, indicating full maturity. Details of the criteria used in NHANES III characterizing the appearance of each Tanner stage for each sexual maturity indicator have been described and reported extensively.[7,12,18] The notation used in this report for each maturity indicator contains the initial letters as follows: pubic hair (PH), breast development (B), and genital development (G). Thus, Tanner stage 2 for genital development in boys is indicated as G2.

Data Analysis

SUDAAN[19] was used to calculate means, standard errors, and design effects for each stage in each indicator using the final adjusted individual weight and incorporating the complex sampling design specifying the strata and primary sampling units. Mean ages for being in each of the stages for each sexual maturity indicator were calculated by gender and race. The sample sizes in the present study were larger than that required for reliable estimates for the total population.[20]

Estimates of median age of entry into a stage for each indicator were computed in several steps. First, the proportion of children who entered a specified stage within each age group for a given maturity indicator was computed using PROC CROSSTAB of SUDAAN,[19] which adjusts for the individual sampling weights and the design effects of the complex sampling design. In the probit analysis, the data were grouped into 3-month age groups starting at 8 years of age. Sex- and race-specific probit analyses were applied to proportions across age groups using SAS 8.2.[21] In the probit analysis, the proportion of children who entered a maturity stage is transformed into "y," a normal equivalent deviate, ie, $P = \int_{-\infty}^{y} f(\theta)d\theta$, where $y = a + bx$ and x is the age in months and a and b are the parameters to be estimated from the data. The median age at entry is estimated when P is at 50%. Therefore, median age at entry into a stage is the age at which 50% of the children entered a maturity stage. The fiducial limits of the median age at entry into a stage were computed using Fieller's theorem.[22] The ranges for the fiducial limits indicate the level of precision about these estimated median ages from the probit analysis. The more narrow the range about the median, the higher the precision of the estimated age.

Because comparisons were made among 3 racial groups within a gender, the fiducial limits for each median age for each group were calculated at a 98.3% confidence level. The 3 sets of fiducial limits yielded a comparison-wise confidence level of 95%, ie, $(1 - \alpha) = 0.983$ and $(1 - \alpha)^3 = 0.95$. Intervals were adjusted for multiple comparisons between races for each gender, stage, and sexual maturity indicator to test for significant differences with an overall α of 0.05. In addition to the median age at entry (50th percentile), ages at the onset of puberty at the 25th and 75th percentiles indicating when 25% and 75% of children transitioned from stage 1 to stage 2 were obtained for each maturity indicator.

It is anticipated that median age at entry for a maturity stage will be earlier than the mean age of all children who are in a specific maturity stage. This is because age at entry for a stage is the age at which an individual child progresses from one stage to the next, whereas mean age for being in a stage is the average ages at examination of all individual children who were assessed as being in a stage. Some children may be in a given stage for some time.

RESULTS

The results are presented for each sexual maturity indicator for girls and boys separately for each race in the following sections. The median ages for entry for a stage and the mean ages for specific stages for each maturity indicator were calculated with adjust-

TABLE 1. Sample Sizes for Each Age Group for Boys and Girls by Race/Ethnic Group

Age (Years)	Boys			Girls		
	Whites	Blacks	Mexican Americans	Whites	Blacks	Mexican Americans
8–8.99	61	71	81	52	71	82
9–9.99	70	96	85	76	87	78
10–10.99	65	97	89	61	82	81
11–11.99	62	92	101	62	79	93
12–12.99	42	68	62	45	82	73
13–13.99	39	48	64	50	71	67
14–14.99	43	70	47	48	56	69
15–15.99	33	71	62	57	56	49
16–16.99	43	65	61	43	72	57
17–17.99	39	61	65	52	61	66
18–19.00	40	59	66	48	71	48
Total	537	798	783	594	788	763

ment of individual sampling weights and the design effects. Therefore, these median and mean ages represent national estimates. The standard errors for the mean ages for specific stages for the indicators ranged from 0.08 to 0.34 years. By approximately 16.5 years, most US girls and boys were sexually mature, ie, they had attained stage 5 for all indicators.

Sexual Maturation in Girls

Age at Entry

The median age at entry and the fiducial limits, a measure of the precision of the estimated median age, for pubic hair and breast development stages are presented in Table 2. The median age at the onset of pubic hair development was approximately 9.4 years for non-Hispanic black girls, approximately 10.6 years for non-Hispanic white girls, and approximately 10.4 years Mexican American girls. The ages when 25%, 50%, and 75% of the girls entered stage 2 from stage 1 for pubic hair were 8.3, 9.5, and 10.6 years, respectively, for non-Hispanic blacks; 9.7, 10.6, and 11.5 years, respectively, for non-Hispanic whites; and 9.4, 10.4, and 11.5 years, respectively, for Mexican Americans (Fig 1). For all girls, the median age at entry increased by approximately 1 year from stages PH2 to PH4, but from stages PH4 to PH5, the median age at entry increased by approximately 2.3 years. Non-Hispanic black girls had significantly earlier median ages at entry for each pubic hair stage than non-Hispanic white and Mexican American girls. There was little difference between the median ages at entry for non-Hispanic white and Mexican American girls for all stages PH2 through PH5. The median age for full maturity for pubic hair was approximately 14.7 years for non-Hispanic black girls and approximately 16.3 years for non-Hispanic white and Mexican American girls. The time frame from the onset of pubic hair development or the median age at entry for stage PH2 to maturity or entry for stage PH5 was approximately 5 years for non-Hispanic black girls and 5.8 years for non-Hispanic white and Mexican American girls.

The median age for the onset of breast development was approximately 9.5 years for non-Hispanic black girls, approximately 9.8 years for Mexican American girls, and approximately 10.4 years for non-Hispanic white girls (Table 2). The ages when 25%, 50%, and 75% of the girls entered stage 2 from stage 1 for breast development were 8.5, 9.5, and 10.5 years, respectively, for non-Hispanic blacks; 9.5, 10.4, and 11.2 years, respectively, for non-Hispanic whites; and 8.6, 9.8, and 11.0 years, respectively, for Mexican Americans (Fig 2). For all girls, the median age at entry increased by approximately 1.5 years per stage from stages B2 to B5. Non-Hispanic black girls had significantly earlier median ages at entry for each breast development stage than non-Hispanic white and Mexican American girls. There was little difference between the median ages at entry for non-Hispanic white and Mexican American girls for all breast development stages. The median age for full breast development was approximately 14.0 years for non-Hispanic black girls and approximately 14.7 to 15.5 years for Mexican American and non-Hispanic white girls, respectively. The time frame from the onset of breast development or the median age at entry for stage B2 to maturity or entry for stage B5 was approximately 5 years for all girls.

Age in a Stage

The mean ages for pubic hair and breast development stages are presented in Table 3. The mean age for each pubic hair stage increased approximately 1.5 to 2 years from one stage to the next for all of the girls. The non-Hispanic black girls had significantly earlier ($P < .05$) mean ages than the non-Hispanic white and Mexican American girls for stages PH2 to PH5. However, the mean ages for each stage for the non-Hispanic white girls were not statistically different from the means of the Mexican American girls. The mean age for the appearance of pubic hair was approximately 10.0 years in non-Hispanic black girls and approximately 11.0 years for non-Hispanic white and Mexican American girls. The average age for the end of pubic hair development was 16.0 years in non-Hispanic black girls and approximately 16.5 years for the non-Hispanic white and Mexican American girls. The time frame from the average age for the appearance of pubic hair to the average age for

TABLE 2. Median Ages at Entry into Each Maturity Stage and Fiducial Limits* in Years for Pubic Hair and Breast Development in Girls by Race

Stage	Age at Entry for Girls					
	Non-Hispanic White		Non-Hispanic Black		Mexican-American	
	Median	FL	Median	FL	Median	FL
Pubic hair						
PH2	10.57†	10.29–10.85	9.43†	9.05–9.74	10.39	—
PH3	11.80†	11.54–12.07	10.57†	10.30–10.83	11.70†	11.14–12.27
PH4	13.00†	12.71–13.30	11.90†	11.38–12.42	13.19†	12.88–13.52
PH5	16.33†	15.86–16.88	14.70†	14.32–15.11	16.30†	15.90–16.76
Breast development						
B2	10.38†	10.11–10.65	9.48†	9.14–9.76	9.80	0–11.78
B3	11.75†	11.49–12.02	10.79†	10.50–11.08	11.43	8.64–14.50
B4	13.29†	12.97–13.61	12.24†	11.87–12.61	13.07†	12.79–13.36
B5	15.47†	15.04–15.94	13.92†	13.57–14.29	14.70†	14.37–15.04

FL indicates fiducial limit.
* Calculated 98.3% FLs to adjust for multiple comparisons between races for an overall α of 0.05.
† Significant pair-wise racial difference, $P < .05$.

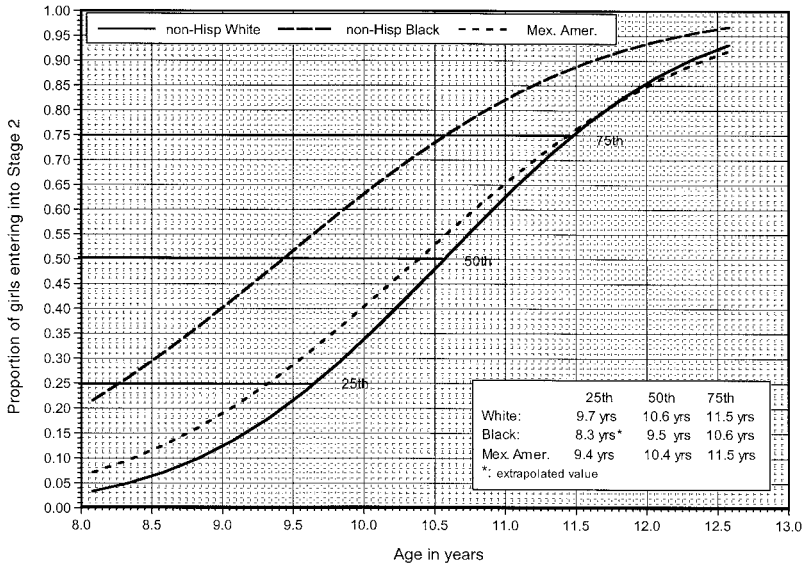

Fig 1. Reference data for age at onset of transition from stage 1 to stage 2 of pubic hair in girls.

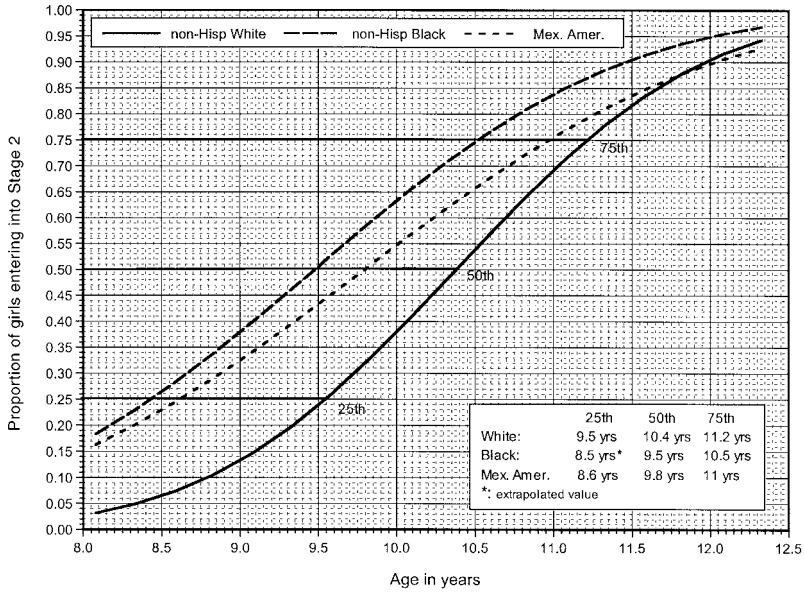

Fig 2. Reference data for age at onset of transition from stage 1 to stage 2 of breast development in girls.

full pubic hair development was approximately 5.5 to 6 years.

The mean age for each breast development stage increased approximately 1.5 years from one stage to the next for all of the girls except between stages B4 and B5, for which the interval was almost 2.0 years (Table 3). Non-Hispanic black girls had significantly earlier ($P < .05$) mean ages than non-Hispanic white girls for stages B2 to B5 and the Mexican American girls for stages B3 and B5. The mean ages for all stages for the Mexican American girls were not statistically different from the means of the non-Hispanic white girls except for B4. The average age for full breast development was 15.8 years in non-Hispanic black girls and approximately 16.2 years for non-Hispanic white and Mexican American girls. The time frame from the average age for the appearance of breast development to the average age for full breast development was approximately 5.5 years.

Sexual Maturation in Boys

Age at Entry

The median ages at entry for pubic hair and genital development stages are presented in Table 4. The median age for the onset of pubic hair development was approximately 11.2 years for non-Hispanic black boys, approximately 12.0 years for non-Hispanic white boys, and 12.3 years Mexican American boys. The ages when 25%, 50%, and 75% of the boys entered stage 2 from stage 1 for pubic hair were 10.0, 11.2, and 12.4 years, respectively, for non-Hispanic blacks; 11.0, 12.0, and 12.9 years, respectively, for non-Hispanic whites; and 11.4, 12.3, and 13.3 years, respectively, for Mexican Americans (Fig 3). For all boys, the median age at entry increased by approximately 1 year per stage from stages PH2 to PH4, but from stages PH4 to PH5, the median age at entry increased by at least 1.5 years. Non-Hispanic black boys had significantly earlier median ages at entry

TABLE 3. Mean Ages in Years and SEs for Being in a Stage for Pubic Hair and Breast Development in Girls by Race

Stage	Age in a Stage for Girls								
	Non-Hispanic White			Non-Hispanic Black			Mexican-American		
	N	Mean	SE	*N*	Mean	SE	*N*	Mean	SE
Pubic hair									
PH2	67	10.96*	0.23	85	10.25*	0.15	105	11.17*	0.21
PH3	61	12.41*	0.19	98	11.37*	0.23	108	12.84*	0.18
PH4	154	15.11*	0.18	184	13.69*	0.31	177	14.61*	0.26
PH5	133	16.53*	0.17	282	16.05*	0.14	161	16.61*	0.12
Breast development									
B2	82	11.05*	0.18	99	10.25*	0.20	129	10.70	0.21
B3	80	12.80*	0.19	106	11.94*	0.22	131	12.61*	0.20
B4	110	15.16*	0.32	112	13.61*	0.34	97	14.03*	0.27
B5	173	16.25*	0.18	338	15.78*	0.14	254	16.21*	0.12

SE indicates standard error.
* Significant pair-wise racial difference, $P < .05$.

TABLE 4. Median Ages of Entry into Each Stage and FLs* in Years for Pubic Hair and Genitalia Development in Boys by Race

Stage	Age at Entry for Boys					
	Non-Hispanic White		Non-Hispanic Black		Mexican-American	
	Median	FL	Median	FL	Median	FL
Pubic hair						
PH2	11.98†	11.69–12.29	11.16†	10.89–11.43	12.30†	12.06–12.56
PH3	12.65	12.37–12.95	12.51†	12.26–12.77	13.06†	12.79–13.36
PH4	13.56	13.27–13.86	13.73	13.49–13.99	14.08	13.83–14.32
PH5	15.67	15.30–16.05	15.32	14.99–15.67	15.75	15.46–16.03
Genitalia development						
G2	10.03	9.61–10.40	9.20†	8.62–9.64	10.29†	9.94–10.60
G3	12.32	12.00–12.67	11.78†	11.50–12.08	12.53†	12.29–12.79
G4	13.52	13.22–13.83	13.40	13.15–13.66	13.77	13.51–14.03
G5	16.01†	15.57–16.50	15.00†	14.70–15.32	15.76†	15.39–16.14

FL indicates fiducial limit.
* Calculated 98.3% FLs to adjust for multiple comparisons between races for an overall of 0.05.
† Significant pair-wise racial difference, $P < .05$.

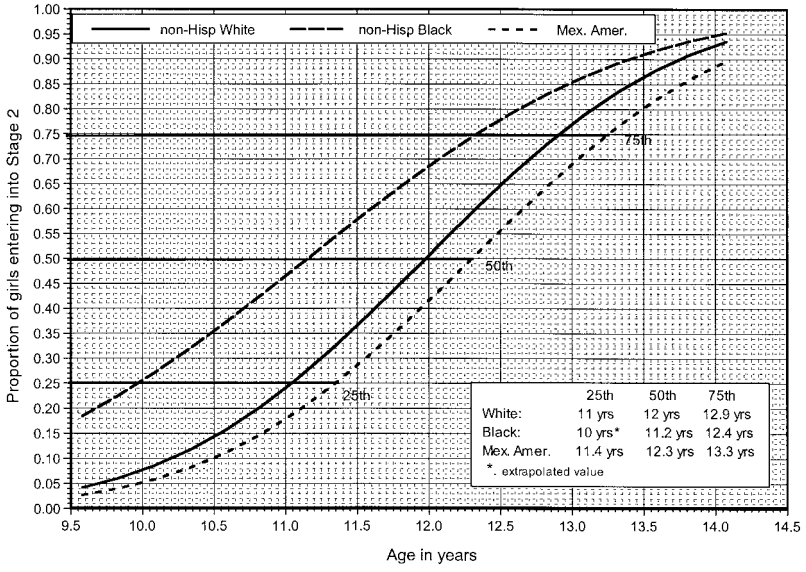

Fig 3. Reference data for age at onset of transition from stage 1 to stage 2 of pubic hair in boys.

for stage PH2 than non-Hispanic white and Mexican American boys and for stage PH3 than Mexican American boys. The median age for full maturity for pubic hair stage PH5 was approximately 15.5 years for all boys. The time frame from the onset of pubic hair development or the median age at entry for stage PH2 to maturity or entry for stage PH5 was approximately 3.5 to 4 years for all boys.

The median age for the onset of genital development was approximately 9.2 years for non-Hispanic black boys, approximately 10.0 years for non-Hispanic white boys, and 10.3 years for Mexican American boys (Table 4). The ages when 25%, 50%, and 75% of the boys entered stage 2 from stage 1 for genital development were 7.5, 9.2, and 10.9 years, respectively, for non-Hispanic blacks; 8.6, 10.0, and

11.4 years, respectively, for non-Hispanic whites; and 8.9, 10.3, and 11.7 years, respectively, for Mexican Americans (Fig 4). Non-Hispanic black boys had significantly younger median ages at entry for stages G2, G3, and G5 than the Mexican American boys. The only significant difference among all 3 racial groups occurred at stage G5, when the non-Hispanic black boys entered this stage earlier than the Mexican American boys who had younger median ages than the non-Hispanic white boys. The median age for the start of full genital development for boys was approximately 15 years for non-Hispanic blacks, 16.0 for non-Hispanic whites, and approximately 15.7 for Mexican Americans. The time frame from the onset of genital development or the median age at entry for stage G2 to maturity or entry for stage G5 was approximately 5 to 6 years for all boys.

Age in a Stage

The mean ages for pubic hair and genital development stages are presented in Table 5. The mean age for each pubic hair stage increased approximately 1.5 years from one stage to the next for all of the boys. Non-Hispanic black boys had significantly earlier mean ages than Mexican American boys for all stages except PH4 and earlier mean ages for each stage than non-Hispanic white boys. The average age for the full pubic hair development was approximately 16.5 to 17.0 years for all boys. The time frame from the average age for the appearance of pubic hair to the average age for full pubic hair development was approximately 5 years.

Non-Hispanic black boys had significantly ($P < .05$) earlier mean ages than Mexican American boys for stages G3 and G5. None of the other comparisons between these groups of boys for the genital development stages was significant. The average age for the end of genital development was approximately 16.5 years for all boys. The time frame from the average age for the appearance of pubic hair to the average age for full pubic hair development was approximately 5.6 years.

Racial Comparisons

The significant racial pair-wise comparisons for the medians for the sexual maturity indicators are summarized in Fig 5. Non-Hispanic black girls have a pattern of earlier sexual development for median age at entry than Mexican American or non-Hispanic white girls. Median ages for pubic hair development in stages 2, 3, 4, and 5 were significantly earlier in non-Hispanic black girls than in Mexican American or non-Hispanic white girls. There was no significant difference between the Mexican American and non-Hispanic white girls for these same comparisons. This same pattern existed for breast development. The non-Hispanic black girls had significantly earlier median ages for breast development for all stages than the non-Hispanic white girls and for stages 3, 4, and 5 among the Mexican American girls. Again, there was no significant difference between the Mexican American and non-Hispanic white girls in breast development for these same comparisons.

There was a similar pattern among the boys, with non-Hispanic black boys having earlier median ages for sexual maturity stages than non-Hispanic white and Mexican American boys. Non-Hispanic black boys had significantly earlier median ages for PH2 than non-Hispanic white and Mexican American boys, and there was a similar difference between the last 2 groups of boys for this stage also. Non-Hispanic black boys also had a significantly earlier median age at entry for PH3 than Mexican American boys. Non-Hispanic black boys again had significantly earlier median ages at entry for G2, G3, and G5 than Mexican American boys. The only significant difference between non-Hispanic black and white boys for genital development was for the median age at entry for stage G5.

DISCUSSION

The present analyses used data from NHANES III, a national probability sample of non-Hispanic white, non-Hispanic black, and Mexican American children

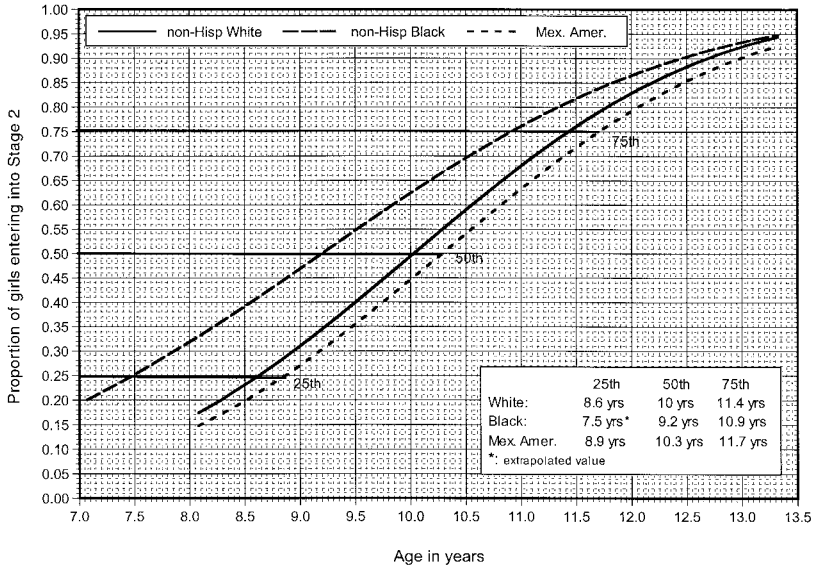

Fig 4. Reference data for age at onset of transition from stage 1 to stage 2 of genitalia development in boys.

TABLE 5. Mean Ages in Years and SEs for Being in a Stage for Pubic Hair and Genitalia Development in Boys by Race

Stage	Age in a Stage for Boys								
	Non-Hispanic White			Non-Hispanic Black			Mexican-American		
	N	Mean	SE	*N*	Mean	SE	*N*	Mean	SE
Pubic hair									
PH2	42	11.81	0.16	106	11.48*	0.13	50	12.20*	0.24
PH3	39	13.03	0.27	86	12.79*	0.19	55	13.44*	0.26
PH4	75	14.89	0.18	94	15.21	0.26	93	15.25	0.16
PH5	133	16.84	0.13	238	16.67*	0.08	211	17.14*	0.10
Genitalia development									
G2	136	11.08	0.18	181	10.79	0.13	183	11.09	0.17
G3	63	12.55	0.29	113	12.03*	0.28	80	12.97*	0.28
G4	91	15.29	0.19	98	15.07	0.33	104	15.38	0.19
G5	120	16.64	0.15	253	16.42*	0.09	219	16.85*	0.13

* Significant pair-wise racial difference, $P < .05$.

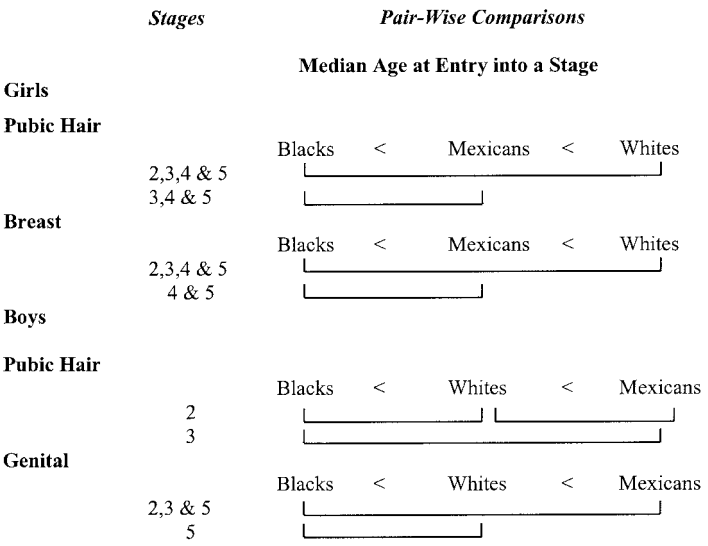

Fig 5. Significant ($P < .05$) pair-wise racial differences in median age at entry and mean ages of a stage for each sexual maturity indicator. Groups connected by underlines indicate statistically significant differences.

as young as 8.00 years. In the analysis, the data were adjusted for the individual sampling weights and the design effects of the complex sampling design. Therefore, these findings are recommended as race-specific normative reference values for the timing of sexual maturation for clinical and research assessments of growth and endocrine status in US children.

The few reports of the reliability for sexual maturity assessments indicate that the errors are generally small. Matsudo and Matsudo[23] reported that the concordance between repeated self-assessments, averaged across stages, was 85% to 90%. Measurement errors between physicians for children aged 10 to 13 years were 0.4 years for pubic hair and 0.6 years for genital and breast development stages.[24] Herman-Giddens et al[9] reported high levels of reliability between assessments by pairs of physicians for girls aged 7 to 12 years with κ coefficients, corrected for chance, of 0.86 for breast development and 0.93 for pubic hair stages. Reliability data are not available for the sexual maturity assessments in NHANES III at this time. The physicians did compare their ratings with consultant physicians to maintain a quality control level of a 1-stage variance during the course of NHANES III.[25] It is expected that the assessment errors in NHANES III are similar to those of the other national surveys.[3,11]

Racial Differences

Racial differences in the timing of the early onset of maturation for median ages at entry and mean ages for being in a stage occur predominantly among the non-Hispanic black children. On average, girls start to mature earlier than boys by approximately 1.5 years, but this gender difference was more distinct for pubic hair between the non-Hispanic black girls and boys than among the non-Hispanic white and Mexican American girls and boys. The mean age for being in PH2 was younger in the girls than in the boys, but this gender difference was largest between the non-Hispanic black girls and boys. There are few significant differences in these ages for the Tanner stages between the non-Hispanic white and Mexican American children (Fig 5).

The NHANES III assessed children as young as 8.00 years, and these results show that there is significantly earlier maturation in non-Hispanic black girls than in non-Hispanic white and Mexican American girls. This trend occurs also among the non-Hispanic black boys, who were significantly earlier in their onset of maturation than the non-Hispanic white and Mexican American boys for pubic hair and genital development. Previously, there has been a lack of available data for boys at ages young enough

to demonstrate early sexual maturation, so the findings in these NHANES III data may have been present in the past but undetected.

The early onset of maturation among non-Hispanic black girls has been noted for some time. Harlan et al[3,4,18] reported national prevalences for stages of sexual maturity indicators from the NHES conducted between 1966 and 1970. These estimates showed that maturation was more rapid in non-Hispanic black girls than in white girls by 12.00 years of age, but levels of sexual maturity did not differ between non-Hispanic black and white boys in that survey at this age. This racial difference in timing tended to be larger for breast development than for pubic hair. The early onset of maturation among non-Hispanic black children using Tanner stages has also been reported from nonnational studies. Herman-Giddens et al[9] also reported earlier maturation in non-Hispanic black girls than in white girls using data collected as part of a collaborative pediatric interoffice research study. However, these data by Herman-Giddens[9] did not include girls older than 13 years, so the contribution of late-maturing girls to the results were not considered. Most small studies of boys in the US have not noticed any racial/ethnic differences until recently.[25,26]

The sexual maturation of Mexican American girls and boys in the HHANES conducted between 1982 and 1984[12] was slightly slower than the present NHANES III estimates for the total US population. The HHANES included children only as young as 10 years, and it was not a national probability sample.[12] The differences in the timing of sexual maturation of Mexican American girls between HHANES and NHANES III is attributed to differences in the design of the surveys, especially the ages at which assessments were started.[26]

Recently, data for the sexual maturity indicators from NHANES III have been published for boys. The values obtained from the present study are similar to corresponding values for boys in the report by Herman-Giddens et al.[11] Differences in statistical technique exist between the analysis by Herman-Giddens et al[11] and this analysis. The present study describes both the median age of entry for a stage and the mean age of being in a stage within each indicator. Mean age for being in a stage generally occurs later than the median age at entry for all stages within all maturity indicators (Tables 2–5).

CONCLUSION

This study presents national reference data for sexual maturation, including median ages at entry for the stages of sexual maturation and the mean ages for being in a stage derived from a national probability sample of all US children and separately for non-Hispanic white, non-Hispanic black, and Mexican American girls and boys. Such data will assist in the recognition of children with unusual rates of sexual maturation and numerous growth disorders, including constitutional delay, hypothalamic pituitary hormone deficiencies, and primary gonadal failure. Non-Hispanic black girls and boys start to mature earlier than children in the other 2 groups. However, US children are completing their secondary sexual development at approximately the same ages. Because of the significant racial differences in sexual maturation, it is important to present these national normative reference data for each race separately. Racial differences in the timing of sexual maturation can have significant impact on growth assessment in the use of the growth charts. Within age and gender groups, children who are sexually more mature tend to be taller and weigh more than less mature children. Rapidly maturing children within a gender tend to have larger body mass index values than those who are maturing slowly.[27–29] In clinical and research situations for endocrine and growth assessment, it is important to consider levels of sexual maturity.

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DISEASE-MONGERING

"Trying to convince essentially well people that they are sick, or slightly sick people they are very ill, is big business."

Payer L. *Disease Mongers*. New York, NY: Wiley; 1992