

Parent Ratings of Attention-Deficit/Hyperactivity Disorder Symptoms: Factor Structure and Normative Data

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Abstract:

Changes in the diagnostic criteria for attention-deficit/hyperactivity disorder (ADHD) have necessitated the creation of new measures for clinical assessment. The factor structure of a parent rating scale containing the 18 symptoms of ADHD was examined in this study. Factor analyses and assessment of differences in ADHD ratings across sex, age, and ethnic group were conducted using a sample of 4666 participants ranging in age from 4 to 20 years old who attended kindergarten through 12th grade in 22 school districts across the United States. Two factors (Inattention and Hyperactivity-Impulsivity) were derived and normative data for a nationally representative sample are presented. A higher frequency of ADHD symptoms was found for boys, younger children, and African-American participants. Potential uses of this scale in clinical practice and research are discussed.

KEY WORDS: attention-deficit/hyperactivity disorder; parent rating scale.

Article:

INTRODUCTION

Over the past two decades, the diagnostic criteria for attention-deficit/hyperactivity disorder (ADHD) have undergone several changes that have significantly impacted the clinical assessment of this disorder. During the 1960s and 1970s, the disorder was viewed as being comprised of a single dimension of hyperactivity and inattention (American Psychiatric Association, 1968). As empirical investigations began to highlight the importance of problems with inattention and impulsivity in this syndrome (e.g., Douglas, 1980), a tripartite model was developed wherein children had to meet criteria in three separate dimensions of inattention, impulsivity, and hyperactivity (American Psychiatric Association, 1980). In the absence of empirical data, the diagnostic criteria were temporarily reconceptualized as comprising a unitary dimension [Diagnostic and Statistical Manual of Mental Disorders—Third Edition—Revised (DSM-III-R), American Psychiatric Association, 1987]. Consistent with recently espoused, theoretical views of this disorder (e.g., Barkley, 1997), subsequent factor analyses of teacher ratings of DSM-III-R symptoms of ADHD have consistently revealed two separate factors of Inattention and Hyperactivity-Impulsivity (Bauermeister et al., 1995; Baumgartel, Wolraich, &

Dietrich, 1995; Brito, Pinto, & Lins, 1995; DuPaul, 1991; Lahey et al., 1988). Based, in part, on these findings, the fourth edition of the DSM (DSM-IV; American Psychiatric Association, 1994) provides diagnostic criteria organized into two dimensions of inattention and hyperactivity-impulsivity. In addition to the change in the dimensional conceptualization of ADHD, some DSM-III-R symptoms have been deleted and some new behaviors have been added to the symptom list. More specifically, the DSM-IV criteria include two lists, each with 9 symptoms, instead of a unitary list of 14 symptoms as in the DSM-III-R.

Typically, clinicians attempt to determine whether a child meets the diagnostic criteria for ADHD by interviewing the child and his or her parents and teachers, by having parents and teachers complete behavior rating scales, and through clinic-based testing (Barkley, 1990; Hinshaw, 1994). Rating scales, in particular, are popular because of the ease of administration. A number of parent questionnaires have been developed for assessing children with ADHD, including the Conners (1989) Parent Rating Scale, the Attention Deficit Disorder with Hyperactivity Comprehensive Teacher Rating Scale (ACTeRS) Parent Form (Ullmann, Sleanor, & Sprague, 1996), and the Attention Deficit Disorders Evaluation Scale (McCarney, 1989). In addition, the ADHD Rating Scale (DuPaul, 1991) was developed specifically to obtain parent ratings of the frequency of DSM-III-R (American Psychiatric Association, 1987) symptoms of ADHD. Although all of these questionnaires have demonstrated reliability and validity, their clinical utility is limited given the change from a unidimensional to a bidimensional structure for the diagnostic criteria for ADHD. Thus, there is a need for psychometrically sound, parent and teacher questionnaires that incorporate the DSM-IV criteria for ADHD. The development of a teacher rating scale for this purpose has been reported elsewhere (DuPaul et al., 1997a).

In contrast to the volume of studies that have examined the factor structure of teacher ratings of ADHD symptoms, very few investigations have evaluated the underlying dimensions of parent ratings. Both Bauermeister et al. (1995) and DuPaul (1991) found parent ratings of the 14 DSM-III-R symptoms to comprise two factors of Inattention and Hyperactivity-Impulsivity, as has been the case for teacher ratings. Both of these studies used local samples (i.e., Puerto Rico and Massachusetts), thus limiting the generalizability of findings, including normative data, to the United States population. To date, the factor structure and the normative distribution of parent ratings of DSM-IV symptoms have not been examined.

The purpose of the present study was to develop a rating scale containing DSM-IV criteria for ADHD that could be completed by parents in the context of screening and/or multimethod assessment of this disorder. A primary interest was to ascertain (a) whether parent ratings of ADHD symptoms in a community sample conformed to the two-factor model delineated in the DSM-IV using exploratory and confirmatory factor analyses with oblique rotation and (b) whether the frequencies of ADHD symptoms varied as a function of sex, age, and ethnic group. Normative data were obtained using a subsample of children that was representative of U.S. Census (1990) distributions for region and ethnicity. It was predicted that a two-factor solution would be supported in accordance with prior factor analytic work and current theoretical conceptualizations of the disorder. Further, based on previous empirical data (e.g., Bauermeister et al., 1995), we hypothesized that significantly more ADHD symptoms would be reported for boys and for younger children. No specific hypotheses were formulated regarding possible ethnic differences given the dearth of previous research in this area.

METHOD

Participants

Two samples of children were used in the present study. The second sample was a subset of the first sample. The first sample was comprised of 4860 children and adolescents between 4 and 20 years of age from 22 school districts across the United States. This sample was used for factor analyses and examination of the effects of sex, age, and ethnic group on ADHD ratings.

Complete ratings of ADHD symptoms were available for 4666 participants (2470 girls, 2134 boys, and 62 unspecified). Participants ranged in age from 4 to 20 years ($M = 9.57$, $SD = 3.33$) and attended kindergarten through 12th grade ($M = 4.17$, $SD = 3.27$). Participants were predominantly Caucasian ($n = 3999$; 85.7%) with additional subjects identified as African-American ($n = 318$; 6.8%), Hispanic ($n = 105$; 2.3%), Asian-American ($n = 99$; 2.1%), Native American ($n = 13$; 0.3%), Other ($n = 61$; 1.3%), and unspecified ($n = 71$; 1.5%).

Of the 4666 respondents, the vast majority were mothers ($n = 4071$; 87.2%), with additional ratings completed by fathers ($n = 494$; 10.6%), guardians ($n = 39$; 0.8%), grandparents ($n = 36$; 0.8%), and unspecified ($n = 26$; 0.5%). A total of 4131 (88.5%) of the respondents were female, 524 (11.2%) were male, and 11 (0.2%) were unspecified. The age of respondents ranged from 19 to 80 years old ($M = 36.93$, $SD = 6.05$). As was the case for child participants, most parent/guardian respondents were Caucasian ($n = 4063$; 87.1%), with additional respondents identifying themselves as African-American ($n = 295$; 6.3%), Hispanic ($n = 100$; 2.1%), Asian-American ($n = 87$; 1.9%), Native American ($n = 26$; 0.6%), other ($n = 52$; 1.1%), and unspecified ($n = 43$; 0.9%). The socioeconomic status of families was coded using a modified version of the Hollingshead (1975) Index based on highest occupation in the household as reported by respondents. Hollingshead Index ranged from 10 to 90 (10 to 30 = 20.5%; 31 to 60 = 30.5%; 61 to 90 = 43.5%; missing = 5.5%), with a median of 60 ($M = 58.05$, $SD = 23.46$) indicative of middle-class socioeconomic status.

The second sample was comprised of 2000 (1043 girls, 930 boys, and 27 unspecified) randomly selected participants from Sample 1. Sample 2 was used to derive normative data that could be used for screening and identification purposes. Participants ranged in age from 4 to 20 years ($M = 9.63$, $SD = 3.53$) and attended kindergarten through 12th grade ($M = 4.21$, $SD = 3.46$). As described below, this sample was selected to approximate U.S. Census (1990) data distributions for ethnic group and region (see Table I).

For Sample 2, parent/guardian respondents (1753 female, 244 male, and 3 unspecified) ranged in age from 19 to 80 years old ($M = 37.12$; 6.35). Parent/guardians were predominantly Caucasian ($n = 1470$; 73.5%), with additional respondents identifying themselves as African-American ($n = 285$; 14.2%), Hispanic ($n = 93$; 4.7%), Asian-American ($n = 86$; 4.3%), Native American ($n = 14$; 0.7%), other ($n = 47$; 2.4%), or of unspecified ethnic background ($n = 5$; 0.3%). As was the case with Sample 1, most of

Table I. Percentage of Participants in Normative Sample by Region and Ethnic Group

	Percentage in sample	U.S. Census percentage ^a
Region		
Northeast	25.5	20.0
Midwest	25.2	24.0
South	28.0	34.0
West	21.3	21.0
Ethnic group		
White, non-Hispanic	70.2	74.8
African-American	15.9	11.9
Hispanic	5.3	9.5
Native American	0.7	0.7
Asian American	5.0	3.1
Other	3.1	—

^aPercentages are from 1990 U.S. Census data.

the respondents were mothers ($n = 1711$; 85.6%), with remaining ratings provided by fathers ($n = 226$; 11.3%), grandparents ($n = 23$; 1.2%), guardians ($n = 21$; 1.1%), and unspecified ($n = 19$; 1.0%). Families were primarily living in middle-class socioeconomic circumstances, with a median Hollingshead Index of 60 (range, 10 to 90; 10 to 30 = 22.2%; 31 to 60 = 28.6%; 61 to 90 = 43.3%; missing = 5.9%; $M = 56.16$, $SD = 24.52$).

Measures

Parents and *guardians* were asked to complete a two-page packet. On the first page, parents provided information regarding their age, sex, relationship to the child, occupation, spouse's occupation, and ethnic group. Information also was provided about the child being rated, such as age, sex, grade, and ethnic group.

The second page of the packet included the ADHD Rating Scale-IV Home Version (DuPaul, Anastopoulos, Power, Murphy, & Barkley, 1994) (see Appendix) which consists of 18 items directly adapted from the ADHD symptom list as specified in the DSM-IV. Parents selected the single response for each item that best described the frequency of the specific behavior displayed by the target child over the past 6 months. In order to address possible response bias, Inattention symptoms were designated as odd-numbered items and Hyperactivity-Impulsivity symptoms were displayed as even-numbered items. The frequency of each item or symptom was delineated on a 4-point Likert scale ranging from never or rarely (0) to very often (3), with higher scores indicative of greater ADHD-related behavior. Scores on the ADHD Rating Scale-IV—Home Version have been found to be internally consistent, to be stable over a 4-week period, and to correlate significantly with parent and teacher ratings of behavior (DuPaul, Power, McGoey, Ikeda, & Anastopoulos, 1997b). Further, scores on this questionnaire have been found to have adequate positive and negative predictive power in the diagnosis of ADHD (Power *et al.*, 1998).

Procedures

Sample 1 was recruited by distributing the ADHD Rating Scale-IV Home Version and a letter inviting participation in the study to students in kindergarten through 12th grade in 22 school districts from across the United States. These districts were selected to represent urban, suburban, and rural locales such that geographic locations were sampled in accordance with U.S.

Census data. Contacts to these districts were made by one of the six coinvestigators. For districts in suburban/rural locations ($n = 14$), parent rating packets were distributed to every student in the district. In the larger, urban locales ($n = 8$), because it was not practically possible to distribute packets to every student in the district, schools at the elementary and secondary levels were selected by school district administrators to provide a cross section of the community. Parent ratings were then distributed by classroom teachers to all students at each selected school. No incentives were offered to parents for completing the questionnaire. Ratings were completed between October and May in either the 1994-1995 or the 1995-1996 school year with return rates ranging from 22 to 40% ($M = 30\%$) across school districts. Parent/guardian ratings were anonymous and confidential with subject numbers being the only form of identification, thus written informed consent was not obtained.

Normative data (i.e., Sample 2) were obtained by selecting a subsample of ratings from Sample 1 so as to conform, as closely as possible, to U.S. Census data population proportions regarding region and ethnic group. Participants were randomly selected from Sample 1 in a stratified manner (i.e., random selection was constrained to conform with proportions of regional and ethnic distribution). Percentages of children by region and ethnic group are displayed in Table I relative to corresponding percentages from the 1990 U.S. Census. The resulting normative sample closely matches U.S. Census distributions for region with the exception of the southern part of the U.S., which is somewhat underrepresented in the sample (i.e., 27.8% in the sample vs. 34% in the Census). The Northeastern region is slightly overrepresented in the normative sample (i.e., 25.4% in the sample vs. 20% in the Census). African-Americans (15.9% in the sample vs. 12% in the Census) were slightly overrepresented in the normative group. Nevertheless, differences between sample proportions and U.S. Census data are minimal, thus we consider Sample 2 to be representative of the U.S. population.

RESULTS

Two types of factor analyses were conducted. First, an exploratory factor analysis was conducted using principal axis factoring (PAF) and oblique rotation, which allows factors to correlate. Two solutions were computed: a forced one-factor solution that served as a baseline and an unforced solution that extracted all factors with eigenvalues greater than 1.0. Second, linear structural equation modeling was used to perform a confirmatory factor analysis to test the results of the PAF solution.

Exploratory Factor Analysis

Analysis was performed on data from Sample 1 ($N = 4666$) for which ratings on all 18 items were available. Visual analysis of the correlation and antiimage correlation (i.e., the negative of the partial correlation coefficients) matrices and the results of the Kaiser-Meyer-Olkin measure of sampling adequacy (.96) indicated that the data were adequate for analysis. A forced one-factor solution accounted for 45% of the variance (eigenvalue = 8.09). A subsequent PAF analysis resulted in a two-factor solution which accounted for 51.8% of the variance. After factor rotation, the proportion of explained variance accounted for by each factor was calculated by summing the squared loadings for each factor and dividing by the number of items (Gorsuch, 1983). Factor 1 accounted for 25% of the variance and Factor 2 accounted for 22% with eigenvalues of 8.16 and 1.16, respectively. The sum of variance accounted for by each factor is less than the 51.8% total variance accounted for because factors were allowed to correlate and

the loadings reflect only unique variance. Table II shows the factor loadings (i.e., the pattern matrix) and communalities for the one-factor and two-factor solutions.

As was the case with teacher ratings of ADHD symptoms (DuPaul *et al.*, 1997a), the pattern matrix approximates a simple structure, with even-numbered items (i.e., those reflecting hyperactivity-impulsivity) loading on Factor 1 and odd-numbered items (i.e., reflecting inattention) loading on Factor 2. Items 3, 5, and 15 loaded on both factors; however, loadings on

Table II. Rotated Pattern Matrix for Parent Ratings of ADHD Symptoms

	Forced one-factor solution		Two-factor solution		
	Communality	Loading	Communality	Factor 1	Factor 2
ITEM10	.35835	.59987	.47794	.76775	.12008
ITEM16	.50100	.70781	.57818	.75000	-.01508
ITEM18	.49285	.70203	.56139	.72829	-.03022
ITEM6	.42957	.65541	.50463	.71635	.00879
ITEM12	.34804	.58995	.42422	.68179	.04588
ITEM14	.35727	.59772	.41007	.63189	-.01232
ITEM4	.42224	.64980	.46180	.62665	-.07430
ITEM8	.44414	.66568	.47224	.60366	-.11480
ITEM2	.43105	.65655	.45803	.59161	-.11680
ITEM7	.47420	.68863	.61860	-.03691	-.81126
ITEM11	.44460	.66678	.58334	-.04286	-.79239
ITEM9	.48835	.69882	.60751	.00814	-.77385
ITEM1	.35835	.59863	.48443	-.06770	-.74049
ITEM17	.46853	.68449	.55517	.05519	-.70631
ITEM13	.41961	.64777	.46755	.11642	-.59896
ITEM3	.57586	.75886	.57653	.35642	-.46984
ITEM15	.61303	.78296	.61165	.38528	-.46656
ITEM5	.46566	.68239	.46347	.34952	-.39239

the secondary factor were all $<.40$. The correlation between the two factors was $-.68$ indicating that the factors are closely related. The interpretation of the between-factor correlation should be based on the absolute magnitude of this statistic. The negative correlation between factors is most likely an artifact related to the nature of the inattention factor (i.e., higher scores represent less attention) and the fact that with simple structure, there will be an inverse relation between factors.

Confirmatory Factor Analysis

Linear structural equation modeling (LISREL 8) was used to perform a confirmatory factor analysis (CFA), using polychoric correlations and an asymptotic covariance matrix, to test the results of the PAF solution and the theoretical two-dimensional structure of DSM-IV criteria. Two models were computed, including a one-factor model, where all items were constrained to load on a single factor, and a two-factor model, where odd-numbered items were constrained to load on an Inattention factor and even-numbered items were constrained to load on a Hyperactivity—Impulsivity factor. The goodness of fit of both models was analyzed by examination of multiple fit indices. The assumption that a two-factor solution (as opposed to a one-factor solution) significantly improved the model fit was tested by (a) computing chi-square estimates of improvement of the one- and two-factor models over the null model and (b) comparing goodness-of-fit estimates [for a discussion of goodness-of-fit estimates used in this study along with computational formulas, see Medsker, Williams, & Holahan (1994)].

It should be noted that because there is no single, generally accepted index of model fit (Bollen, 1990) and because very large sample sizes can affect fit indices (Marsh, Balla, & McDonald, 1988), the process is more one of interpretation through analysis and comparison of multiple fit indices, as opposed to simply rejecting (or failing to reject) the null hypothesis based on a single test statistic. For the two-factor model, the correlation between factors was .92. The chi-squares for both the one- and the two- factor models were significant; however, the root mean square errors of approximation [RMSEA; i.e., a measure of discrepancy per degree of freedom (Jorakeskog & Sorbom, 1993)] of both models were below the .05 value suggested by Browne and Cudeck (1993), indicating a close fit. Additionally, the test of RMSEA was 1.00 for both models, also suggesting a good fit. These results suggest that both models adequately fit the observed data. The two-factor model resulted in a significant increase in fit over the one- factor model [$\chi^2(1) = 178, p < .01$].

To test the stability of the two models, Sample 1 was randomly split into two groups and a cross-validation index (CVI) was computed using covariance matrices and unweighted least-squares (ULS) estimation, as the latter has no distributional assumptions. The fit of the two models was tested by using one subsample as the calibration sample and the other as the validation sample. For the two-factor model, the CVI obtained was .42 (90% confidence interval = .37 to .44), suggesting that the same factor structure held for both samples. Alternatively, the one-factor model appears to be less stable (CVI = 1.05).

Sex, Age, and Ethnic Group Differences

For the purposes of further analyses, ADHD Rating Scale-IV scores in Sample 1 were computed for Inattention (IA; sum of odd-numbered items), Hyperactivity-Impulsivity (HI; sum of even-numbered items), and Total Score (sum of all items).

A 2 (Sex) x 4 (Age) x 3 (Ethnic Group) multivariate analysis of variance (MANOVA) was conducted employing the three ADHD Rating Scale- IV scores as the dependent variables. To maximize individual cell size, data for 4, 19, and 20 year olds were dropped and the Age factor was blocked into four levels (5-7, 8-10, 11-13, and 14-18 years old). This blocking scheme was supported by age differences found in an initial one-way MANOVA with 13 levels of age used as the independent variable. Given the relatively small numbers of Asian-American and Native American participants, analyses of the effects of Ethnic group were restricted to Caucasian, African-American, and Hispanic children. Finally, because data for all three rating scale scores were highly positively skewed, a logarithmic transformation was conducted prior to the MANOVA.

No statistically significant interactions were obtained. Statistically significant results were obtained for the main effects of Sex [Wilk's $\lambda = .99, F(3,4349) = 6.82, p < .001$], Age [Wilk's $\lambda = .99, F(9,10,584.47) = 5.96, p < .001$], and Ethnic Group [Wilk's $\lambda = .99, F(6,8698) = 4.87, p < .001$].

Separate 2 (Sex) x 4 (Age) x 3 (Ethnic Group) univariate analyses of variance (ANOVAs) were conducted for each of the ADHD Rating Scale- IV scores. A single significant interaction effect was obtained for Sex x Age for HI scores only [$F(3,4351) = 3.10, p < .05$]. Simple effects tests

of Age at each level of Sex followed by Tukey HSD post hoc comparisons were then conducted. Significant Age effects on HI scores were found for both boys [$F(3,2166) = 46.44, p < .001$] and girls [$F(3, 2498) = 35.16, p < .001$]. For both boys and girls, the youngest age group (5-7 year olds) received higher ratings of HI symptoms than the three older age groups [effect size¹ (ES) range, from .24 to .63]. Also, 8- to 10-year-old boys and girls received higher parent ratings than did 11-13 year olds (ES = .18 and .19 for boys and girls, respectively). Finally, boys in the 8- to 10-year-old group received higher ratings than 14- to 18-year-old boys (ES = .38). No further age differences were found for girls. The pattern of age differences in parent-reported HI symptoms for boys and girls is portrayed in Fig. 1. Boys were reported to exhibit more HI symptoms than girls for all age groups except for 14-18 year olds, where mean scores were equivalent for boys and girls² (see Fig. 1).

Significant main effects for Sex were found for IA [$F(1,4351) = 12.93, p < .001$], HI [$F(1,4351) = 5.77, p < .05$], and Total [$F(1,4351) = 8.09, p < .01$] scores. Boys received higher ratings of ADHD symptoms than girls in all three cases (ES ranged from .33 to .38). In a similar fashion, significant main effects for Age were obtained for IA [$F(3,4351) = 2.65, p < .05$], HI [$F(3,4351) = 11.76, p < .001$], and Total [$F(3,4351) = 5.40, p < .01$] scores. Tukey HSD post hoc comparisons revealed that 11-13 and 14-

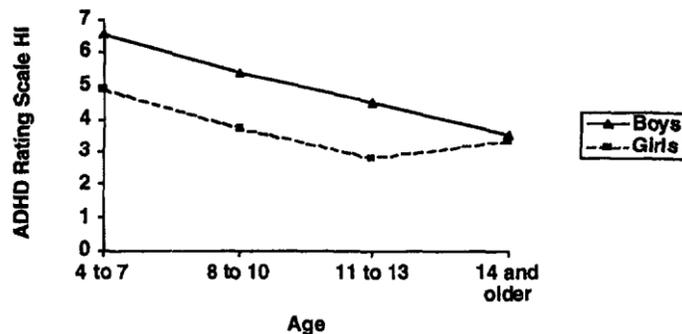


Fig. 1. ADHD Rating Scale-IV Hyperactivity-Impulsivity scores for boys and girls as a function of age.

18 year olds received significantly lower HI (ES range, from .18 to .49) and Total (ES range, from .09 to .27) scores than did the two younger age groups. In a similar fashion, 8-10 year olds received lower HI (ES = .27) and Total (ES = .11) symptom ratings than children in the 5- to 7-year-old age group. Fewer age differences were found for ratings of IA symptoms wherein 14-18 year olds received lower ratings than did 5-7 and 8-10 year olds (ES = .03 and .08, respectively).

Significant main effects for Ethnic group were found for IA [$F(2,4351) = 11.00, p < .001$], HI [$F(2,4351) = 9.90, p < .001$], and Total [$F(2,4351) = 11.95, p < .001$] scores. Tukey HSD tests indicated that African-American participants received higher ratings on all three ADHD Rating Scale-IV scores than did Caucasian subjects (ES range, from .28 to .31), with no differences

¹ Between-group effect sizes for Sex, Age, and Ethnic Group were calculate using a formula provided by Glass, McGaw, and Smith (1981), as follows: M for Group 1 (e.g., Boys) minus M for Group 2 (e.g., Girls) divided by pooled SD.

² Simple effects tests of Sex differences at each level of Age were statistically significant ($p < .01$) except for 14-18 year olds.

between Hispanic participants and the other two groups. Because correlations between parent ratings and Hollingshead Index scores were significant (for Hyperactivity-Impulsivity $r = -.14$, $p < .001$; for Inattention $r = -.11$, $p < .001$), Ethnic Group effects were also examined using the Hollingshead Index as a covariate. Separate analyses of covariance indicated significant effects for Ethnic Group on HI [$F(2,4119) = 3.92$, $p < .02$], IA [$F(2,4119) = 7.46$, $p < .001$], and Total [$F(2,4119) = 6.92$, $p < .001$] scores. The same pattern of between-group differences were evident with African- American children receiving significantly greater ratings than Caucasian participants (ES range, from .22 to .29).

Normative Data

Normative data (using Sample 2) are provided separately for boys and girls in Tables III and IV, respectively, because of gender differences

Table III. Normative Data for Boys on ADHD RS-IV Parent Ratings

Age (yr)	n	Inattention					Hyperactivity-Impulsivity					Total Score				
		M (SD)	80th %ile	90th %ile	93rd %ile	98th %ile	M (SD)	80th %ile	90th %ile	93rd %ile	98th %ile	M (SD)	80th %ile	90th %ile	93rd %ile	98th %ile
5-7	353	5.94 (5.08)	9.0	13.0	15.0	20.0	6.59 (5.56)	11.0	15.0	17.0	22.0	12.54 (9.97)	19.0	29.0	30.2	38.9
8-10	289	6.65 (8.49)	11.0	14.0	15.0	22.2	5.53 (8.05)	9.0	13.0	15.0	21.2	12.18 (15.51)	20.0	25.0	27.0	42.2
11-13	149	6.70 (6.27)	10.0	18.0	18.5	24.0	4.79 (5.54)	8.0	14.0	16.0	21.0	11.50 (11.32)	19.0	31.0	34.0	47.0
14-18	133	5.70 (5.36)	9.0	13.6	15.6	23.0	3.68 (4.32)	7.0	10.0	11.0	16.3	9.38 (8.96)	16.2	23.4	27.0	36.3

Table IV. Normative Data for Girls on ADHD RS-IV Parent Ratings

Age (yr)	n	Inattention					Hyperactivity-Impulsivity					Total Score				
		M (SD)	80th %ile	90th %ile	93rd %ile	98th %ile	M (SD)	80th %ile	90th %ile	93rd %ile	98th %ile	M (SD)	80th %ile	90th %ile	93rd %ile	98th %ile
5-7	314	4.51 (4.45)	7.0	10.0	12.0	18.0	5.00 (4.53)	8.0	11.0	13.0	19.7	9.51 (8.17)	15.0	20.5	24.0	30.0
8-10	327	4.17 (4.36)	7.0	10.0	12.0	16.4	3.39 (3.79)	6.0	8.0	9.0	15.4	7.56 (7.51)	12.0	16.2	20.0	30.4
11-13	173	4.61 (5.12)	8.0	11.0	12.8	21.0	2.88 (3.48)	5.0	7.6	9.0	12.0	7.49 (7.84)	13.0	18.0	20.0	28.5
14-18	225	4.07 (4.57)	7.0	11.0	12.2	16.5	3.29 (3.82)	5.0	8.0	10.0	16.0	7.36 (7.74)	12.0	19.0	22.0	32.5

obtained in the above analyses. Within each table, means and standard deviations are provided for three scores in accordance with factor analytic results: Inattention (IA; sum of nine odd-numbered items), Hyperactivity-Impulsivity (HI; sum of nine even-numbered items), and Total Score (sum of Inattention and Hyperactivity-Impulsivity scores). Given the age differences obtained in prior analyses, separate normative data are provided for four age groups (5-7, 8-10, 11-13, and 14-18 year olds). Because very few cases were available for 4, 19, and 20 year olds, these ages were not included in the normative data set. Although ethnic differences in parent ratings were obtained in the above analyses, normative data were not presented by ethnic group, as there were insufficient numbers of participants for normative data to be displayed by gender,

age, and ethnic group. Scores are provided for four cutoff points: 80th, 90th, 93rd, and 98th percentiles.

DISCUSSION

The results of the current investigation provide support for both the one-factor and the two-factor conceptualization of DSM-IV-defined ADHD symptoms. Although the one-factor model is more parsimonious, the two-factor model accounted for significantly more variance, albeit small in the absolute sense. Of the two factors that emerged from the PAF analysis, the Hyperactivity-Impulsivity dimension accounted for somewhat more of the total variance (25%) than did the Inattention dimension (22%). Of additional interest is that two of the three impulsivity items (i.e., item 16, "has difficulty awaiting turn"; and item 18, "interrupts or intrudes on others") were among the three highest loadings on the Hyperactivity-Impulsivity factor. Taken together, such findings are consistent not only with the results of prior research examining the factor structure of DSM-III-R-defined ADHD symptoms (Bauermeister *et al.*, 1995; DuPaul, 1991), but also with recent theoretical formulations of ADHD, emphasizing deficits in behavioral inhibition as the hallmark feature of this disorder (Barkley, 1997; Quay, 1996). The two-factor model also allows for identification of clinical subtypes of ADHD (i.e., predominantly inattentive, predominantly hyperactive-impulsive, and combined types) as obtained in the DSM-IV field trials (Lahey *et al.*, 1994).

Of further clinical and theoretical interest are the findings pertaining to the reported frequency of DSM-IV-defined ADHD symptoms within the sample. Contrary to the one-size-fits-all approach that is inherent in the DSM-IV criteria for this disorder, the frequency of ADHD symptoms would appear to vary a great deal as a function of several factors, most notably age and gender. For example, 5- to 7-year-old children received significantly higher Hyperactivity-Impulsivity and Total scores than did 8- to 10-year-old children, with both of these age groups receiving higher ratings than children and adolescents from 11 to 18 years of age. Children 10 years of age and below also received Inattention ratings that were significantly higher than those found among 14 to 18 year olds. Effect sizes associated with age group differences were in the low to moderate range. On all three measures, boys received significantly higher ratings than girls with effect sizes in the moderate range. Although interesting in and of themselves, such age- and gender-related findings must be qualified by a consideration of the significant interaction that was found for the Hyperactivity-Impulsivity dimension. More specifically, boys received significantly higher Hyperactivity-Impulsivity ratings than did girls from 5 to 13 years of age. Such differences were not, however, evident in the 14- to 18-year-old age bracket, largely due to an apparent increase in reported symptoms for these older girls (see Fig. 1). That age and gender would influence the reported frequency of ADHD symptoms within the sample is not that surprising, in view of prior research reporting similar demographic influences (e.g., Hart, Lahey, Loeber, Applegate, & Frick, 1995).

Another variable affecting the distribution of DSM-IV-defined symptoms was ethnicity. In particular, African-American children received significantly higher ratings on all three ADHD Rating Scale-IV indices relative to Caucasian children. As was the case for age and gender effects, ethnic group differences were associated with moderate effect sizes. Why this would occur is not at all clear. To some extent, socioeconomic factors play a role in moderating this effect, as evidenced by the small but significant correlations that were found between

Hollingshead SES estimates and Inattention and Hyperactivity-Impulsivity scores. For the most part, ethnic group differences persisted when SES was used as a covariate; however, effect sizes were reduced to some degree. This finding, together with the fact that so little of the variance was explained by SES, suggests that other factors, such as differences in cultural expectations, may be involved.

Overall, numerous similarities exist between these parent-generated ADHD Rating Scale-IV findings and those that were obtained in a parallel investigation involving teachers (DuPaul *et al.*, 1997a). In both studies, there was support for a two-factor *conceptualization* of ADHD symptoms. Although the magnitude of the item loadings on the Inattention and Hyperactivity-Impulsivity factors was somewhat greater for the teacher data, the pattern of loadings for both data sets was highly similar, closely matching the symptom listings set forth in the DSM-IV. A very similar pattern of findings has been found in other studies investigating parent ratings of ADHD symptoms (Bauermeister *et al.*, 1995; DuPaul, 1991). Also, for both the parent and the teacher data sets derived in this study, impulsivity symptoms received the highest loadings on the Hyperactivity-Impulsivity factor. Similarities across the two independent samples also were evident with respect to the moderating influence of age, gender, and ethnicity. In contrast with the parent data, however, the teacher findings did not include any age-related differences in terms of the Inattention dimension. Nor did teacher ratings reveal any interaction effect between age and gender on the Hyperactivity-Impulsivity dimension, which was apparent among the parent data.

Another potentially important difference between the parent and the teacher ratings may be gleaned from an examination of the normative data tables. In particular, the overall means and percentile cutpoints are considerably higher for the teacher ratings. This may suggest that children display more ADHD symptoms in school versus at home, or it may be indicative of differences in behavioral standards and expectations between parents and teachers. Because such normative data were derived from independent parent and teacher samples, it is not possible at present to clarify the nature of this discrepancy. In the meantime, the fact that a discrepancy in normative data does exist should alert clinicians and researchers to the need for cautiously interpreting comparisons across parent and teacher ratings on this measure as is the case for other behavior rating scales (Drotar, Stein, & Perrin, 1995). Preliminary results indicate that when the ADHD Rating Scale-IV (Home Version) is used as part of a multimethod assessment battery with other types of measures mentioned above in a clinic-based setting, then selection of a cutoff score at the 93rd (for predicting inattentive subtype) or 90th (for predicting hyperactive-impulsive subtype) percentile appears most appropriate (Power *et al.*, 1998). When used in research, if it is critical to ensure that subjects meet criteria for ADHD, a more conservative approach using the 98th percentile as a cutoff score may be indicated.

Before concluding, certain limitations inherent in this study should be addressed. One such limitation pertains to the manner in which the data were collected. Although it is customary to obtain parent ratings in the fashion conducted in this study [e.g., Devereux Scales of Mental Disorders (Naglieri, LeBuffe, & Pfeiffer, 1994)], the fact of the matter remains that a substantial number of parents receiving the questionnaire chose not to participate in the study. Whether this introduced some type of bias into the data certainly remains a possibility. To the extent that this did occur, it may help to explain some of the above-noted differences with the teacher norms,

which were generated with more certainty regarding representativeness and randomness. Arguing against a possibility of bias, however, is the fact that there were so many striking similarities across the parent and teacher data sets as well as between this data set and those derived from other samples of parents on similar factors (Bauermeister *et al.*, 1995; DuPaul, 1991). Additional research, involving comparisons of parent and teacher ratings on the same children, will need to be conducted in order to shed further light on this matter. In the meantime, it is strongly recommended that the Home Version of the ADHD Rating Scale-IV not be used *by itself* to make diagnostic decisions about ADHD.

Another potential limitation is the cross-sectional nature of the design, which has its greatest impact on the interpretation of the developmental trends in symptoms that emerged. Although it remains entirely possible that as children get older, they display decreases in hyperactivity—impulsivity symptoms and, according to parents at least, decreases in inattention as well, the design of the current investigation leaves open the possibility that there may be other explanations for this observed trend. For example, as has been noted elsewhere (DuPaul *et al.*, 1997a), this finding may be a reflection of a ceiling effect inherent in the DSM-IV items themselves. More specifically, because the same symptom lists are used for all individuals regardless of their age, some items may not be developmentally appropriate, especially for older children and adolescents. To the extent that this does indeed occur, it puts a ceiling on the total number of potential symptoms that might be endorsed for such an individual. This, in turn, may shift the distribution of symptoms in the direction of there being lower overall means. Thus, instead of reflecting a true developmental trend, these observed differences across the age range may result from a ceiling effect. Although this hypothesis remains a distinct possibility, it nevertheless should be noted that recent longitudinal research has detected developmental trends in the distribution of ADHD symptoms, quite similar to that reported in this investigation (Hart *et al.*, 1995). Thus, there is at least some basis for suspecting that real developmental trends in ADHD symptoms exist.

Limitations also exist with respect to the ethnic differences that were found. Although we were able to examine the moderating influence of socioeconomic status (as measured by parental occupation), other variables that could have influenced group differences were not examined. For example, it was not possible to assess the role that cultural differences in parental expectations and thresholds for deviance could have played in obtaining these findings. Clearly more research is needed to examine differences in ADHD symptomatology across ethnic groups given the growing minority population in the United States and the fact that most research on the assessment of ADHD has been conducted with children of Caucasian background (Reid, 1995). Further, caution must be employed in using this instrument in the evaluation of African-American children.

In conclusion, the parent-completed ADHD Rating Scale-IV would appear to be an assessment instrument that is suitable for use in both research and clinical practice. Like any other device of this sort, however, it should not be used by itself for diagnostic purposes. In combination with other assessment procedures, such as interviews, psychological testing, and direct observations, it would appear to have great potential for increasing diagnostic accuracy, for facilitating treatment planning, and for objectively assessing treatment outcome.

APPENDIX

ADHD Rating Scale-IV—Home Version

Child's name _____ Sex: M ___ F ___ Age ___ Grade ___

Completed by: Mother ___ Father ___ Guardian ___ Grandparent ___

Circle the number that **best describes** your child's home behavior over the past 6 months.

	Never or rarely	Sometimes	Often	Very often
1. Fails to give close attention to details or makes careless mistakes in schoolwork.	0	1	2	3
2. Fidgets with hands or feet or squirms in seat.	0	1	2	3
3. Has difficulty sustaining attention in tasks or play activities.	0	1	2	3
4. Leaves seat in classroom or in other situations in which remaining seated is expected.	0	1	2	3
5. Does not seem to listen when spoken to directly.	0	1	2	3
6. Runs about or climbs excessively in situations in which it is inappropriate.	0	1	2	3
7. Does not follow through on instructions and fails to finish work.	0	1	2	3
8. Has difficulty playing or engaging in leisure activities quietly.	0	1	2	3
9. Has difficulty organizing tasks and activities.	0	1	2	3
10. Is "on the go" or acts as if "driven by a motor."	0	1	2	3
11. Avoids tasks (e.g., schoolwork, homework) that require sustained mental effort.	0	1	2	3
12. Talks excessively.	0	1	2	3
13. Loses things necessary for tasks or activities.	0	1	2	3
14. Blurts out answers before questions have been completed.	0	1	2	3
15. Is easily distracted.	0	1	2	3
16. Has difficulty awaiting turn.	0	1	2	3
17. Is forgetful in daily activities.	0	1	2	3
18. Interrupts or intrudes on others.	0	1	2	3

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