

**CONFIRMATORY FACTOR ANALYSIS OF PARENTS' AND TEACHERS' RATINGS
OF DSM-IV SYMPTOMS OF ATTENTION DEFICIT HYPERACTIVITY DISORDER IN
A SPANISH SAMPLE**

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Running head: Factor structure of parents' and teachers' ratings of ADHD symptoms

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Summary.

This study used confirmatory factor analysis to examine the factor structure of DSM-IV Attention Deficit Hyperactivity Disorder symptoms and analyzed the differences in informants' ratings of ADHD symptoms according to children's age and sex. A sample of 1018 Spanish school children, 554 girls and 444 boys, aged 4 to 12 years, was rated by teachers and parents. Confirmatory factor analysis showed a similar fit for the three-factor model Inattention, Hyperactivity and Impulsivity (Teachers: CFI = .976, RMR = .041, % of total variance = 83.2; parents: CFI = .969, RMR = .037, % of total variance = 82.7), and for the two-factor model Inattention and Hyperactivity-impulsivity (Teachers: CFI = .958, RMR = .044, % of total variance = 79.3; parents: CFI = .961, RMR = .038, % of total variance, 79.9). In view of these results, the two-factor model was selected as a parsimonious representation of the teachers' and parents' ratings of ADHD symptoms. ANOVAs indicated there were significant differences on teachers' and parents' ratings across gender and schools grades of children.

Keywords: Attention Deficit Hyperactivity Disorder, DSM-IV symptoms, Assessment, Confirmatory Factor Analysis.

CONFIRMATORY FACTOR ANALYSIS OF PARENTS' AND TEACHERS' RATINGS OF DSM-IV SYMPTOMS OF ATTENTION DEFICIT HYPERACTIVITY DISORDER IN A SPANISH SAMPLE

Attention deficit hyperactivity disorder (ADHD) is a common psychopathological disorder in childhood and adolescence and is believed to affect between 3% and 6% of all school children (American Psychiatric Association [APA], 1994, 2000). Reports of prevalence rates depend on the type of assessment instrument used (interviews, rating scales or observation) and the informants: teachers (Pineda, Ardila, Rosselli, Arias, Henao, Gomez, Mejia, & Miranda, 1999; Nolan, Gadow, & Sprafkin, 2001), parents (Gimpel & Kuhn, 2000) or both (Gomez, Harvey, Quick, Scharer, & Harris, 1999; Amador, Forn, & Martorell, 2001; Gadow, Sprafkin, & Nolan, 2001).

The diagnostic criteria for ADHD in the Diagnostic and Statistical Manual of Mental Disorders (DSM) have undergone several changes in the last thirty years. Although the main characteristics of inattention, hyperactivity and impulsivity have been maintained, the specific symptoms and their groupings have been modified. In the DSM-III (APA, 1980), three separate dimensions were proposed: inattention, hyperactivity and impulsivity, which were then listed in one single dimension in the DSM-III-R (APA, 1987). However, the DSM-IV and the DSM-IV-TR (APA, 1994, 2000) differentiate between only two categories of symptoms: inattention, and hyperactivity-impulsivity.

Since the DSM-IV is widely used in various countries and the diagnosis of ADHD has been recognized in different cultures in the United States (APA, 1994) and elsewhere, for

example, Australia (Graetz, Sawyer, Hazell, Arney, & Baghurst, 2001), Brazil (Rohde, Biederman, Busnello, Zimmermann, Schmitz, Martins, & Tramontina, 1999), Colombia (Pineda, et al., 1999), Germany (Baumgaertel, Wolraich, & Dietrich, 1995) and Spain (Amador, et al., 2001), the consistency of the ADHD factor structure needs to be confirmed. Cross-cultural investigations are important in order to test if whether the dimensions and symptom groupings proposed in the DSM-IV are valid in different geographical locations, and if the core features of the disorder are culturally equivalent. Confirmatory factor analysis appears to be well suited to testing symptom structures and the underlying dimensions.

Pillow, Pelham, Hoza, Molina, and Stulz (1998) analyzed the factor structure of DSM-III and DSM-III-R symptoms of ADHD, oppositional defiant disorder and conduct disorder using confirmatory factor analysis in a sample of 282 boys, aged 5 to 15, referred for treatment at an ADHD clinic. They examined three models: The first placed all ADHD symptoms in a unitary construct as in the DSM-III-R; the second placed inattention symptoms in one factor, and hyperactivity and impulsivity symptoms combined in another factor (as in the DSM-IV), and the third had inattention, hyperactivity and impulsivity symptoms in three separate factors, as in the DSM-III. The results show that the three-factor model fit the data best, but the two-factor model was more parsimonious when other behaviors strongly associated with impulsivity were accounted for. Burns, Walsh, Patterson, Holte, Sommers-Flanagan, and Parker (1997) found similar results with both community and clinically-referred children.

Previous research has used rating scales composed of items taken from the lists of symptoms in the DSM-IV (APA, 1994). Table 1 summarizes the results of ten studies with confirmatory factor analysis of ADHD symptoms proposed by the the DSM-IV, conducted since

1997.

INSERT TABLE 1

The findings of these studies support the grouping of symptoms in the DSM-IV for the diagnosis of ADHD in different cultures, but they also reveal the possible effect of differences in reporting on the results of structural model testing (Gomez, et al., 1999; Burns, Boe, Walsh, Sommers-Flanagan, & Teegarden, 2001; Wolraich, Lambert, Baumgaertel, García-Tornel, Feurer, Bickman, & Doffing, 2003). Furthermore, these factor analyses are based on samples of a broad range of ages. Teachers and parents provided ratings for kindergarten aged children to 20-year-olds. Self-reports were obtained for people from 17 to 55 years of age.

Several studies point out that symptoms of ADHD change during the developmental process and vary in frequency according to age and gender. In community populations, parents and teachers consider that younger children present more symptoms corresponding to hyperactivity and impulsivity than inattention. (Amador, et al., 2001). Younger children also received higher ratings on Hyperactivity-impulsivity symptoms than older age groups (Gomez, et al., 1999; Pineda, et al., 1999). Inattention symptoms are highest in 6 to 12 and 14 year-olds and lowest in the 4 to 5 and 14 to 18 year groups (DuPaul, Anastopoulos, Power, Reid, Ikeda, & McGoey, 1998; Pineda, et al., 1999). Boys have higher scores for ADHD symptoms than girls (DuPaul, Power, Anastopoulos, Reid, McGoey, & Ikeda, 1997; DuPaul, et al., 1998; Gomez, et al., 1999; Molina, Smith, & Pelham, 2001; Amador, et al., 2001), but another study (Rohde, Barbosa, Polanczyk, Eizirik, Rasmussen, Neuman, & Todd, 2001) found no significant differences according to age or gender on the Hyperactivity-impulsivity and Inattention factors.

One of the criteria required for a diagnosis of ADHD is that some impairment from the symptoms must be present in two or more settings (for example, at school or at work, and at home). This means that data must be obtained from different informants, generally parents and teachers. However, the ratings of symptom frequency vary according to the identity of the informant. For instance, teachers tend to report more inattention and hyperactivity-impulsivity symptoms than parents (Gomez, et al., 1999; Amador, et al., 2001).

In summary, the preschool period is characterized by hyperactivity-impulsivity, primary school by both inattention and hyperactivity-impulsivity, and adolescence by inattention (Applegate, Lahey, Hart, Biederman, Hynd, Barkley, Ollendick, Frick, Greenhill, McBurnett, Newcorn, Kerdyk, Garfinkel, Waldman, & Shafferet, 1997; Barkley & Biederman, 1997). Some experts (for example, Barkley, 1997) have suggested that hyperactive-impulsive symptoms appear first, whereas inattention symptoms arise later in the developmental course and increase during compulsory school years.

We do not know of any Spanish studies analyzing the factor structure of DSM-IV-ADHD symptoms. The present study assessed parents' and teachers' ratings of a scale prepared with the 18 ADHD symptoms from the DSM-IV. The main aim was to evaluate the factor structure of ADHD symptoms, using confirmatory factor analysis, and to validate the cross-cultural consistency of the ADHD symptoms factor structure.

Method

Participants

The sample comprised 1018 school children, 444 boys and 574 girls from 48 classes in 6 partially State-funded schools in the city of Barcelona (Spain). The schools were selected randomly from all the State-funded schools of the 10 districts of the city of Barcelona. One school was selected from each district, though four declined to participate. From each school, 8 classes were selected, one for each grade (first and second preschool, and first, second, third, fourth, fifth, and sixth grade elementary school). The sample was accidental, and the socioeconomic status was in the medium range according to the Hollingshead index (1975). The age range was from 4 to 12 years – 48 to 148 months – (M = 98.46; SD = 27.62 months; M = 98.57; SD = 28.11 months, for boys and girls respectively). Two hundred and thirty-four were preschool children: 122 first preschool, 60 girls and 62 boys, and 112 second preschool, 77 girls and 35 boys. Seven hundred and eighty four were at elementary school: 124 in first grade, 72 girls and 52 boys; 135 in second grade, 66 girls and 69 boys; 129 in third grade, 77 girls and 52 boys; 112 in fourth grade, 56 girls and 56 boys; 161 in fifth grade, 95 girls and 66 boys, and 123 in sixth grade, 71 girls and 52 boys.

Questionnaires were initially sent to the parents and teachers of 1200 children, and 1018 were returned. Of the 1018 questionnaires returned, 896 (74.6 %) were completed by teachers, and 775 (64.6 %) by parents. Of the parents' ratings, 51.2% were completed by the child's mother, 18.3% by the father, and 30.5% by both parents. Both teachers and parents completed the questionnaires in 653 cases (54.4%). Two hundred and forty-three questionnaires were completed only by teachers, and 122 only by parents. For these two groups of children, the differences were non-significant for gender ($\chi^2 = 3.57$, $df = 1$, $p = .059$), but statistically significant for age ($t = 11.69$, $df = 363$, $p < .001$). Children with only parents' ratings were older than those with only teachers' ratings (mean 122.73 months for only parents' ratings and 92.53 months for only

teachers' ratings).

Measure

A bilingual Spanish-Catalan questionnaire was prepared consisting of the 18 items from the ADHD symptom list in the DSM-IV. The wording of the items was the same as the description of the symptoms in the DSM-IV, with one exception: the term “often” was omitted. The first nine items covered inattention symptoms, and the others referred to hyperactivity and impulsivity. For each item, parents and teachers selected the answer that best described the frequency of the behavior being rated. The frequency of each type of behavior or symptom was scored on a four-point Likert scale, ranging from 0 (*Not true at all, never, seldom*) to 3 (*Very much true, very often, very frequent*). Table 2 shows Cronbach's alphas for the whole scale and for the two models evaluated in the confirmatory factor analysis. Alpha values are indicative of adequate internal consistency.

INSERT TABLE 2

Procedure

The school staff and parents' associations approved the research protocol. Parents and teachers received the questionnaire in a closed envelope, with a letter informing them of the aims of the research and requesting their voluntary and unpaid collaboration in a developmental study of certain behaviors in their children. The informants were not explicitly told that the contents of the questionnaire referred to ADHD symptoms. Parents and teachers were requested to evaluate

the items according to the habitual behavior of their children or pupils during the last six months. To ensure that teachers were sufficiently familiar with their students, data were collected in the second semester.

Statistical Analyses

Two different models were tested. Model 1 had two factors: Inattention which was comprised of the nine inattention symptoms of DSM-IV-ADHD, and Hyperactivity-impulsivity which consisted of the nine hyperactivity-impulsivity symptoms. Model 2 had three: Inattention with nine symptoms, Hyperactivity with six symptoms and Impulsivity with three symptoms. To confirm the two- and three- factor structures, each model underwent confirmatory factor analysis with the program EQS (version 5.7, Bentler, 1995). Given the nature of the items the elliptic robust least square method (ERLS) was chosen for parameter estimation, with a Likert format and biased distribution (Bentler & Dijkstra, 1985). Separate analyses were conducted for parents and teachers. The analyses were performed for the total sample as well as for subjects about whom information had been obtained from both parents and teachers. Factor scores were then obtained for each subject from the coefficients provided by the measurement equations from the two factors confirmatory factor analysis, Inattention and Hyperactivity-impulsivity.

2 x 4 factor analyses of variance were used to examine whether there were differences in terms of gender and school cycle¹. The analysis was carried out using the Statistical Package for the Social Sciences-Windows version 11.0, and assessed teachers and parents separately. Specific

1. Preschool : children aged 4 to 6; Primary school: Initial grades, first and second grades, children aged 6 to 8; Middle grades, third and fourth grades, children aged 8 to 10; and Upper grades, fifth and sixth grades, children

group differences were examined with Scheffé post-hoc contrasts, using a p value of .05.

Results

Two different confirmatory factor models were evaluated: one with two factors of Inattention and Hyperactivity-impulsivity and one with three factors (Inattention, Hyperactivity, and Impulsivity). These two models were analyzed using the sample of teachers and parents separately. Moreover, in both cases a difference was made between the analyses of the total sample and of the subjects for whom data were available from both parents and teachers. The matrices of factor coefficients are shown in Tables 3 and 4, together with the errors for the four factor analyses.

INSERT TABLES 3 and 4

The values for the coefficients and for the errors were practically the same for teachers and parents, either considering the sample as a whole or considering the set of subjects for whom data were available from both sets of informants. Further, the coefficients obtained were very similar in the two-factor and three-factor models, but the errors were slightly lower for hyperactivity and impulsivity in the three-factor model. This pattern appeared in both the teachers' and the parents' samples. Table 5 shows the indices of adjustment for the four confirmatory factor analyses.

INSERT TABLE 5

Both models present good adjustment of the indices for parents' and teachers' ratings. However, the indices were slightly better in the three-factor -structure, especially in the teacher sample. The correlation matrix between factors, both for parents and teachers, indicates a moderate-to-high correlation for both models. In the three-factor model, the correlations were higher between the Hyperactivity and Impulsivity factors (see Table 6).

INSERT TABLE 6

Since the differences between the models for the adjustment indices and the error estimation of the coefficients were slight, for the sake of plausibility, we decided to use the two-factor model for the ANOVA subsequent analyses. Since the adjustment indices and the coefficients and errors in teachers and in parents were very similar in the total sample and in the set of subjects in which information was available from both sets of informants, we decided to carry out the subsequent analyses (ANOVAs) with the total sample which consisted of 896 teacher ratings and 775 parent ratings. The scores on the two factors were thus obtained for teachers and for parents from the coefficients provided by the measurement equations obtained in the two factors of confirmatory factor analysis, Inattention and Hyperactivity-impulsivity.

Tables 7 and 8 summarize the ANOVAs carried out for the teachers' and parents' samples respectively.

INSERT TABLES 7 and 8

For the teachers' sample (Table 7), there were statistically significant differences between the two factors for the sources of variation according to gender (Inattention: $F_{(1, 888)} = 33.09$, $p < .001$; Hyperactivity-impulsivity: $F_{(1, 888)} = 53.21$, $p < .001$ and school grades (Inattention: $F_{(3, 888)} = 12.39$, $p < .001$; Hyperactivity-impulsivity: $F_{(3, 888)} = 7.29$, $p < .001$, but none for the interaction. For the two factors, boys scored higher than girls. As for the school grades, the two factors presented different patterns; on the Inattention factor, the preschool group scored lower than the other grade groups; and on the Hyperactivity-impulsivity factor, the children in the initial grades scored the highest. In any case, both for gender and for school grades, the effect sizes were very low (ranging from .024 to .057).

Similarly, for the parents' sample (Table 8), the interaction between gender and school grades was not statistically significant in any analysis. The source of variation for gender was statistically significant in the two factors (Inattention: $F_{(1, 767)} = 24.95$, $p < .001$; Hyperactivity-impulsivity: $F_{(1, 767)} = 7.86$, $p = .005$), in which boys invariably scored higher than girls. This result was already observed with the teachers as informants, although the mean scores for boys and girls for the Inattention factor were lower if the informants were the parents. Again, the effect sizes were very low (ranging between .010 and .032).

The source of variation for school grades was statistically significant for Inattention ($F_{(3, 767)} = 5.26$; $p = 0.001$) and Hyperactivity-impulsivity ($F_{(3, 767)} = 6.43$; $p < .001$). Preschoolers' ratings on Inattention were lower than the groups in the middle and upper grades. This result was already observed when the informants were the teachers, although with the sample of parents no significant differences were obtained between the preschoolers and children in the initial grades.

For the Hyperactivity-impulsivity factor, the pattern was different from that observed in the teachers: the upper grades group scored lower score than the preschoolers and the initial grades. However, for the source of variation for school grades the effect size is very low.

Discussion

Several recent studies have used confirmatory factor analysis to evaluate the organization of parent, teacher and self-report ratings of DSM-IV-ADHD symptoms. These studies have found that the grouping of ADHD symptoms in two clusters, inattention and hyperactivity-impulsivity, provides a parsimonious model for the organization of parent and teacher ratings in community samples of different ages and from different countries. Other studies have found that the symptoms of ADHD group into three factors: inattention, hyperactivity and impulsivity. The present study compared the two-dimension model proposed by the DSM-IV with the three-dimension model proposed in the DSM-III. Confirmatory factor analysis indicated that both models represented the data adequately, but that the three-factor model fitted the data slightly better for parents' and teachers' ratings. However, since the differences between the models were slight for the adjustment indices and the error estimation of the coefficients and since the correlation between Hyperactivity and Impulsivity in the three-factor model was high, we consider the two-factor model as a more parsimonious representation of the teachers' and parents' evaluations of the ADHD symptoms. Our findings, taken together with the results of previous factor analytic studies carried out in Australia, Brazil, Canada, Colombia, Germany and United States, support the construct validity of the DSM-IV dimensions of inattention and hyperactivity-impulsivity, and suggest that there are more cross-cultural similarities than differences in the

organization of DSM-IV-ADHD symptoms rated by teachers and parents.

Parents' and teachers' ratings for boys were higher than for girls in these two factors, as other authors have reported (for example, Brito, Pinto, & Lins, 1995; Gomez, et al., 1999; Pineda, et al., 1999). However, when the variable school grade is taken into account, the patterns of scores rated by parents and teachers are different (Amador, et al., 2001). According to the rating by teachers, there is an increase in Inattention and Hyperactivity-impulsivity behavior from preschool to the initial grades. Inattention problems tend to persist throughout the school years, whereas Hyperactivity-impulsivity problems tend to decrease slightly. For parent ratings, there is a moderate increase in Inattention problems from preschool to middle and upper grades, but a decrease in Hyperactivity-impulsivity symptoms throughout the school grades. This decrease is significantly larger in the upper grades.

In summary, this is the first study in a Spanish population to analyze the structure and organization of ADHD symptoms in a community sample with information from both parents and teachers. The results support the grouping of the 18 ADHD symptoms in two factors, as proposed by the DSM-IV, and confirm the cross-cultural value of this grouping. Studies of this type, performed in different contexts and with diverse populations, have reproduced the two-factor structure proposed by the DSM-IV, thus providing support for the validity of the diagnostic subtypes.

Finally, gender introduces important differences in teachers' and parents' ratings of the symptoms. Overall, boys were rated higher than girls. The differences according to school grade also depended on the identity of the raters.

References

- American Psychiatric Association (1980) *Diagnostic and statistical manual of mental disorders* (third edition) Washington, DC: Author.
- American Psychiatric Association (1987) *Diagnostic and statistical manual of mental disorders* (third edition revised) Washington, DC: Author.
- American Psychiatric Association (1994) *Diagnostic and statistical manual of mental disorders* (fourth edition) Washington, DC: Author.
- American Psychiatric Association (2000) *Diagnostic and statistical manual of mental disorders: DSM-IV-TR* (text revision) Washington, DC: Author.
- Amador, J. A., Forns, M., & Martorell, B. (2001). Trastorno por déficit de atención con hiperactividad: Análisis evolutivo y consistencia entre informantes [Symptoms of inattention and hyperactivity-impulsivity: Developmental analysis and inter-informant consistency]. *Anuario de Psicología*, 32,51-66.
- Applegate, B., Lahey, B. B., Hart, E. L., Biederman, J., Hynd, G. W., Barkley, R. A., Ollendick, T., Frick, P. J., Greenhill, L., McBurnett, K., Newcorn, J. H., Kerdyk, L., Garfinkel, B., Waldman, I., & Shaffer, D. (1997) Validity of the age-of-onset criterion for ADHD: a report from the DSM-IV field trials. *Journal of the American Academy of Child and Adolescent Psychiatry*, 36, 1211-1221.
- Barkley, R. A. (1997) *ADHD and the nature of self-control*. New York: Guilford Press.
- Barkley, R. A., & Biederman, J. (1997) Toward a broader definition of the age of onset criterion for attention deficit hyperactivity disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*, 36, 1204-1210.

- Baumgaertel, A., Wolraich, M. L., & Dietrich, M. (1995) Comparison of diagnostic criteria for attention-deficit disorder in a German elementary school sample. *Journal of the American Academy of Child and Adolescent Psychiatry*, 34, 629-638.
- Beiser, M., Dion, R., & Gotowiec, A. (2000) The structure of attention-deficit and hyperactivity symptoms among native and non-native elementary school children. *Journal of Abnormal Child Psychology*, 28, 425-437.
- Bentler, P. (1995) *EQS v5.1. Manual*. Chicago, IL: University Press.
- Bentler, P., & Dijkstra, T. (1985) Efficient estimation via linearization in structural models. In P. R. Krishnaiah (Ed.), *Multivariate analysis VI*. Amsterdam: North-Holland (pp. 9-42).
- Brito, G. N. O., Pinto, R. C. A., & Lins, M. F. C. (1995) A behavioral assessment scale for attention deficit disorder in Brazilian children based on DSM-III-R criteria. *Journal of Abnormal Child Psychology*, 23, 509-520.
- Burns, L. G., Boe, B., Walsh, J. A., Sommers-Flanagan, R., & Teegarden, L. A. (2001) A confirmatory factor analysis on the DSM-IV ADHD and ODD symptoms: what is the best model for the organization of these symptoms?. *Journal of Abnormal Child Psychology*, 29, 339-349.
- Burns, G. L., Walsh, J. A., Patterson, D. R., Holte, C. S., Sommers-Flanagan, R., & Parker, C. M. (1997) Internal validity of the disruptive behavior disorder symptoms: Implications from parent ratings for a dimensional approach to symptom validity. *Journal of Abnormal Child Psychology*, 25, 307-319.
- Collet, B. R., Crowley, S. L., Gimpel, G. A., & Greenson, J. N. (2000) The factor structure of DSM-IV Attention Deficit-Hyperactivity symptoms: a confirmatory factor analysis of the

- ADHD-SRS. *Journal of Psychoeducational Assessment*, 18 361-373.
- DuPaul, G. J., Anastopoulos, A. D., Power, T. J., Reid, R., Ikeda, M. J., & McGoey, K. E. (1998) Parent rating of Attention Deficit Hyperactivity Disorder symptoms: factor structure and normative data. *Journal of Psychopathology and Behavioral Assessment*, 20, 83-102.
- DuPaul, G. J., Power, T. J., Anastopoulos, A. D., Reid, R., McGoey, K. E., & Ikeda, M. J. (1997) Teacher rating of Attention Deficit Hyperactivity Disorder symptoms: factor structure and normative data. *Psychological Assessment*, 9, 436-443.
- Gadow, K. D., Sprafkin, J., & Nolan, E. (2001) DSM-IV symptoms in community and clinic preschool children. *Journal of the American Academy of Child and Adolescent Psychiatry*, 40, 1383-1392.
- Gimpel, G. A., & Kuhn, B. R. (2000) Maternal report of attention deficit hyperactivity disorder symptoms in preschool children. *Child: Care, Health and Development*, 26, 163-176.
- Gomez, R., Burns, G. L., Walsh, J. A. & Alves de Moura, M. (2003) A multitrait-multisource confirmatory factor analytic approach to the construct validity of ADHD rating scales. *Psychological Assessment*, 15 (1), 3-16.
- Gomez, R., Harvey, J., Quick, C., Scharer, I., & Harris, G. (1999) DSM-IV AD/HD: Confirmatory factor models, prevalence, and gender and age differences based on parent and teacher ratings of Australian primary school children. *Journal of Child Psychology and Psychiatry*, 40, 265-274.
- Graetz, B. W., Sawyer, M., Hazell, P., Arney, F., & Baghurst, P. (2001) Validity of DSM-IV ADHD subtypes in a national representative sample of Australian children and adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry*, 40, 1410-1417.

- Hollingshead, A. B. (1975) *Four-factor Index of Social Status*. New Haven, CT: Yale University Press.
- Molina, B. S. G., Smith, B. H., & Pelham, W. E. (2001) Factor structure and criterion validity of secondary school teacher ratings of ADHD and ODD. *Journal of Abnormal Child Psychology*, 29, 71-82.
- Nolan, E. E., Gadow, K. D., & Sprafkin, J. (2001) Teacher reports of DSM-IV ADHD, ODD, and CD symptoms in school children. *Journal of the American Academy of Child and Adolescent Psychiatry*, 40, 241-249.
- Pillow, D. R., Pelham, W. E., Hoza, B., Molina, B. S. G., & Stulz, C. H. (1998) Confirmatory factor analyses examining Attention Deficit Hyperactivity Disorder symptoms and other childhood disruptive behavior. *Journal of Abnormal Child Psychology*, 26, 293-309.
- Pineda, D., Ardila, A., Rosselli, M., Arias, B. F., Henao, G. C., Gomez, L. F., Mejia, S. E., & Miranda (1999) Prevalence of Attention-Deficit/Hyperactivity Disorder symptoms in 4- to 17-year-old children in the general population. *Journal of Abnormal Child Psychology*, 27, 455-462.
- Rohde, L. A., Barbosa, G., Polanczyk, G., Eizirik, M., Rasmussen, E. R., Neuman, R. J., & Todd, R. D. (2001) Factor and latent class analysis of DSM-IV ADHD symptoms in a school sample of Brazilian adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry*, 40, 711-718.
- Rohde, L. A., Biederman, J., Busnello, E., Zimmermann, H., Schmitz, M., Martins, S., & Tramontina, S. (1999) ADHD in a school sample of Brazilian adolescents: a study of prevalence, comorbid conditions, and impairments. . *Journal of the American Academy of*

Child and Adolescent Psychiatry, 38, 716-722.

Span, S. A., Earleywine, M., & Strybel, T. Z. (2002) Confirming the factor structure of Attention Deficit Hyperactivity Disorder symptoms in adult, nonclinical samples. *Journal of Psychopathology and Behavioral Assessment, 24, 129-136.*

Wolraich, M. L., Lambert, E. W., Baumgaertel, A., García-Tornel, S., Feurer, I. D., Bickman, L., & Doffing, M. A. (2003) Teachers' screening for Attention Deficit/Hyperactivity Disorder: comparing multinational samples on teacher rating of ADHD. *Journal of Abnormal Child Psychology, 31, 445-455.*

Table 1. Studies with Confirmatory Factor Analysis of ADHD-DSM-IV symptoms since 1997: authors, sample/population, raters, confirmatory factor analysis model and correlations between factors.

Authors	Sample/Population	Raters	Confirmatory Factor Analysis model (r between factors)
DuPaul et al. (1997)	4,009 (4 to 19 years) / American	Teachers	Two factors: Hyperactivity-Impulsivity and Inattention (r = .94)
DuPaul et al. (1998)	4,666 (4 to 20 years) / American	Parents	Two factors: Hyperactivity-Impulsivity and Inattention (r = .92)
Gomez et al. (1999)	1,275 (5 to 11 years) / Australian	Parents and Teachers	Three factors: I. Inattention, II. Hyperactivity, III. Impulsivity (Parents: r I-II = .77; r I-III = .64; r II-III = .84. Teachers: r I-II = .73; r I-III = .57; r II-III = .86)
Beiser et al. (2000)	2,044 (1555 Native and 489 non-Native) US and Canada. Grades 2 (1510) and 4 (534)	Teachers and Parents	Two factors: Attention-deficit and Hyperactivity-Impulsivity (Teachers: Non-Native, r = .75; Native, r = .68. Parents Non-Native, r = .89; Native, r = .87)
Collet et al. (2000)	Two samples: <i>sample 1</i> , 624 American (Grades K to 12); <i>sample 2</i> , 572 American (Grades K to 5).	Parents	Two factors: Inattention and Hyperactivity-Impulsivity (r = .84)
Burns et al. (2001)	833 American. 742 not in treatment (average age = 8.28, SD = 3.68) ; 91 in treatment for ADHD (average age = 10.26 ; SD = 2.92)	Parents or Guardians	Two factors: Inattention and Hyperactivity-Impulsivity (r = .68 for No treatment and Treatment)
Molina et al. (2002)	Study 1: 247 (11 to 16 years) American Study 2: 224 (13 to 18 years), 132 with childhood history of ADHD, and 92 without history of ADHD.American	Teachers	Study 1: Two factors: Inattention and Hyperactivity-Impulsivity (r = .85) Study 2: Two factors: Inattention and Hyperactivity-Impulsivity (r = .77)
Gomez et al. (2003)	<i>Australian sample:</i> 1,475 (average age 8.28 years, SD = 1.80). Australian <i>Brazilian sample:</i> 285 (average age 8.91 years, SD = 1.26) Brazilian	Parents and Teachers	Two factors: Inattention and Hyperactivity-Impulsivity (Australian sample: Parents, r = .76; Teachers, r = .69. Brazilian sample: Parents, r = .73; Teachers, r = .67)
Wolraich et al. (2003)	19,542 in 4 locations: Germany (1077; Grades 1 to 4), Spain (1283 ; Grades 1 to 4), suburban US (11,092; kindergarten through fifth grade), and urban US (6090; kindergarten through fourth grade)	Teachers	Two factors: Inattention and Hyperactivity-Impulsivity (r = .87)
Span et al. (2002)	Study 1: 262 (17 to 39 years) / American Study 2: 237 (17 to 55 years) / American	Self- report	Study 1: Three factors: I. Inattention, II. Hyperactivity, III. Impulsivity (r I-II = .64; r I-III = .47; r II-III = .52) Study 2: Three factors: I. Inattention, II. Hyperactivity, III. Impulsivity (r I-II = .75; r I-III = .38; r II-III = .49)

Table 2. Cronbach's alpha for the whole scale, and for the two and three factors evaluated in confirmatory factor analysis.

Factors		Children rates by teachers and parents		Children rates by teachers or parents	
		Teachers n = 653	Parents n = 653	Teachers n = 896	Parents n = 775
Whole scale		.956	.889	.957	.892
Two factors	Inattention	.848	.949	.859	.857
	Hyperactivity-Impulsivity	.951	.952	.859	.858
Three factors	Inattention	.948	.949	.859	.857
	Hyperactivity	.927	.928	.809	.809
	Impulsivity	.934	.934	.736	.734

Table 3. Two-factor model standardized solution model with confirmatory factor analysis, ERLS method.

Factors	Items	Teachers				Parents			
		(n = 896)		(n = 653)		(n = 775)		(n = 653)	
		Coef.	Errors	Coef.	Errors	Coef.	Errors	Coef.	Errors
Inattention	1. Fails to pay close attention	.847	.532	.842	.539	.725	.689	.738	0.675
	2. Difficulty sustaining attention	.757	.654	.763	.647	.566	.825	.550	0.835
	3. Does not seem to listen	.785	.620	.798	.603	.545	.839	.571	.821
	4. Does not follow instructions	.894	.448	.892	.453	.668	.744	.672	.740
	5. Difficulty organizing tasks	.844	.537	.834	.552	.559	.829	.542	.841
	6. Avoids tasks	.819	.574	.811	.585	.697	.717	.674	.739
	7. Loses things	.747	.665	.724	.690	.524	.852	.505	.863
	8. Easily distracted	.853	.522	.843	.538	.756	.655	.761	.649
	9. Forgetful	.864	.504	.857	.515	.685	.729	.670	.742
Hyperactivity and impulsivity	10. Fidgets	.846	.533	.846	.533	.677	.736	.681	.732
	11. Leaves seat	.863	.505	.866	.501	.709	.705	.720	.694
	12. Runs about or climbs	.848	.530	.842	.540	.742	.670	.739	.673
	13. Difficulty playing	.688	.726	.690	.724	.466	.885	.473	.881
	14. "On the go"	.887	.462	.889	.458	.691	.723	.693	.720
	15. Talks excessively	.786	.618	.784	.620	.575	.818	.564	.826
	16. Blurts out answers	.829	.559	.829	.560	.628	.778	.624	.781
	17. Difficulty waiting	.856	.516	.848	.530	.627	.779	.617	.787
	18. Interrupts	.869	.494	.866	.500	.631	.776	.621	.784
Percentage of variance accounted		79.3		79.1		79.9		79.2	

Note: Coef. = Coefficients, ERLS = elliptical robust least squares.

Table 4. Three-factor model standardized solution model with confirmatory factor analysis, ERLS method.

Factors	Items	Teachers				Parents			
		(n = 896)		(n = 653)		(n = 775)		(n = 653)	
		Coef.	Errors	Coef.	Errors	Coef.	Errors	Coef.	Errors
Inattention	1. Fails to pay close attention	.847	.532	.842	.540	.725	.689	.738	.675
	2. Difficulty sustaining attention	.757	.653	.763	.647	.564	.825	.548	.836
	3. Does not seem to listen	.785	.620	.798	.603	.545	.839	.572	.821
	4. Does not follow instructions	.894	.449	.891	.453	.669	.743	.674	.739
	5. Difficulty organizing tasks	.844	.537	.834	.552	.558	.830	.541	.841
	6. Avoids tasks	.819	.574	.811	.585	.697	.717	.674	.739
	7. Loses things	.747	.665	.724	.690	.524	.852	.505	.863
	8. Easily distracted	.853	.523	.843	.538	.756	.654	.761	.649
	9. Forgetful	.864	.504	.857	.515	.685	.728	.670	.742
Hiperactivity	10. Fidgets	.869	.495	.870	.492	.708	.706	.715	.700
	11. Leaves seat	.885	.465	.889	.457	.733	.681	.744	.668
	12. Runs about or climbs	.872	.490	.868	.497	.764	.645	.764	.645
	13. Difficulty playing	.695	.719	.701	.713	.460	.888	.463	.886
	14. "On the go"	.906	.423	.907	.420	.703	.711	.707	.707
	15. Talks excessively	.760	.650	.751	.661	.553	.833	.539	.842
Impulsivity	16. Blurts out answers	.897	.442	.898	.440	.684	.729	.690	.724
	17. Difficulty waiting	.930	.367	.927	.376	.695	.719	.690	.724
	18. Interrupts	.901	.434	.903	.430	.704	.710	.697	.717
Percentage of variance accounted		83.2		80.1		82.7		80.6	

Note: Coef. = Coefficients, ERLS = elliptical robust least squares

Table 5. Fit indices for the two-factor and three-factor model for the confirmatory factor analysis of teacher and parent ratings.

Fit indices	Teachers				Parents			
	Two Factors		Three Factors		Two Factors		Three Factors	
	n = 896	n = 653	N = 896	n = 653	n = 775	n = 653	n = 775	n = 653
χ^2	1285.48	1028.596	785.069	630.347	545.536	479.587	459.477	391.191
	df = 134	df = 134	df = 132	df = 132	df = 134	df = 134	df = 132	df = 132
	p < .001	p < .001	p < .001	p < .001	p < .001	p < .001	p < .001	p < .001
BBNFI	.953	.947	.971	.967	.949	.945	.957	.956
BBNNFI	.952	.946	.972	.970	.955	.954	.964	.965
CFI	.958	.953	.976	.974	.961	.960	.969	.970
GFI	.795	.775	.864	.849	.909	.906	.922	.922
AGFI	.738	.713	.823	.804	.883	.879	.899	.898
RMR	.044	.045	.041	.042	.038	.040	.037	.037

χ^2 : chi square, d.f: degrees of freedom, BBNFI: Bentler-Bonett normed fit index, BBNNFI: Bentler-Bonett nonnormed fit index, CFI: comparative fit index, , GFI: LISREL, GFI fit index, AGFI: LISREL AGFI fit index, RMR: root mean squared residual. Values over 0.9 of CFI indicates a good fit of the model and values of RMR less than 0.05 also indicates a good fit of the model

Table 6. Correlations between factors for the two- and the three-factor model solution

Factorial solution	Correlations	Teachers		Parents	
		n = 896	n = 653	n = 775	n = 653
Two Factors	F1 – F2	.615 *	.609 *	.591 *	.581 *
	F1 – F2	.628 *	.622 *	.561 *	.545 *
Three Factors	F1 – F3	.531 *	.523 *	.574 *	.575 *
	F2 – F3	.868 *	.861 *	.821 *	.805 *

Two factor solution: F1 – Inattention and F2: Hyperactivity-impulsivity

Three factor solution: F1 – Inattention, F2 - Hyperactivity and F3 - Impulsivity

* Significant at $p < .01$

Table 7. ANOVAs for the two-factor model solution in the sample of teachers.

Factor	S.V.	F	df	p	η^2	Contrasts	mean	p
Inattention	Gender	33.090	1, 888	< .001	.036	boys > girls	6.10 > 4.20	
	School Grade	12.391	3, 888	< .001	.040	I > preschool	5.62 > 3.35	< .001
						M > preschool	5.60 > 3.35	< .001
U > preschool	5.67 > 3.35	< .001						
Hyperactivity-Impulsivity	Gender	53.210	1, 888	< .001	.057	boys > girls	4.70 > 2.58	
	School Grade	7.296	3, 888	< .001	.024	I > preschool	4.53 > 2.65	< .001
						I > U	4.53 > 3.39	.045

S.V.: Source of Variation, F: Snedecor's F, df: degrees of freedom, p: significance level, η^2 : effect size, contrast: significant "a posteriori" comparisons, Grades: I: initial, M: middle, U: upper.

Table 8. ANOVAs for the two-factor model solution in the sample of parents.

Factor	S.V.	F	df	p	η^2	Contrasts	mean	p
Inattention	Gender	24.950	1, 767	< .001	.032	boys > girls	3.31 > 2.49	
						M > preschool	3.20 > 2.29	.002
	School Grade	5.263	3, 767	.001	.020	U > preschool	2.96 > 2.29	.027
Hyperactivity-Impulsivity	Gender	7.858	1, 767	.005	.010	boys > girls	4.79 > 3.79	
						Preschool > U	4.65 > 3.33	.001
	School Grade	6.425	3, 767	< .001	.025	I > U	4.38 > 3.33	.007

S.V.: Source of Variation, F: Snedecor's F, df: degrees of freedom, p: significance level, η^2 : effect size, contrast: significant "a posteriori" comparisons, Grades: I: initial, M middle, UC: upper.