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Title: Differential impact of a multimodal versus pharmacological therapy on the core symptoms of Attention Deficit/Hyperactivity Disorder in childhood

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Abstract: The aim of this study was to analyze the relative and differential efficacy of a combined versus medical treatment to reduce the symptoms of ADHD children in the school and family environment.

A total of 100 subjects participated: 20 children with ADHD, their 40 parents and their 40 teachers. Half of the subjects were assigned to the drug group and half to the combined (drug plus psychosocial, psychoeducational intervention with teachers and parents / mothers).

Results: The group analyses indicated that both treatments were effective, without significant differences between them. Individualized clinical analyses indicated that higher percentages of improvement and normalization were obtained in the children in the combined group than in the drug only group. Our findings point to the desirability of implementing multimodal, multicontextual interventions, and long-lasting for ADHD in childhood.

Dear Editor,

Please find enclosed the manuscript "Differential impact of a multimodal versus pharmacological therapy on the core symptoms of Attention Deficit/Hyperactivity Disorder in childhood", by Laura Amado, Sonia Jarque y Roberta Ceccato, which we like to submit for publication in the journal *Research in Developmental Disabilities*.

The research reported in this piece of work has been funded by the Spanish Ministry of Economy and Competitiveness.

We confirm that this manuscript has not been published elsewhere and is not under consideration by another journal.

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We look forward to hearing from you at your earliest convenience.

Sincerely,

Sonia Jarque

Highlights

- Long-lasting, multimodal and multicontextual interventions for ADHD children.
- Efficacy of a combined versus medical treatment for ADHD children.
- Both treatments were effective, without significant differences between them.

Differential impact of a multimodal versus pharmacological therapy on the core symptoms of Attention Deficit/ Hyperactivity Disorder in childhood

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Abstract

The aim of this study was to analyze the relative and differential efficacy of a combined versus medical treatment to reduce the symptoms of ADHD children in the school and family environment.

A total of 100 subjects participated: 20 children with ADHD, their 40 parents and their 40 teachers. Half of the subjects were assigned to the drug group and half to the combined (drug plus psychosocial, psychoeducational intervention with teachers and parents / mothers).

Results: The group analyses indicated that both treatments were effective, without significant differences between them. Individualized clinical analyses indicated that higher percentages of improvement and normalization were obtained in the children in the combined group than in the drug only group. Our findings point to the desirability of implementing multimodal, multicontextual interventions, and long-lasting for ADHD in childhood.

Keywords: ADHD children; multimodal treatment; methylphenidate; psychosocial treatment; training teachers.

1. Introduction

ADHD is a neurodevelopmental disorder characterized by inattention, impulsivity and/or motor activity, which significantly interfere in the social, emotional and cognitive levels of affected children in their natural developmental contexts (APA, 2013; Cardo & Servera, 2008).

Its high prevalence, along with its negative impact, frequent comorbidity and chronic nature, make it one of the most researched and treated childhood disorders in the last decade. Indeed, the number of children diagnosed with ADHD increased by 24% from 2001 to 2010 (Getahun, 2013) so that between 3% and 7% of school-age children present the disorder (Cardo, Servera, Vidal, De Azúa, Redondo & Riutort, 2011; Polanczyk et al., 2007). Often associations with behavioral problems, learning difficulties, socio-affective deficits and risk behaviors occur (Humphreys et al., 2013; McQuade et al., 2011; Sexton et al., 2012).

The etiology of ADHD is multifactorial. Its origin is genetic and neurobiological, but its clinical course and prognosis are greatly influenced by environmental factors (Bralten et al., 2013; Del Campo, Chamberlain, Sahakian & Robbins, 2011; Owens & Hinshaw, 2013). In keeping with the nature of the disorder, interventions that have been validated empirically include psychostimulants, psychosocial interventions, and treatments that combine both types of intervention (Coghill et al., 2013; Gerber et al., 2012; American Academy of Pediatrics, 2011).

Stimulant medication, in the form of methylphenidate, is the pharmacological treatment of choice for managing ADHD, having been endorsed by hundreds of efficacy studies to reduce core symptoms and difficulties in cognitive function (Charach & Fernández, 2013; Coghill et al., 2013; Scheweren et al., 2012).

These benefits are generally maintained over several years, although most children relapse when medication is discontinued (Abikoff et al., 2004; Charack et al., 2004; Buitelaar et al., 2007; Swanson et al., 2008).

The potential benefits of psychostimulants in the short term must be weighed up against their limitations and risks, such as adverse side effects, especially in preschool children (González de Dios, Cardo & Servera, 2006; Swanson, Elliott, Greenhill, Wigal, Arnold & Vitiello, 2007; Swanson et al., 2008; Charach, Carson, Fox, Ali, Beckett & Lim, 2013; Ghuman, Arnold & Anthony, 2008).

Moreover, medication dropout rates ranging from 13% to 64% have been observed, especially in immediate action stimulants (Adler & Nierenberg, 2010).

These drawbacks justify the implementation of psychosocial interventions that have been empirically validated as parents' and teachers' training in behavior management techniques, and cognitive behavioral techniques (Arco, Fernández & Hinojo, 2004; Fabiano, Pelham, Coles & Gnagy, 2009; Hodgson, Hutchinson & Denson, 2014; Miranda, Jarque & Tárraga, 2006; Presentación, Siegenthaler, Jara & Miranda, 2010; Chronis et al., 2006; Pelham & Fabiano, 2008).

In the school environment, these interventions were shown to be effective in reducing the core symptoms of ADHD, difficulties in cognition, and disruptive and aggressive behaviors (Miranda et al., 2011; Antshel & Barkley, 2008; Miranda, Jarque & Rosel, 2006). They have also have been shown to be effective in increasing academic productivity, social competence and rules compliance (Abikoff et al., 2013).

Similarly, in the family context various training programs for parents of children with ADHD have been implemented, and were found to be effective in reducing the core symptoms and family distress, and improving parenting skills (Ferrin et al.,

2013; Fabiano, Pelham, Coles & Gnagy, 2009; Jones, Daley, Hutchings, Bywater & Eames, 2008; Mikami, Lerner, Griggs, McGrath & Calhoun, 2010).

Moreover, studies that have implemented psychosocial intervention programs in both settings have shown they can result in more successful outcomes than its use alone (Miranda et al., 2011; Siegenthaler, 2009).

However, as with medication, these interventions are not exempt from limitations, including limited evidence of maintenance of the improvements, or the generalization of learned behavior in other situations (Fabiano, Pelham, Coles & Gnagy, 2009).

In addition, dropout rates in these cases are also high, reaching up to 50%, particularly in parents suffering a lot of stress, who do not agree with the principles of training, or who perceived their child as a difficult person and/or with severe behavior problems (Friars & Mellor, 2007).

Recognizing the limitations of both interventions applied in isolation, different clinical practice guidelines on ADHD support the use of multimodal treatments (American Academy of Pediatrics, 2001; Grupo de trabajo de la guía de práctica clínica sobre el TDAH del Sistema Nacional de Salud, 2010; Institute for Clinical Systems Improvement, 2007; National Institute for Health and Clinical Excellence, 2009).

Along this vein, some studies have found that the dose of medication can be reduced when prescribed in combination with psychosocial interventions whilst obtaining the same results. Furthermore, a reduction of the possible side effects of long-term medication is also observed (Antshel & Barkley, 2008; Van der Oord et al., 2012; Pelham, Burrows, Gnagy & Fabiano, 2005; So, Leung & Hung, 2008).

In conclusion, the three interventions that have shown efficacy are pharmacological, psychosocial and combined. However, there are still few studies that have compared the differential effectiveness of these interventions, at least in our country, Spain.

Indeed, the objective of this research was to analyze the effects of a combined intervention versus pharmacological treatment in reducing the core symptoms of ADHD children in the school and family environment.

The specific objectives and hypotheses of this study are:

1. *To analyze the relative and differential efficacy of pharmacological intervention versus a combined one on the core symptoms of ADHD in the school environment.*

We hypothesized that both treatments would be effective, but that the combined intervention would produce a significantly greater reduction in symptoms compared with medication alone.

2. *To analyze the relative and differential efficacy of pharmacological intervention versus a combined one on the core symptoms of ADHD in the family environment.*

We hypothesized that both would be effective, but that the combined intervention would produce a significantly greater reduction in symptoms, compared with medication alone.

2. Method

2.1. Setting and participants

This study involved three related samples (N = 100): a group of children with ADHD (N = 20), their families (parents/mothers, N = 40) and teachers (tutors, specialists, N = 40).

Half of the children received stimulant medication exclusively, while the other half received a combined treatment (stimulant medication plus psychosocial intervention).

Sample of children

For the selection of children with ADHD, we collaborated with the psychoeducation teams of four concerted schools in Barcelona (Catalonia, Spain), who conducted the ADHD diagnoses. A total of 20 children with ADHD, whose demographic characteristics are shown in Table 1, participated in the study. Half of them were assigned to the group receiving drug treatment and the other half to the other, which received the combined intervention.

(table 1 here)

The 10 children in the “drug group” were selected from three concerted schools in Barcelona (Spain) with the cooperation of the educational and psychology teams, after informed consent and a commitment for participation of their families and teachers was obtained. The children were aged between 7 and 9 years (mean 7.6 years), with a clear predominance of males over females (8/2). All of them were diagnosed with ADHD combined subtype by the psychology team and were not receiving any specific treatment.

The sample comprising the combined treatment group consisted of 10 children from a concerted school of Barcelona (Spain) whose parents had provided informed

consent and commitment to participate in the study to the psychology team. The children were aged between 7 and 9 years (mean 7.8), with a clear predominance of males over females (9/1). 8 of them were diagnosed with ADHD combined subtype, 1 with inattentive subtype and 1 with hyperactive-impulsive subtype, none of whom were receiving treatment.

Sample of parents

The parent sample consisted of the 20 fathers and 20 mothers of the ADHD children described above. Half of the couples formed the drug group sample, and the other half, the combined group sample. Table 2 shows the sociodemographic characteristics of each group.

(table 2 here)

The parents of the children in the drug group sample had a mean age of 37.5 years and an average of 2.1 children per family. They belonged to a medium-high socioeconomic status and educational levels were heterogeneous (10%, basic studies; 25%, secondary education; 65%, university graduates). They were duly informed and agreed that, upon completion of the investigation, the school teachers would receive a refresher course in ADHD and families would receive multiple sessions of psychoeducational counseling (waiting list).

The parents of the children in the combined group had a mean age of 39.3 years and an average of 2.5 children per family. They belonged to a medium-high socioeconomic status and educational levels were heterogeneous (20%, basic studies; 40%, secondary education; 40%, university graduates). All of them agreed to participate in the training program that would be implemented.

Sample of teachers

In addition, 40 teachers also participated, half of them in the drug group and the other half in the combined group. All of them were primary school teachers, 20 of them being main teacher of children with ADHD, and the others, specialist teachers.

As seen in Table 3, the average age of teachers in the pharmacological group was 40.3 years, with a clear predominance of women over men (16/4).

(table 3 here)

Teachers had an average of 23.5 years teaching experience and 45% had had some teaching experience with pupils with ADHD. None of the teachers had previously attended specialization courses on ADHD.

On the other hand, the average age of the teachers in the combined group was 38.4 years. There was also a clear predominance of women over men (13/7). They had an average of 19.1 years teaching experience and 60% had had some teaching experience with children with ADHD. Only one of the teachers had previously attended specialization courses on ADHD.

2.2. Mesures

The diagnosis of ADHD in the children was conducted by educational psychology teams working in their school. The specific criteria adopted to determine the presence of ADHD were those designated by the DSM-IV-TR (APA, 2000) as well as an IQ score equal to or greater than 80 in the Raven test.

In addition, the ADHD Questionnaire (Amador, Forns, Guardia & Peró, 2005) was used in both the diagnostic process (pretreatment phase) and in the posttreatment phase in the two samples of children. This questionnaire includes the 18 symptoms defined by the DSM-IV-TR (2000) for ADHD. The wording of the items is the same as

in the DSM-IV-TR, except that it does not include the word “often”. Instead, it includes a Likert rating ranging between 0 (never) to 3 (almost always). The first nine items of the questionnaire define the symptoms of inattention and 9 following items define the symptoms of hyperactivity-impulsivity. Indeed, confirmatory factor analysis found that the 18 ADHD symptoms are grouped into two types: inattention and hyperactivity-impulsivity (Amador et al. (2005). Moreover, the reliability of the two types and the questionnaire, as measured by Cronbach’s alpha coefficient, was found to be high, with coefficients between 0.948 and 0.957.

For each item, parents and teachers selected the answer that best fit the behavior under evaluation. To receive a diagnosis of ADHD, both parents and teachers had to have marked at least 6 of the 9 symptoms of inattention and/or at least 6 of the hyperactivity-impulsivity symptoms.

2.3. Treatments

Children started stimulant medication as prescribed by their pediatricians, and families and teachers of the combined group received parallel psychoeducational group training on ADHD. Treatment took place throughout the school year, excluding the student holiday periods.

Pharmacological intervention

Children of the drug group started their pediatrician’s prescribed treatment at the beginning of the school year. Specifically, 3 of them (30%) received quick-release methylphenidate in daily doses of 5 mg each before breakfast and lunch; 7 children (70%) received delayed-release methylphenidate in a single daily dose of 18 mg in the morning. During weekends they did not receive pharmacological treatment.

Children of the combined group also began drug treatment at the start of the school year under the guidance of their pediatricians. Specifically, 4 patients (40%) were treated with quick-release psychostimulant medication and 6 (60%) delayed-release methylphenidate. Like the drug group, they did not receive drug treatment at the weekend.

Training Program for Teachers of Children with ADHD

The program for teachers was conducted over 17 sessions of two hours, on a fortnightly basis. It was carried out over this extended period not only to provide teachers with intensive training in ADHD but to also give them practical advice throughout the academic year to help them manage issues in the classroom as they arose.

The course consisted of 34 hours of continuous education by the school. The schedule was adjusted to the preferences of teachers, with sessions taking place after school hours (17.30); the venue was a classroom in the same school. These conditions greatly favored the attendance of the participants (98%).

The program was adapted from other empirically validated programs and materials developed by the ADANA Foundation and by the authors (Miranda, Jarque & Rosel, 2006; Mena, Nicolau, Salat, Tort & Romero, 2006).

The program was divided into seven thematic sections (see Picture 1) (Amado, Jarque, Signes, Acereda & López, 2014), which were: 1. Information on ADHD; 2. Forms of intervention in ADHD; 3. Strategies to improve behavior, and instructional management; 4. Strategies to adapt teaching and learning activities; 5. Strategies to increase self-control; 6 Communication Skills; and 7. Closing session.

Training Program for parents of children with ADHD

The program for parents took place over nine sessions of two hours, on a monthly basis. The training was carried out over an extended period since our main objective was to improve the family functioning of these children and such a schedule allowed for sufficient time to assimilate, implement, review and automate strategies proposed throughout the program.

All times were adjusted to parents' preferences and sessions were conducted in such school conditions that favored high attendance of participants (97%).

The program was adapted from other empirically validated programs and materials developed by the ADANA Foundation and by the authors (Barkley, 1997; Miranda, Grau, Meliá & Roselló, 2008).

The program was divided into six thematic sections (see Picture 1) (Jarque & Amado, 2010), which were: 1 Presentation of the family; 2. ADHD in school; 3. ADHD in the family, and emotional implications; 4. ADHD in the family, and educational implications; 5. Communication Skills; 6. Skills for stress and conflict management; and 7. Closing session.

(Picture 1 here)

3. Results

According to the objectives, we developed a mixed, quasi-experimental design (inter-group and intra-group), conducting assessments in the pretreatment and posttreatment phases.

For statistical analyses, SPSS-17.0 software was used, with a confidence interval of 0.05 or less.

The effects of interventions (independent variables) on the core symptoms of ADHD in children (inattention, hyperactivity and impulsivity), both in the school and the family as measured by the ADHD Questionnaire, were analyzed (Amador et al., 2005).

Various statistical analyses of the data were performed. First, descriptive statistics were used to establish the sociodemographic characteristics of the participating samples, and the various means and standard deviations of the various measurements.

Moreover, to perform inter-group and intra-group comparisons, nonparametric tests were applied since parametric conditions were not satisfied. The Wilcoxon test was used to perform comparisons between related samples (intra-group) between the pretreatment and posttreatment phases. Independent inter-group comparisons, that is, between the drug and combination groups, were also performed in both the pretreatment and posttreatment phases using the Mann Whitney U test.

Finally, in addition to group statistical analyses, individualized quantitative analyses were carried out by calculating the percentage of improvement for each child after treatment, according to scores of the ADHD Questionnaire given by parents and teachers (Amador et al., 2005; Bados & García, 2009). The percentage improvement is calculated by subtracting the posttreatment score from the pretreatment one and dividing the result by the pretreatment score. It is considered a significant improvement if the resulting percentage is equal to or greater than some arbitrary value, which varies, according to the authors, between 20% to 50%.

3.1. Results of the comparison of the effectiveness of treatments as estimated by teachers.

In the pretreatment phase, no significant inter-group differences were observed (see Table 4) (inattention: $Z = -0.114$, $p = 0.909$; hyperactivity: $Z = -0.112$, $p = 0.911$; impulsivity: $Z = -0.270$, $p = 0.787$).

Furthermore, no significant differences between the two groups were observed posttreatment (inattention: $Z = -0.553$; $p = 0.580$; hyperactivity: $Z = -0.798$; $p = 0.425$; impulsivity: $Z = -1.845$; $p = 0.065$) (see Table 4).

(Table 4 here)

However, intra-group comparisons indicated that in the posttreatment phase a significant decrease is produced in the severity of symptoms of ADHD as estimated by teachers both in the drug group (inattention: $Z = -3.774$, $p = 0.000$; hyperactivity: $Z = -3.898$, $p = 0.000$; impulsivity: $Z = -3.5$, $p = 0.000$) and the combined (inattention: $Z = -3.867$, $p = 0.000$; hyperactivity: $Z = -3.834$, $p = 0.000$; impulsivity: $Z = -2.530$, $p = 0.000$) (see Table 5).

(Table 5 here)

With regard to individual analyses in the posttreatment assessments (see Tables 6 and 7), improvements of between 20% and 55% were observed in the combined treatment group and between 0% and 42% in the drug-only group.

The normalization data indicated that 20% of the children from the drug-only group were no longer considered to show ADHD symptoms, while this figure rose to 30% in the combined group.

(Table 6 here)

(Table 7 here)

3.2 Results of the comparison of the effectiveness of treatments as estimated by parents.

The results of the pretreatment assessments indicated that no differences were found between groups (inattention: $Z = -1.633$, $p = 0.103$; hyperactivity: $Z = -0.070$, $p = 0.944$; impulsivity: $Z = -0.277$, $p = 0.782$) (see Table 8).

Furthermore, no statistically significant differences between the groups were observed posttreatment (inattention: $Z = -1.633$, $p = 0.103$; hyperactivity: $Z = -1.522$, $p = 0.128$; impulsivity: $Z = -0.172$, $p = 0.863$) (Table 8).

(table 8 here)

However, intra-group comparisons indicated that in the posttreatment phase, a significant decrease occurred in the severity of symptoms of ADHD as estimated by parents in both the pharmacological group (inattention: $Z = -3.345$; $p = 0.001$; hyperactivity: $Z = -3.508$; $p = 0.000$; impulsivity: $Z = -3.638$; $p = 0.000$) (see Table 8), and the combined group (inattention: $Z = -3.663$; $p = 0.000$; hyperactivity: $Z = -3.699$; $p = 0.000$; impulsivity: $Z = -3.557$; $p = 0.000$) (see Table 9).

(table 9 here)

Regarding the individual analyses (see Tables 10 and 11), while children of the drug group achieved improvement percentages ranging from 0% to 40%, the combined group improved between 20% and 75%.

The normalization data indicated that while only 20% of the children in the drug only group were considered to no longer show symptoms, in the combined group the percentage of normalized children as assessed by parents rose to 90%.

(table 10 here)

(table 11 here)

4. Discussion and conclusions

The main objective of this study was to deepen our understanding of the relative and differential efficacy of combined versus pharmacological interventions for childhood ADHD in the school and family environment.

The group results demonstrate that both intervention types are equally effective in reducing the core symptoms of ADHD in children in both settings after ten months of treatment.

Our results partially confirm the initial hypotheses, namely that although both treatments were effective, the combined treatment was not significantly better than the drug-only treatment.

Our findings are in the line with previous studies that compared the effects of different intervention procedures on childhood ADHD (The MTA Cooperative Group, 1999, 2004; Van der Oord et al., 2007, 2008, 2012; Ercan et al., 2012). No statistically significant differences were observed between the combined and drug-only treatments.

In the study carried out by the MTA Cooperative Group, preliminary analyses revealed that there were no significant differences between the combined and drug-only treatments in terms of their efficiency in reducing the core symptoms of ADHD after 14 months and two years (MTA Cooperative Group 1999; 2004).

The research by Van der Ord et al. (2007), which compared the effects of drug treatment with a multimodal therapy, including training for parents, teachers and children themselves, found that both are equally effective treatments. In a meta-analysis conducted later by the same authors (Van der Ord et al., 2008), they explained that these results could possibly be due to the sequencing of treatments and the dosage of methylphenidate used. For the core symptoms of ADHD, psychostimulant effects are

broad and leave little possibility for improvement when psychosocial treatment is subsequently incorporated.

In a subsequent study, Van der Oord et al. (2012) also did not find any differences in the diagnostic status and symptoms in long-term ADHD after a combined or drug-only treatment in ADHD children. However, the adolescents who received the combined treatment received significantly less medication than those in the drug-only group in the 4.5 to 7.5 year follow-up phase.

Ercan et al. (2014) also did not observe any significant improvements in the combined group versus the drug-only group. Thus, results revealed that no significant effects were observed on the severity of the symptoms after the inclusion of parent training in the MPH treatment.

On the other hand, other studies support the significant superiority of the multimodal versus the drug-only treatment in reducing the core symptoms of ADHD in children (Swanson et al., 2001; Conners et al., 2001; Pelham et al., 2005; Bogdana et al., 2012).

MTA authors conducted secondary analyses to explore the utility of a single, statistically derived composite measure of treatment outcome for the MTA trial. Data analyses revealed that a combined treatment was significantly better than all other treatments, with effect sizes ranging from a small to moderately large (Conners et al., 2001; Swanson et al., 2001). The authors explained that when the precision of the measurement was increased, a statistically significant increase in the combined treatment over the drug-only treatment was detected.

Pelham et al. (2005) also analyzed the differences in the efficacy of a combined versus drug-only treatment and observed a significant improvement in the combined treatment in a summer treatment program. The author suggest that the low doses of

MPH, which were even lower than in previous studies, yielded enhanced effects in combination with behavior modification.

Bogdana et al. (2012) also observed that a multimodal intervention proved to be more effective than medication alone in ameliorating the child's social behavior in both the family and school environment with regards to the main ADHD symptoms.

The second part of our results was obtained from individualized clinical analyses. After carrying out individualized data analysis, clinically important differences were found. Specifically, with regard to the percentage improvement, both parents and teachers were of the opinion that all the ADHD children who received a combined treatment showed signs of clinical improvement in the core symptoms of ADHD.

However, with regard to the drug-only treatment, 10% of the children did not show any clinical improvement in the core symptoms in the opinion of the teachers. Furthermore, according to the parents, 30% of the children failed to show clinical improvements in attention, with 20% of the children showing no improvement in the hyperactivity-impulsivity symptoms.

With regard to the normalization data, the results reveal that improvements were greater in the combined group, especially in the opinion of the parents: 90% no longer displayed clinical symptoms after receiving a combined treatment. One possible explanation for this may be the emphasis given to the reduction in family distress through training in emotional and communication strategies in the parental intervention program.

Finally, when we analyze our normalization and clinical improvement results in each of the children integrated into the school and family context, we also found that the

highest percentage of improvement and normalization occurred in the children who followed the combined intervention.

Our clinical results are consistent with those obtained by other authors who have supported the superiority of combined treatment to any single treatment in normalizing behavior, as well as in achieving higher rates of improvement in children with ADHD (Conners et al., 2001; Swanson et al., 2001; So et al., 2008).

So et al. (2008) also found higher proportions of children with ADHD of the combined treatment group who met the criteria for normalization posttreatment, even with lower doses of medication.

The first results produced by the MTA Cooperative Group revealed that at the end of the study a similar number of children from both the combined and drug-only groups no longer met the criteria for ADHD (combined: 90%; pharmacological: 88%) (MTA, 1999).

To supplement the primary analyses, the MTA investigators developed and analyzed a qualitative outcome measure of success to explore the study's clinical relevance and practical significance (Swanson et al., 2001). Specifically, each subject was evaluated at the end of the study with the SNAP scale developed by Swanson et al. (2001), which evaluates the core symptoms of ADHD and ODD as defined by DSM-IV, and which was completed by parents and teachers. The results revealed a small to moderate improvement in the combined treatment versus drug-only. The multimodal treatment resulted in a 12% improvement over the pharmacological treatment. Logistic regression analyses were used to compare success rates for the treatments. The results showed the following proportions of children that were normalized in each of the groups: combined (68%), pharmacological (56%), behavioral (34%), and routine community care (25%).

Furthermore, the psychosocial intervention in the MTA study was discontinued in the behavioral and combined treatments whilst continuing with the medication, which may have resulted in a bias in the results, favoring the effects of the drug-only treatment (Swanson et al., 2001).

Finally, a follow-up analysis of the MTA study at 6 and 8 years revealed that there was no significant difference between the treatment groups in terms of the core symptoms of ADHD possibly as a result of the changes in the medication procedure, in that some of the children stopped taking it whilst others started taking it (Jensen et al., 2007; Molina et al., 2008). The authors also postulate that the differences in the effects of the treatments can be seen when the treatments are in progress but diminish when the intensity of treatment is reduced (Molina et al., 2009).

4.1. Strengths and limitations

Although our results are positive, our study has a number of limitations that could be improved upon in future studies. Firstly, the small sample size has meant that we have had to carry out nonparametric statistical analyses, which may have a lower discrimination power.

Secondly, parents and teachers are active agents in the intervention and at the same time evaluators of their results, which could lead to some kind of bias.

Finally, we do not have any follow-up data that helps us to discriminate the effects of long-term intervention and differentiate between the improvements brought about by the child's development.

In future studies, it would be useful to extend the sample size, collecting additional data from other evaluators and performing follow-up analyses.

However, despite these limitations, our study provides valuable information regarding the efficacy of a multimodal, multicontextual and long-lasting intervention to

improve the core symptoms of ADHD in children. One of the most important conclusions derived from our study is the superiority of the multimodal intervention versus an exclusively pharmacological treatment to normalize the behavior of children with ADHD in their everyday contexts. These findings allow us to maintain a hopeful attitude about the possibilities that this type of intervention may offer.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Table 1. Sociodemographic characteristics of the sample of children with ADHD

CHARACTERISTICS	PHARMACOLOGICAL GROUP	COMBINED GROUP
Age		
7 years	3 (30%)	3 (30%)
8 years	4 (40%)	4 (40%)
9 years	3 (30%)	3 (30%)
Mean age	7.6	7.8
Sex		
Male	8 (80%)	9 (90%)
Female	2 (20%)	1 (10%)

Table 2. Sociodemographic characteristics of the sample of parents

CHARACTERISTICS	PHARMACOLOGICAL GROUP	COMBINED GROUP
Mean age	37.5	39.3
Sex		
Males	10 (50%)	10 (50%)
Females	10 (50%)	10 (50%)
Number of children		
Mean	2.1	2.5
Educational Level		
Basic studies	2 (10%)	4 (20%)
Secondary	5 (25%)	8 (40%)
University	13 (65%)	8 (40%)

Table 3. Sociodemographic characteristics of the sample of teachers

CHARACTERISTICS	PHARMACOLOGICAL GROUP	COMBINED GROUP
Mean age	40.3	38.4
Sex		
Males	4 (20%)	7 (35%)
Females	16 (80%)	13 (65%)
Experience as a teacher (mean)	23.5	19.1
Experience with children with ADHD	9 (45%)	12 (60%)
Attendance of ADHD courses	0	1 (5%)

Picture 1. Timing of intervention developed with parents and teachers

Month	Session	PARENTS	Session	TEACHERS
September	0	Presentation and organization	0	ADHD seminar
October	1	I INTRODUCE MYSELF: My child and I	1	I INTRODUCE MYSELF: My student and I
			2	
November	2	I KNOW IT AND I UNDERSTAND: Knowledge about ADHD	3	I KNOW IT AND I UNDERSTAND: Knowledge about ADHD
			4	
December	3	ADHD IN SCHOOL: Difficulties in learning how to relate	5	WHAT WE CAN DO
			6	
January	4	ADHD IN MY FAMILY: Emotional implications	7	
			8	I VALUE HIM/HER POSITIVELY, she values and reinforces him/herself
February	5		9	I ORGANIZE HIM/HER, s/he organizes him/herself and s/he listens
			10	
March	6	ADHD IN MY FAMILY: Educational implications	11	
			12	I ADAPT the classroom and activities
April	7	I IMPROVE MY COMMUNICATION	13	WE BUILD BRIDGES
			14	
May	8	I IMPROVE MY SELF CONTROL	15	I IMPROVE MY SELF CONTROL
			16	
June	9	FAREWELL: what I take with me	17	FAREWELL: what I take with me
Hours	18		34	

Table 4. Intergroup comparison of the perception of the symptoms of ADHD as estimated by teachers in the pre- and post-treatment phases

	PHARMACOL. TREATMENT		COMBINED TREATMENT		Z	p
	Average	DT	Average	DT		
PRE TREATMENT						
Inattention	7.05	1.70	7.00	1.74	-0.114	0.909
Hyperactivity	5.05	1.09	5.1	1.16	-0.112	0.911
Impulsivity	2.3	0.65	2.35	0.67	-0.270	0.787
POST TREATMENT						
Inattention	5.2	3.8	5.05	0.887	-0.553	0.580
Hyperactivity	3.8	0.83	3.55	0.887	-0.798	0.425
Impulsivity	1.6	0.59	1.90	0.447	-1.845	0.065

**p < .01 *p < .05

Table 5. Intragroup comparison of the perception of ADHD symptoms as estimated by the teachers of the pharmacological and combined groups.

	PRETEST		POSTEST		Z	p	d
	Average	DT	Average	DT			
PHARMACOL.							
Inattention	7.05	1.70	5.2	0.89	-3.774	0.000**	1.08
Hyperactivity	5.05	1.09	3.8	0.83	-3.898	0.000**	1.14
Impulsivity	2.3	0.65	1.6	0.59	-3.5	0.000**	1.07
COMBINED							
Inattention	7.00	1.74	5.05	0.887	-3.867	0.000**	1.12
Hyperactivity	5.1	1.16	3.55	0.887	-3.834	0.000**	1.33
Impulsivity	2.35	0.67	1.90	0.447	-2.530	0.000**	0.67

**p < .01 *p < .05

Table 6. Percentage improvement as estimated by teachers in pharmacological group of ADHD symptom of each child according to the DSM-IV-TR (APA, 2000).

TEACHERS IN DRUG GROUP			
Children	PRE	POST	% IMPROV
	I H/I	I H/I	I H/I
1	7	5	28
	6	5	16
2	7	5	28
	7	6	14
3	6	5	16
	7	6	14
4	7	6	14
	6	6	0
5	6	6	0
	6	6	0
6	6	6	0
	8	7	12
7	7	4	42
	8	7	12
8	6	5	16
	8	5	37
9	9	6	33
	6	4	33
10	7	6	14
	8	6	25

Table 7. Percentage improvement as estimated by teachers in the combined group of ADHD symptoms of each child according to the DSM-IV-TR scale (APA, 2000).

TEACHERS IN COMBINED GROUP			
Children	PRE	POST	% IMPROV
	I H/I	I H/I	I H/I
1	8	5	37
	9	6	33
2	9	6	33
	5	3	40
3	8	4	50
	8	5	37
4	9	4	55
	8	6	25
5	9	5	44
	9	6	33
6	9	5	44
	8	6	25
7	8	6	25
	8	4	50
8	9	4	55
	9	4	55
9	6	4	33
	9	6	33
10	5	4	20
	9	5	44

Table 8. Intergroup comparison of ADHD symptoms as estimated by parents in the pre- and post-treatment phases

	PHARMACOL. TREATMENT		COMBINED TREATMENT		Z	p
	Average	DT	Average	DT		
PRE TREATMENT						
Inattention	7.05	1.70	6.35	2.20	-1.633	0.103
Hyperactivity	5.05	1.09	4.60	1.50	-0.070	0.944
Impulsivity	2.3	0.65	2.20	0.61	-0.277	0.782
POST TREATMENT						
Inattention	5.05	1.43	4.35	1.42	-1.633	0.103
Hyperactivity	3.50	1.14	3.0	0.91	-1.522	0.128
Impulsivity	1.45	0.60	1.45	0.51	-0.172	0.863

**p < .01 *p < .05

Table 9. Intragroup comparison of ADHD symptoms as estimated by parents of the pharmacological and combined treatment groups.

	PRETEST		POSTEST		Z	p	d
	Average	DT	Average	DT			
PHARMACOL.							
Inattention	6.35	2.20	5.05	1.43	-3.345	0.001**	0.59
Hyperactivity	4.60	1.50	3.50	1.14	-3,508	0.000**	0.73
Impulsivity	2.20	0.61	1.45	0.60	-3.638	0.000**	1.22
COMBINED							
Inattention	6.15	2.34	4.35	1.42	-3.663	0.000**	0.76
Hyperactivity	4.60	1.53	3.0	0.91	-3.699	0.000**	1.04
Impulsivity	2.25	0.63	1.45	0.51	-3.557	0.000**	1.26

**p < .01 *p < .05

Table 10. Percentage improvement as estimated by parents in pharmacological group of ADHD symptoms of each child according to the DSM-IV-TR scale (APA, 2000).

PARENTS IN PHARMACOLOGICAL GROUP			
Children	PRE	POST	% IMPROV
	I H/I	I H/I	I H/I
1	6	5	16
	6	4	33
2	5	5	0
	8	6	25
3	6	5	16
	6	6	0
4	9	6	33
	5	4	20
5	8	6	25
	8	6	25
6	5	5	0
	7	5	28
7	2	2	0
	8	6	25
8	5	3	40
	7	7	0
9	9	6	33
	5	4	20
10	6	4	33
	7	6	14

Table 11. Percentage improvement as estimated by parents in the combined group of ADHD symptoms of each child according to the DSM-IV-TR scale (APA, 2000).

PARENTS IN COMBINED GROUP			
Children	PRE	POST	%
	I H/I	I H/I	IMPROV I H/I
1	6	4	33
	9	5	44
2	9	6	33
	5	3	40
3	7	3	57
	9	4	55
4	3	2	33
	9	4	55
5	6	3	50
	8	4	50
6	9	5	44
	9	5	44
7	9	5	44
	5	4	20
8	8	4	50
	8	2	75
9	5	2	60
	8	5	37
10	7	4	42
	7	3	57