Research article
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# Attention Deficit/Hyperactivity Disorder (ADHD) symptoms and cognitive skills of preschool children

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Attention deficit/hyperactivity disorder (ADHD) constitutes a neurobehavioral disorder which may potentially adversely affect children's wellbeing and academic achievement. The onset of symptoms is present prior to 12 years of age, and often the symptoms are evident in the preschool years. In fact, it has been suggested that screening for ADHD symptoms may be initiated as early as four years of age. Preschool children with ADHD have been shown to present with poor pre-academic skills and might be at increased risk for numerous school-related problems, including functional impairment during elementary school years and persistent poor academic performance thereafter. Although preschool years are characterized by rapid cognitive growth, preschoolers with ADHD may present with poorer cognitive and neuropsychological functioning. Due to the early onset of ADHD symptoms, exploring the cognitive correlates of this condition among preschool children is thought to be of notable importance. The aim of the present study was to evaluate any association between ADHD symptoms and cognitive skills among preschool children. A cross-sectional study was conducted among a nationwide random sample of 4,480 preschool children. ADHD symptoms were assessed though interviews with parents and teachers based on DSM-IV-TR criteria. Cognitive skills were assessed through a standardized school readiness test (A' TEST). Among participants, the occurrence of ADHD symptoms was 4.6% (boys/girls: 3.4/1). The presence of ADHD symptoms among children was inversely associated with non-verbal and verbal cognitive skills; specifically, with abstract thinking (aOR 1.97, 95% CI 1.30–3.00), language (2.36, 1.55–3.59), critical reasoning (2.58, 1.84–3.62), visual perception (2.42, 1.38–4.24), and visual motor skills (2.61, 1.91–3.55). Children with ADHD symptoms were five times as likely to have compromised organizational skills (4.92, 3.04–7.97). Abstract thinking was the least affected domain particularly among boys, while organizational skills were the most affected domain in both sexes, and possibly more among girls. Concluding, the present study confirms that even during preschool years, children with ADHD symptoms are more likely to present with concomitant cognitive difficulties. Thus, screening for the presence of ADHD, as well as cognitive and affective screenings among preschool aged children may facilitate the early detection and determent of the development of cognitive difficulties, and subsequently the early intervention for fostering skills that are amenable to change, such as organizational skills and planning. As a result, the study findings reveal the necessity for the evaluation of pre-academic skills among preschool children with ADHD symptoms in order to mitigate unfavorable academic functioning.

**Key words**: Attention Deficit/Hyperactivity Disorder (ADHD), cognitive skills, preschool children.

## Introduction

Attention deficit/hyperactivity disorder (ADHD) constitutes a neurobehavioral disorder which may potentially adversely affect children's wellbeing and academic achievement. Children with ADHD present with clinically significant symptoms of hyperactivity, poor sustained attention, and diminished impulse control. The onset of symptoms must be present prior to 12 years of age, and often the symptoms are evident as early as preschool age.[1] In fact, it has been suggested that screening for ADHD symptoms may be initiated as early as 4 years of age.[2] Moreover, the American Academy of Pediatrics suggested that detectable ADHD symptoms in preschool ages may predict compromised academic skills later on.[2] This issue has not yet been fully elucidated to date among preschool children.

Prevalence rates of ADHD among preschoolers are reported to range between 3.3% and 12.8%, and are particularly elevated among boys.[3–5] The prevalence of ADHD among Greek school-aged children ranges between 6% and 18%.[6–8] Differing rates of ADHD between different countries and across studies may be affected by the assessment tool used. Also, cultural environment may affect a child's behaviour and differing attitudes of parents, teachers, clinicians, and society towards acceptable behaviour may also influence diagnosis. If assessment criteria could be consistently applied across studies, the prevalence of ADHD would probably be similar.

It has been suggested that preschool children with ADHD may present with poor pre-academic skills and might be at increased risk for numerous school-related problems, including functional impairment during elementary school years and persistent poor academic performance thereafter.[9–12] Although preschool years are characterized by rapid cognitive growth,[13] preschoolers with ADHD may present with poorer cognitive and neuropsychological functioning.[14] While ADHD prevalence rates among boys exceed those of girls, recent findings suggest that affected girls are at greater risk for presenting with impaired cognitive functioning.[15] Due to the early onset of ADHD symptoms and the increased risk for school-related problems, exploring the cognitive correlates of this condition among preschool children is thought to be of notable importance.

The aim of the present study was to confirm and expand current knowledge as well as to compare the cognitive functioning of preschool children with ADHD symptoms with their non-ADHD peers. We hypothesized that the proportion of children with ADHD symptoms exhibiting deficits in cognitive functioning, in relation to both verbal and non-verbal skills, would be significantly greater than that among their normal counterparts. Additionally, we hypothesized that both boys and girls with ADHD symptoms would be at significantly greater risk for abnormal verbal and non-verbal skills as compared to their normal counterparts, with girls being more likely to present with compromised skills. Lastly, we aimed to estimate the likelihood of impaired cognitive skills among children with ADHD symptoms, following stratification by sex and adjustment for the potential confounding effects of age, and parental educational level.

## Material and method

### *Subjects*

The cross-sectional study population consisted of a nationwide convenience sample of 4,480 preschool children. All participants attended mainstream public and private preschool settings. Children reported to have pervasive developmental disorders, intellectual disabilities, and chronic neurological disorders (e.g., epilepsy, cerebral palsy) were excluded. No children were taking medication for ADHD at the time of the study. Parental educational attainment was categorized into two levels: low/middle (≤12 years) and high educational level (>12 years). Educational status of the parent with the higher education level was used in the analyses. All data were collected during the spring and summer months of three consecutive school years (2008–2011). The study was approved by the Ethical Committee of the "P. & A. Kyriakou" Children's Hospital in Athens, Greece. Legal guardians provided written informed consent for study participation of all eligible children prior to the initiation of the study.

### *Measures*

ADHD symptoms were assessed through ADHD Checklist[16] administered individually by two trained psychologists to both parents and teachers at preschool. The ADHD Checklist is composed of 14 items. These items are listed as the criteria for ADHD in the DSM-III-R and have been placed into a checklist format. The same checklist can be used for both parents and teachers. The 14 items evaluate a child's behavior and the likelihood of the child having ADHD. Each item is scored on a response scale of 0 to 3, where 0=not at all, 1=just a little, 2=pretty much, and 3=very much. Adding the number of all items rated as 2 or higher scores the scale Number of Symptoms Present. A score of 8 or more exceeds the DSM-III-R cutoff for a diagnosis of ADHD. The highest possible score for this scale is 14. Respondents with a total score at or above the clinical cutoff receive a "1" to indicate a diagnosis of ADHD. A "0" indicates that the respondent is not diagnosed with ADHD.

Cognitive skills were assessed individually by trained professionals through a school readiness-screening test developed and applied to children aged 5–6 years old prior to starting school in Greece (A΄ TEST). The psychometric properties of the A' TEST have been described elsewhere.[17] The test consists of three verbal and three non-verbal subtests. The verbal subtests reflect the application of verbal skills to new situations, and include: (1) Abstract thinking: The respondent is requested to identify the common underlying characteristic between two objects; (2) Critical reasoning: The child clarifies his/her comprehension of general principles and social situations; (3) Language skills: The examinee is requested to complete the missing content of an incomplete sentence. The non-verbal subtests are designed to provide an estimation of fluid reasoning, spatial perception, perceptual-organization, and visual–motor integration. The following subtests were considered to assess aspects of non-verbal reasoning: (1) Visual perception: The respondent is requested to match target symbols with search group symbols; (2) Visual motor skills: The child copies five shapes of increasing difficulty; (3) Organizational skills: The participant is requested to sequence three pictures so as to make a sensible story.

### *Statistical analysis*

Comparisons were conducted between children with ADHD symptoms and their normal peers. Logistic regression analysis stratified by sex was used to derive age-, and parental education adjusted odds ratios (aOR) of abnormal cognitive skills scores (outcome variables) among children with ADHD symptoms as compared to their normal counterparts (exposure variable). The chi-square test was used for the comparison of categorical variables. Fisher's exact test was used instead in cases where sample sizes did not exceed five children. Statistical analyses were conducted with SAS version 9.0 (SAS Institute Inc., USA).

## Results

Among the study population (n=4480), 204 (4.6%) presented with ADHD symptoms, from which 158 were boys (the boys/girls ratio was 3.4/1). Results of the descriptive analysis and the comparison of demographic characteristics and cognitive skills between ADHD and non-ADHD cases are presented in table 1.

### *Overall impaired cognitive skills*

Overall, the proportion of children with ADHD symptoms exhibiting deficits in cognitive functioning, in relation to both verbal and non-verbal skills, was approximately two times as much as that among their normal counterparts (table 1). With regard to their verbal skills, the likelihood of presenting with abnormal abstract thinking, critical reasoning and/or language skills was increased in excess of more than two-fold among children with ADHD symptoms. Along the same line were the findings for their non-verbal skills. Visual perception and visual motor-skill deficits were increased by more than two-fold among children with ADHD symptoms as compared to their normal peers. It is notable that preschool children with ADHD symptoms were in excess of five-fold more likely to present with compromised organizational skills (table 2).

### *The effect of sex*

Both boys and girls with ADHD symptoms were at significantly greater risk to present with abnormal verbal and non-verbal skills as compared to their

**Table 1.** Comparison of demographic characteristics and overall cognitive skills among preschool children with and without ADHD symptoms (n=4480).

| | | Non-ADHD (n=4,275) n (%) | ADHD (n=205) n (%) | p* |
|---|---|---|---|---|
| Sex | Boys | 2,415 (56.5%) | 158 (6.1%) | |
| | Girls | 1,860 (43.5%) | 47 (2.5%) | <0.0001 |
| Parental education level | Low/Middle | 2,812 (65.8%) | 150 (73.2%) | |
| | High | 1,463 (34.2%) | 55 (26.8%) | 0.029 |
| Overall verbal skills | Normal | 3,490 (81.6%) | 132 (64.4%) | |
| | Abnormal | 785 (18.4%) | 73 (35.6%) | <0.0001 |
| Overall non-verbal skills | Normal | 3,575 (83.6%) | 129 (62.9%) | |
| | Abnormal | 700 (16.4%) | 76 (37.1%) | <0.0001 |

**Table 2.** Odds ratios of children with ADHD symptoms to present with compromised verbal and non-verbal skills (n=4480).

| Skills | | Non-ADHD (n=4275) n (%) | ADHD (n=205) n (%) | aOR* (95% CI) |
|---|---|---|---|---|
| *Verbal* | | | | |
| Abstract thinking | Normal | 3,987 (93.3%) | 177 (86.3%) | |
| | Abnormal | 288 (6.7%) | 28 (13.7%) | 1.97 (1.30–3.00) |
| Critical reasoning | Normal | 3,839 (89.8%) | 156 (76.1%) | |
| | Abnormal | 436 (10.2%) | 49 (23.9%) | 2.58 (1.84–3.62) |
| Language | Normal | 4,018 (94.0%) | 177 (86.3%) | |
| | Abnormal | 257 (6.0%) | 28 (13.7%) | 2.36 (1.55–3.59) |
| *Non-Verbal* | | | | |
| Visual perception | Normal | 4,154 (97.2%) | 190 (92.7%) | |
| | Abnormal | 121 (2.8%) | 15 (7.3%) | 2.42 (1.38–4.24) |
| Visual motor | Normal | 3,665 (85.7%) | 140 (68.3%) | |
| | Abnormal | 610 (14.3%) | 65 (31.7%) | 2.61 (1.91–3.55) |
| Organizational | Normal | 4,176 (97.7%) | 182 (88.8%) | |
| | Abnormal | 99 (2.3%) | 23 (11.2%) | 4.92 (3.04–7.97) |

*aOR, adjusted odds ratio, adjusting for age

normal counterparts (table 3). Compared to boys, girls seemed to be more likely to present with compromised verbal (aOR 3.05, 95% CI 1.65–5.66 vs 2.30, 1.63–3.24) and non-verbal skills (5.32, 2.95–9.61 vs 2.30, 1.63–3.24). However, most of the confidence intervals of odds ratios presented for boys overlapped those presented for girls (table 3).

### *The effect of parental education*

Following stratification by sex and adjustment for the potential confounding effects of age, and parental educational level, the likelihood of impaired cognitive skills remained increased among preschool children with ADHD symptoms. Specifically, children

**Table 3.** Occurrence and likelihood of cognitive impairments in preschool children with (versus without) ADHD according to sex.

| | Boys (n=2573) | | | Girls (n=1907) | | |
|---|---|---|---|---|---|---|
| | Non-ADHD (n=2,415) | ADHD (n=158) | | Non-ADHD (n=1860) | ADHD (n=47) | |
| **Skills** | **n (%)** | **n (%)** | **aOR* (95% CI)** | **n (%)** | **n (%)** | **aOR* (95% CI)** |
| *Overall verbal* | | | | | | |
| Normal | 1,899 (78.6%) | 101 (63.9%) | 2.30 | 1,591 (85.5%) | 31 (66.0%) | 3.05 |
| Abnormal | 516 (21.4%) | 57 (36.1%) | (1.63–3.24) | 269 (14.5%) | 16 (34.0%) | (1.65–5.66) |
| *Abstract thinking* | | | | | | |
| Normal | 2,213 (91.6%) | 137 (86.7%) | 1.68 | 1,774 (95.4%) | 40 (85.1%) | 3.61 |
| Abnormal | 202 (8.4%) | 21 (13.3%) | (1.04–2.72) | 86 (4.6%) | 7 (14.9%) | (1.57–8.29) |
| *Critical reasoning* | | | | | | |
| Normal | 2,133 (88.3%) | 119 (75.3%) | 2.48 | 1,706 (91.7%) | 37 (78.7%) | 2.99 |
| Abnormal | 282 (11.7%) | 39 (24.7%) | (1.69–3.63) | 154 (8.3%) | 10 (21.3%) | (1.46–6.14) |
| *Language* | | | | | | |
| Normal | 2,252 (93.3%) | 139 (88.0%) | 1.89 | 1,766 (95.0%) | 38 (80.8%) | 4.45 |
| Abnormal | 163 (6.8%) | 19 (12.0%) | (1.14–3.13) | 94 (5.0%) | 9 (19.2%) | (2.09–9.47) |
| *Overall non-verbal* | | | | | | |
| Normal | 1,960 (81.2%) | 103 (65.2%) | 2.30 | 1,615 (86.8%) | 26 (55.3%) | 5.32 |
| Abnormal | 455 (18.8%) | 55 (34.8%) | (1.63–3.24) | 245 (13.2%) | 21 (44.7%) | (2.95–9.61) |
| *Visual perception* | | | | | | |
| Normal | 2,329 (96.4%) | 146 (92.4%) | 2.22 | 1,825 (98.1%) | 44 (93.6%) | 3.56 |
| Abnormal | 86 (3.6%) | 12 (7.6%) | (1.19–4.16) | 35 (1.9%) | 3 (6.4%) | (1.05–12.0) |
| *Visual motor* | | | | | | |
| Normal | 2,016 (83.5%) | 114 (72.2%) | 1.95 | 1,649 (88.7%) | 26 (55.3%) | 6.31 |
| Abnormal | 399 (16.5%) | 44 (27.8%) | (1.36–2.81) | 211 (11.3%) | 21 (44.7%) | (3.49–11.42) |
| *Organizational* | | | | | | |
| Normal | 2,348 (97.2%) | 140 (88.6%) | 4.51 | 1,828 (98.3%) | 42 (89.4%) | 6.80 |
| Abnormal | 67 (2.8%) | 18 (11.4%) | (2.61–7.79) | 32 (1.7%) | 5 (10.6%) | (2.52–18.32) |

*aOR, adjusted odds ratio, adjusting for age

with ADHD symptoms were significantly more likely to have impaired abstract thinking (3.61, 1.57–8.30), critical reasoning (3.00, 1.46–6.18), and language skills (4.48, 2.09–9.58), respectively. Children among this group were also observed to have an increased likelihood for presenting with impaired non-verbal skills, including visual perception (3.55, 1.05–12.00), visual motor (6.36, 3.51–11.52), and organizational skills (6.80, 2.52–18.31).

## Discussion

The study showed a prevalence rate of 4.6% for ADHD symptoms in a nationwide convenience sample of Greek preschool children, which is comparable to previous findings in other countries indicating prevalence rates within the range for similar age groups.[4] Documented variations may be attributed to both socio-cultural as well as methodological factors.[14]

While the evidence in older children is abundant, research is scarce regarding the degree to which cognitive skill deficits may be apparent in preschoolers with ADHD. Therefore, comparisons with prior studies referring to older children with ADHD should be interpreted with caution. In the present study, a school-readiness screening test (A΄ TEST) constructed to be concise and appealing to preschool children was used to assess six cognitive skills. The study findings indicate that, overall, preschool children with ADHD symptoms performed more poorly on cognitive tasks in both verbal and non-verbal subtests, relative to their non-ADHD peers.

Specifically, abstract reasoning skills were the least associated with the presence of ADHD symptoms. Albeit similar findings have not been documented among preschool children, reports among older children have indicated that the presence of ADHD is related to poorer inductive and deductive reasoning skills.[18] On the other hand, children with ADHD symptoms were more likely to exhibit compromised critical reasoning, language, visual perception and visual motor skills compared to their non-ADHD peers, in agreement with previous reports.[6,17–21]

It is noteworthy that organizational skill impairments were the most pronounced, with a five-fold increase in preschoolers with ADHD symptoms. Similar results are reported among older children, indicating that children with ADHD have greater difficulties in carrying out complex planning actions.[22] Impairments in organizational and planning skills may be behavioral expressions of deficits in executive functioning, including attention, impulse control, delay tolerance, and working memory.[19]

In accordance with previous literature,[2] our study confirmed significant sex differences for ADHD symptoms, indicating a male/female ratio of approximately 3/1. Although the incidence of ADHD is higher among preschool boys, affected preschool girls might be more likely to present with compromised cognitive skills possibly associated with school preparedness in the present sample. This finding seems to support the notion that girls with ADHD symptoms display higher rates of speech and language disorders and delays, and may thus develop elevated rates of compromised cognitive and intellectual abilities as compared to their male counterparts.[23] Indeed, studies in older children have demonstrated subtle but significant sex differences in cognition,[24] brain structure[25] and function[26] that could reflect sex-specific neural organization concerning the expression of ADHD. However, the present study did not manage to reach a definitive conclusion concerning this matter.

Parental education has been a major confounder for children's school performance as reported and accepted in the literature.[27] In the adjusted regression analysis for parental educational attainment, the association between compromised cognitive skills and ADHD symptoms persisted. Assuming that children's cognitive skills can be influenced by a number of factors (i.e., genetic endowment, parental educational level), interventions should be directed towards fostering a stimulating home environment for children and encouraging parents to invest in their children. To the extent that cognitive skills are malleable, it is important to create constructive environments, which will assist preschoolers to achieve their potential.

Although our study findings confirm that preschool aged children with ADHD symptoms performed more poorly on several cognitive tasks consisting of verbal and non-verbal measures, further investigation is needed. It seems that abstract thinking is the least affected domain particularly among boys with ADHD symptoms, while organizational skills are affected in both sexes, particularly among girls. It was not unexpected that preschool children with ADHD symptoms perform poorer on measures of cognitive functioning. Nevertheless, the extent of this difference is notable given that these children might commence school at a considerable short coming as compared to their non-ADHD peers.[9]

While current findings provide further evidence corroborating that ADHD among children is associated with notable impairment in cognitive skills, they should be interpreted in light of certain limitations. The absence of probabilistic methods for sample selection restricted to some extent the data representativeness. Moreover, ADHD symptoms in the present sample were assessed through a checklist based on DSM-III-R criteria instead of the currently used DSM-5 classification system.[28] Due to the study design, the presence and potential confounding effects of psy-

chiatric comorbidities, including oppositional defiant disorder, was not assessed. Therefore, a percentage of the identified ADHD cases may be children with underlying conditions (i.e., false-positives). Also, key confounding variables (i.e. low birth weight/intrauterine growth restriction, etc.) were not included in the present analysis. Finally, as all cross-sectional studies are designed, an etiological association between ADHD and impaired cognitive skills cannot be established. Additional longitudinal studies are needed and scheduled to be conducted by our team to elucidate the etiological association between ADHD symptoms and cognitive skills among preschool children.

The strengths of the present study include the large size of the community-based sample of preschool children evaluated, as well as the wide spectrum of verbal and non-verbal cognitive skills assessment tasks applied concurrently.

Concluding, our study confirms that even during preschool years, children with ADHD symptoms are more likely to present with concomitant cognitive difficulties. Thus, screening for the presence of ADHD, as well as cognitive and affective screenings among preschool aged children may facilitate the early detection and determent of the development of cognitive difficulties, particularly among affected girls and subsequently the early intervention for fostering skills that are amenable to change, such as organizational skills and planning. As a result, the study findings reveal the necessity for the evaluation of pre-academic skills among preschool children with ADHD symptoms in order to mitigate unfavorable academic functioning.

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# Συμπτώματα Διαταραχής Έλλειμματικής Προσοχής/ Υπερκινητικότητας (ΔΕΠ-Υ) και νοητικές δεξιότητες παιδιών προσχολικής ηλικίας

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Η διαταραχή ελλειμματικής προσοχής/υπερκινητικότητας (ΔΕΠ-Υ) συνιστά μια νευροαναπτυξιακή διαταραχή, η οποία μπορεί να επηρεάσει αρνητικά την ευεξία και την ακαδημαϊκή επιτυχία των παιδιών. Η έναρξη των συμπτωμάτων συμβαίνει πριν από την ηλικία των 12 ετών και συχνά τα συμπτώματα είναι εμφανή από τα προσχολικά χρόνια. Μάλιστα, προτείνεται ότι η ανίχνευση των συμπτωμάτων μπορεί να αρχίσει από τα τέσσερα έτη. Έχει καταδειχθεί ότι τα παιδιά προσχολικής ηλικίας με ΔΕΠ-Υ μπορεί να παρουσιάζουν χαμηλές προ-ακαδημαϊκές δεξιότητες και να βρίσκονται σε αυξημένο κίνδυνο για πολυάριθμα προβλήματα που σχετίζονται με το σχολείο, όπως λειτουργική έκπτωση κατά τη διάρκεια της δημοτικής εκπαίδευσης και εμμένουσα χαμηλή ακαδημαϊκή επίδοση έκτοτε. Μολονότι τα προσχολικά

χρόνια χαρακτηρίζονται από ταχεία νοητική ανάπτυξη, τα παιδιά προσχολικής ηλικίας με ΔΕΠ-Υ μπορεί να παρουσιάζουν χαμηλότερη νοητική και νευροψυχολογική λειτουργικότητα. Λόγω της πρώιμης έναρξης των συμπτωμάτων της ΔΕΠ-Υ, η διερεύνηση των νοητικών χαρακτηριστικών που συσχετίζονται με αυτή την κατάσταση στα παιδιά προσχολικής ηλικίας θεωρείται σημαντική. Σκοπός της παρούσας εργασίας ήταν να αξιολογήσει τυχόν συσχετίσεις μεταξύ συμπτωμάτων ΔΕΠ-Υ και νοητικών δεξιοτήτων σε παιδιά προσχολικής ηλικίας. Διεξήχθη συγχρονική μελέτη σε εθνικό τυχαίο δείγμα 4.480 παιδιών. Τα συμπτώματα της ΔΕΠ-Υ αξιολογήθηκαν μέσω συνέντευξης με γονείς και εκπαιδευτικούς βασιζόμενης στα διαγνωστικά κριτήρια του DSM-IV-TR. Οι νοητικές δεξιότητες αξιολογήθηκαν μέσω σταθμισμένης ανιχνευτικής δοκιμασίας σχολικής ετοιμότητας (Α΄ ΤΕΣΤ). Η συχνότητα συμπτωμάτων ΔΕΠ-Υ στους συμμετέχοντες ήταν 4,6% (αγόρια/κορίτσια: 3,4/1). Η παρουσία συμπτωμάτων ΔΕΠ-Υ συσχετιζόταν αντίστροφα με τις μη-λεκτικές και λεκτικές νοητικές δεξιότητες˙ συγκεκριμένα, με την αφαιρετική σκέψη (aOR 1,97, 95% CI 1,30–3,00), τις γλωσσικές αναλογίες (2,36, 1,55–3,59), την κριτική ικανότητα (2,58, 1,84–3,62), την οπτική αντίληψη (2,42, 1,38–4,24), και τον οπτικοκινητικό συντονισμό (2,61, 1,91–3,55). Τα παιδιά με συμπτώματα ΔΕΠ-Υ ήταν πέντε φορές πιθανότερο να έχουν χαμηλές οργανωτικές δεξιότητες (4,92, 3,04–7,97). Η αφαιρετική σκέψη ήταν ο λιγότερο επηρεασμένος τομέας ιδιαίτερα στα αγόρια, ενώ οι οργανωτικές δεξιότητες ήταν ο περισσότερο επηρεασμένος τομέας και στα δύο φύλα και πιθανώς περισσότερο στα κορίτσια. Συμπερασματικά, η παρούσα μελέτη επιβεβαιώνει ότι ακόμη και κατά τη διάρκεια των προσχολικών χρόνων, τα παιδιά με συμπτώματα ΔΕΠ-Υ είναι πιο πιθανό να παρουσιάζουν συνυπάρχουσες νοητικές δυσκολίες. Οι ανιχνευτικές δοκιμασίες συμπτωμάτων ΔΕΠ-Υ, καθώς και νοητικών και συναισθηματικών δυσκολιών σε παιδιά προσχολικής ηλικίας μπορούν να διευκολύνουν την έγκαιρη αναγνώριση και πρόληψη αναπτυσσόμενων νοητικών δυσκολιών, και ακολούθως την πρώιμη παρέμβαση για την ενίσχυση δεξιοτήτων επιδεκτικών σε αλλαγές, όπως οι οργανωτικές δεξιότητες και ο προγραμματισμός. Επομένως, τα ευρήματα της μελέτης αποκαλύπτουν την αναγκαιότητα αξιολόγησης των προ-ακαδημαϊκών δεξιοτήτων σε παιδιά προσχολικής ηλικίας με συμπτώματα ΔΕΠ-Υ, με σκοπό την άμβλυνση πιθανής ακαδημαϊκής δυσλειτουργίας.

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## References

1. Dalsgaard S. Attention-deficit/hyperactivity disorder (ADHD). *Eur Child Adolesc Psychiatry* 2013, 22(Suppl 1):43–48, DOI: 10.1007/s00787-012-0360-z
2. American Academy of Pediatrics. Subcommittee on Attention-Deficit/Hyperactivity Disorder. Committee on Quality Improvement and Management. ADHD: clinical practice guideline for the diagnosis, evaluation, and treatment of attention-deficit/hyperactivity disorder in children and adolescents. *Pediatrics* 2011, 128:1007–1022, DOI: 10.1542/peds.2011-2654
3. Egger HL, Angold A. Common emotional and behavioral disorders in preschool children: presentation, nosology, and epidemiology. *J Child Psychol Psychiatry* 2006, 47:313–337, DOI: 10.1111/j.1469-7610.2006.01618.x
4. Lavigne JV, Lebailly SA, Hopkins J, Gouze KR, Binns HJ. The prevalence of ADHD, ODD, depression, and anxiety in a community sample of 4-year-olds. *J Clin Child Adolesc Psychol* 2009, 38:315–328, http://dx.doi.org/10.1080/15374410902851382
5. Bauermeister JJ, Shrout PE, Chavez L, Rubio-Stipec M, Ramvrez R et al. ADHD and gender: are risks and sequela of ADHD the same for boys and girls? *J Child Psychol Psychiatry* 2007, 48:831–839, DOI: 10.1111/j.1469-7610.2007.01750.x
6. Skounti M, Giannoukas S, Dimitriou E, Nikolopoulou S, Linardakis E, Philalithis A. Prevalence of attention deficit hyperactivity disorder in schoolchildren in Athens, Greece. Association of ADHD subtypes with social and academic impairment. *Atten Defic Hyperact Disord* 2010, 2:127–132
7. Filippatou DN, Livaniou EA. Comorbidity and WISC-III profiles of Greek children with attention deficit hyperactivity disorder, learning disabilities, and language disorders. *Psychol Rep* 2005, 97:485–504, DOI: https://doi.org/10.2466/pr0.97.2.485-504
8. Lazaratou H, Vlassopoulos M, Kalogerakis Z, Zelios G, Anagnostopoulos D, Dellatolas G. Inattention, passivity and reading ability in attention deficit/hyperactivity disorder in a Greek community sample. *J Psychol Abnorm Child* 2014, 2:109, DOI: 10.4172/2329-9525.1000109
9. DuPaul GJ, McGoey KE, Eckert TL, VanBrakle J. Preschool children with attention-deficit/hyperactivity disorder: impairments in behavioral, social, and school functioning. J *Am Acad Child Adolesc Psychiatry* 2001, 40:508–515
10. Lahey BB, Pelham WE, Loney J, Kipp H, Ehrhardt A, Lee SS et al. Three-year predictive validity of DSM-IV attention deficit hyperactivity disorder in children diagnosed at 4-6 years of age. *Am J Psychiatry* 2004, 161:2014–2020
11. Loe IM, Balestrino MD, Phelps RA, Kurs-Lasky M, Chaves-Gnecco D, Paradise JL et al. Early histories of school-aged children with attention-deficit/hyperactivity disorder. *Child Dev* 2008, 79:1853–1868, DOI: 10.1111/j.1467-8624.2008.01230.x

12. Barkley RA, Fischer M, Smallish L, Fletcher K. Young adult outcome of hyperactive children: adaptive functioning in major life activities. *J Am Acad Child Adolesc Psychiatry* 2006, 45:192–202, http://dx.doi.org/10.1097/01.chi.0000189134.97436.e2
13. Pauli-Pott U, Becker K. Neuropsychological basic deficits in preschoolers at risk for ADHD: a meta-analysis. *Clin Psychol Rev* 2011, 31:626–637, http://dx.doi.org/10.1016/j.cpr.2011.02.005
14. Chacko A, Wakschlag L, Hill C, Danis B, Espy KA. Viewing preschool disruptive behavior disorders and attention-deficit/hyperactivity disorder through a developmental lens: what we know and what we need to know. *Child Adolesc Psychiatr Clin N Am* 2009, 18:627–643, http://dx.doi.org/10.1016/j.chc.2009.02.003
15. Rucklidge JJ. Gender differences in neuropsychological functioning of New Zealand adolescents with and without Attention Deficit Hyperactivity Disorder. *Int J Disabil Dev Ed* 2006, 53:47–66, http://dx.doi.org/10.1080/10349120600577402
16. DuPaul GJ. Parent and teacher ratings of ADHD symptoms: psychometric properties in a community-based sample. *J Clin Child Psychol* 1991, 20:245–53, http://dx.doi.org/10.1207/s15374424jccp2003_3
17. Thomaidis L, Mantoudis S, Kyprianou M, Janikian M, Konstantopoulos A. Development of a screening tool for children prior to school entrance. *Turk J Pediatr* 2014, 56:374–384
18. Tillman CM, Bohlin G, Sørensen L, Lundervold AJ. Intellectual deficits in children with ADHD beyond central executive and non-executive functions. *Arch Clin Neuropsychol* 2009, 24:769–782, DOI: https://doi.org/10.1093/arclin/acp075
19. Castellanos FX, Sonuga-Barke EJS, Milham MP, Tannock R. Characterizing cognition in ADHD: beyond executive dysfunction. *Trends Cogn Sci* 2006, 10:117–123, http://dx.doi.org/10.1016/j.tics.2006.01.011
20. Durand M, Hulme C, Larkin R, Snowling M. The cognitive foundations of reading and arithmetic skills in 7- to 10-year-olds. *J Exp Child Psychol* 2005, 91:113–136, http://dx.doi.org/10.1016/j.jecp.2005.01.003
21. Duncan GJ, Dowsett CJ, Claessens A, Magnuson K, Huston AC, Klebanov P et al. School readiness and later achievement. *Dev Psychol* 2007, 43:1428–1446, http://dx.doi.org/10.1037/0012-1649.43.6.1428
22. Abikoff H, Nissley-Tsiopinis J, Gallagher R, Zambenedetti M, Seyffert M, Boorady R et al. Effects of MPH-OROS on the organizational, time management, and planning behaviors of children with ADHD. *J Am Acad Child Adolesc Psychiatry* 2009, 48:166–175, http://dx.doi.org/10.1097/CHI.0b013e3181930626
23. Gershon J. A meta-analytic review of gender differences in ADHD. *J Atten Disord* 2002, 5:143–154, DOI: https://doi.org/10.1177/108705470200500302
24. Maitland SB, Herlitz A, Nyberg L, Bäckman L, Nilsson L-G. Selective sex differences in declarative memory. *Mem Cognit* 2004, 32:1160–1169, DOI: 10.3758/BF03196889
25. Luders E, Narr KL, Thompson PM, Rex DE, Woods RP, Deluca H et al. Gender effects on cortical thickness and the influence of scaling. *Hum Brain Mapp* 2006, 27:314–324, DOI: 10.1002/hbm.20187
26. Goldstein JM, Jerram M, Poldrack R, Anagnoson R, Breiter HC, Makris N et al. Sex differences in prefrontal cortical brain activity during fMRI of auditory verbal working memory. *Neuropsychology* 2005, 19:509–519, http://dx.doi.org/10.1037/0894-4105.19.4.509
27. Visser SN, Lesesne CA, Perou R. National estimates and factors associated with medication treatment for childhood attention-deficit/hyperactivity disorder. *Pediatrics* 2007, 119(Suppl 1):99–106
28. Diagnostic and Statistical Manual of Mental Disorders. 5th ed. Washington DC, American Psychiatric Association, 2013

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