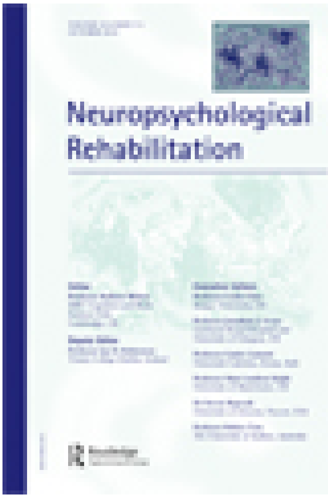


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# Daily functioning profile of children with attention deficit hyperactive disorder: A pilot study using an ecological assessment

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# Daily functioning profile of children with attention deficit hyperactive disorder: A pilot study using an ecological assessment

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Children with attention-deficit hyperactivity disorder (ADHD) often present with activities of daily living (ADL) performance deficits. This study aimed to compare the performance characteristics of children with ADHD to those of controls based on the Do-Eat assessment tool, and to establish the tool's validity. Participants were 23 children with ADHD and 24 matched controls, aged 6–9 years. In addition to the Do-Eat, the Children Activity Scale–Parent (ChAS-P) and the Behavioral Rating Inventory of Executive Function (BRIEF) were used to measure sensorimotor abilities and executive function (EF). Significant differences were found in the Do-Eat scores between children with ADHD and controls. Significant moderate correlations were found between the Do-Eat sensorimotor scores, the ChAS-P and the BRIEF scores in the ADHD group. Significant correlations were found between performance on the Do-Eat and the ChAS-P questionnaire scores, verifying the tool's ecological validity. A single

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discriminant function described primarily by four Do-Eat variables, correctly classified 95.5% of the study participants into their respective study groups, establishing the tool's predictive validity within this population. These preliminary findings indicate that the Do–Eat may serve as a reliable and valid tool that provides insight into the daily functioning characteristics of children with ADHD. However, further research on larger samples is indicated.

***Keywords***: Attention-deficit hyperactivity disorder (ADHD); Evaluation; Daily Performance; Executive Functions; Sensory-Motor.



## INTRODUCTION

Attention-deficit hyperactivity disorder (ADHD) is the most common complex behavioural disorder among children, affecting approximately 5% to 10% of the population worldwide (Barkley, Murphy, & Fischer, 2008; Daley, 2006; Spiliotopoulou, 2009). The high prevalence rate and detrimental effects of ADHD highlight the importance of early identification of the disorder (Bell, 2011; Wilens & Dodson, 2004).

The diagnosis of ADHD is based on the criteria found in the Diagnostic and Statistical Manual of Mental Disorders (DSM-V; American Psychiatric Association, 2013). The Academy of Pediatrics' (2000) clinical guidelines for diagnosing ADHD and the DSM-V (2013) guidelines have both suggested including functional performance as part of an ADHD assessment protocol. Furthermore, the International Classification of Functioning, Disability and Health for Children (ICF-CY) views "activity" as a measure of health and quality of life (WHO, 2001). Accordingly, ecologically valid assessment tools are recommended to evaluate children with ADHD via real world functional tasks (e.g., Burgess et al., 2006; Prudhomme-White & Mulligan, 2005) in two or more contexts (home, school, social) (APA, 2013).

Recent research has indicated that executive function (EF) deficits are associated with various ADHD symptoms that impair daily function, behaviour and learning (Barkley, 1997, 2001, 2006; Biederman et al., 2004; Doyle, 2005; McColskey, Perkins, & Van Divner, 2008). Although parent/teacher EF questionnaires are commonly used to evaluate EF (e.g., Behavioral Rating Inventory of Executive Function – BRIEF; Gioia, Isquith, & Guy, 2000), the evaluation of EF through real world activities enables a broader understanding of the performance of children with ADHD in the context of everyday situations (Chevignard et al., 2008).

Children with ADHD may also display motor deficits which play an important role in the performance of activities of daily living (ADL) and in the development of academic skills (Hemgren & Persson, 2007; Rasmussen & Gillberg, 2000). Research has indicated that approximately 50% of children with ADHD have co-occurring motor problems severe enough to be diagnosed as developmental coordination disorder (DCD; Barkley, 2006; Pitcher, Piek, & Hay, 2003). Some authors relate these motor deficits to impulsive activity rather than to clumsiness and attribute them to deficits in EF mechanisms (Barkley, 2005; Doyle, Wallen, & Whitmont, 1995; Klimkeit, Mattingley, Sheppard, Lee, & Bradshaw, 2005).

Developmentally, difficulties in attention, distractibility, hyperactivity, impulse control, as well as EF and motor impairments may appear as early as 3–7 years of age (Bell, 2011). The long-term complications of ADHD and importance of EF abilities in daily functioning and quality of life (e.g., Barkley, 1997, 2000; Holmes et al., 2010) support the need for early identification of children with suspected ADHD, including the assessment of their daily function, EF and motor abilities. In fact, parents may sense problems early on, since ADHD can influence daily functions such as bathing, eating and sleeping, which impact on the family's daily proceedings (Barkley, 2005; Segal, 1999). Despite the evidence that parents' involvement is critical for the behavioural management of children with ADHD in both the early identification and the intervention processes (e.g., Daley, 2006; Johnston, Seipp, Hommersen, Hoza, & Fine, 2005; Jones, Daley, Hutchings, Bywater, & Eames, 2007), standardised ecological assessments that enable the collection of evidence from daily functioning are still lacking. Unfortunately, diagnosis is often delayed until age 7 or older (Bell, 2011), which may lead to secondary academic and emotional complications (Murphy, 2005; Spencer, 2005). Thus, a practical, standardised assessment tool focusing on children's performance is needed to detect daily functional deficits and ensure that important information from parents is not overlooked.

Currently, parent/teacher report questionnaires examining behaviour or isolated neuropsychological functions are the most commonly used evaluations for children with ADHD (Holmes et al., 2010). To the best of our knowledge, the only performance-based assessment validated among children with ADHD is the Assessment of Motor and Process Skills (AMPS; Fisher, 2003; White & Mulligan, 2005). However, this instrument has been criticised as not enabling the observation of important EF-related deficits that negatively impact on independence in instrumental activities of daily living (IADL) performance (Bottari, Dassa, Rainville, & Dutil, 2009).

The Do-Eat (Josman, Goffer, & Rosenblum, 2010) was developed to detect sensorimotor and EF deficits among children with neuro-developmental disabilities through the execution of real world IADL and learning tasks. So far, a profile of typically developed children has been established as has its reliability and validity among children with developmental coordination disorder (DCD) (Frisch et al., 2009; Josman et al., 2010). This study was conducted to explore the unique performance characteristics of children with ADHD and further establish the reliability and validity of the Do-Eat in this population.

# METHOD

## Participants

The study included 47 participants, aged 6–9 years, from mainstream schools, including 23 children with ADHD and 24 age, gender, and socioeconomically matched typically developing children. All had normal intelligence, confirmed by their scores on the Block Design ($M = 10.49$, $SD = 3.06$) and Vocabulary ($M = 9.97$, $SD = 2.53$) subtests of Wechsler Intelligence Scale for Children-III



TABLE 1
Participants' demographic data and ChAS-P and BRIEF scores

| *Variable* | | *ADHD* (n = *23)* | *Control group* (n = *24)* | *t(45)/* $\chi^2$ |
|---|---|---|---|---|
| Gender | Boys | 62.5% (15) | 65.2% (15) | |
| | Girls | 37.5% (9) | 34.8% (8) | $\chi^2$=.04 |
| Age | | 7.15 (.60) | 7.15 (.68) | t(45)=−.005 |
| Hand dominance | Right | 70% | 79.2% | $\chi^2$=.49 |
| | Left | 30% | 20.8% | |
| Socioeconomic status | Low | 4.3% (1) | 9.1% (2) | $\chi^2$=.56 |
| | Medium | 56.5% (13) | 59.1% (13) | |
| | High | 39.1% (9) | 31.8% (7) | |
| | | Mean (*SD*) | Mean (*SD*) | Z |
| ChAS-P scores | | 4.17 (.60) Range: 2.78–5.00 | 4.76 (.21) Range: 4.20–5.00 | −4.07*** |
| BRIEF scores | | | | |
| Behavioural Regulation Index (BRI) | | 53.32 (9.25) | 37.34 (6.57) | −4.02*** |
| Meta-cognition index (MI) | | 94.68 (22.61) | 57.21 (8.74) | −4.72*** |
| Global Executive Composite score (GEC) | | 144.73 (22.64) | 94.00 (13.43) | −5.07*** |

***$p < .001$.

(Wechsler, 1992). Participants with ADHD were recruited from the Maccabi Healthcare Attention Clinic in northern Israel, where they were diagnosed by developmental paediatricians based on DSM-IV-TR criteria (APA, 2000). In addition, they scored above 65 (+1.5 *SD*) on the Connors Parent Rating Scale Revised – Short Form (CPRSR-SF) and on the Connor's Teacher Rating Scale Revised – Short Form (CTRSR-SF; Connors, 1997). Most participants used a stable dose of psychostimulant medication daily, but none used medication on the day of the assessment. Children were excluded if they used medications other than psychostimulants, or were diagnosed with any physical or mental disorder other than ADHD. The controls were recruited from the same residential environment as participants in the research group, and their scores on the CPRSR-SF ruled out any behavioural concerns.

After verifying the children's suitability to participate in the study according to the study's criteria, the parents of children with ADHD were given the option to have their children evaluated at their community MACCABI Healthcare clinic (39%) or in their homes (61%), according to their preference. All the children in the control group were evaluated in their homes. A Mann-Whitney test indicated no significant differences between the scores of the children with ADHD who were evaluated at their homes or in their clinics. The evaluator was blind to the detailed findings of the children's CPRSR-SF and CTRSR-SF results but was not to the status of the children (ADHD vs. controls) due to the complexity of the recruitment process.

No significant age, gender, or socioeconomic differences were found between the groups (see Table 1). Significant differences were found between the groups on the final score of the ChAS-P (Rosenblum, 2006), used to help identify children with DCD. Six children in the ADHD group (26%) were identified as suspect DCD (Rosenblum, 2006). Significant group differences were also found between the groups' BRIEF scores.

## Instruments

The demographic questionnaire, designed by the authors, was used to collect background data on the participants and their families.

The Children Activity Scale–Parent (ChAS-P; Rosenblum, 2006) was used to identify children aged 4–9 years at risk for DCD, based on parents' reports regarding their child's daily functioning. This 27-item questionnaire includes items related to gross and fine motor functioning, learning, planning and organisation in space and time, self-care, mobility and play. The parent ranks the child's performance of activities in comparison to his/her peers on a 5-point Likert scale (1 = less adequately, 2 = adequately, 3 = almost well, 4 = well, and 5 = very well). The mean score (outcome measure) ranges from 1–5. A mean score of 1–3.82 indicates suspected DCD (Rosenblum, 2006). Internal consistency, construct validity and concurrent validity were established with the Movement-ABC, and the results suggest that the ChAS-P is a reliable tool for identifying children at risk for DCD based on their daily functioning (see Rosenblum, 2006, for further details). The internal consistency of the CHAS-P as established in the current study is $\alpha = .86$.

The Do-Eat performance-based assessment and parent questionnaire (Josman et al., 2010), a standardised evaluation for children aged 5–8 years, was administered in their natural surroundings. The children were asked to perform three tasks: make a sandwich, prepare chocolate milk, and fill in a certificate of outstanding performance for themselves. These tasks were designed based on the rich clinical experience of the tool's developers and on observations of the daily functioning of children (aged $\geq$ 5 years) in their homes, kindergartens and schools.

After the evaluator introduces the three tasks to the child, he/she provides the necessary materials, and demonstrates and explains each phase of each task before the child is asked to perform it. For the "making a sandwich" task the child is asked to don an apron, choose a sandwich filling and spread a thin layer of it on a slice of bread with a plastic knife. The child completes the task by cutting the bread in half to form a sandwich. To perform the "chocolate milk" task, the child is asked to put two full spoons of chocolate powder into a cup, then add a bit of milk and stir until there are no lumps, and then fill the cup with milk and stir again until the drink is ready. The last task involves having the child write his/her name on a paper designed to look like a certificate, cut a circle drawn on another piece of paper, glue the circle onto the certificate and draw a picture of him/herself (or something else that the child wishes to draw). Then the child is asked to score him/herself (from 5 = well, to 1 = poorly) on his/her performance of the sandwich and the chocolate milk tasks and sign the certificate.

Performance on each of these tasks is graded according to three dimensions: task performance, sensorimotor skill, and executive functioning. The sensorimotor skills graded include posture and movement relationships, motor planning, bilateral coordination, fine motor coordination and sensation. The EFs analysed include attention, initiation, sequencing, transition between activities, spatial and temporal organisation, inhibition, problem-solving and remembering instructions. The children may be given cues during their performance. For each task, the evaluator records the lowest cue level required for the child to perform the task. A score of 5 indicates that no cues were needed, whereas a score of 1 indicates that the tester had to physically intervene (e.g., holds the jar of spread while the child tries to open it).

Test scores range from 1 ("unsatisfactory performance") to 5 ("very good performance"). The number of items and range of scores are described in Table 3. The Do-Eat manual provides guidance for scoring each component (i.e., performance, sensorimotor, EF and cueing).

As the test is being administered to the child, the parents complete a 10-statement questionnaire concerning their child's performance on similar tasks at home and their satisfaction regarding the child's performance of the various tasks (e.g., eating, drawing and cutting). The questionnaire emphasises aspects of the child's EF in performing these types of tasks (items 1, 2, 4, and 10). For example, item 4 states: "My child knows how to solve daily life problems" (e.g., knows what to do when cannot reach objects, or when something spills). The questionnaire's statements are given scores ranging from 1 to 5 ("never" to "always"). The Do-Eat outcome measures comprise overall task performance, overall score for sensorimotor skills, and overall score for EF abilities associated with the tasks' performance. The sum of the three scores represents the final Do-Eat score. The cue score and the parent's questionnaire scores (parts A and B) are not included in the final Do-Eat score, but are used to guide intervention planning. Levels of reliability and validity are reported in the manual (Josman et al., 2010).

The Behavioral Rating Inventory of Executive Function (BRIEF) (Parent form) (Gioia et al., 2000), a parent questionnaire used to assess EF in 5–18-year-old children, was used. It includes 86 statements divided into the Behavioural Regular Index (BRI) that incorporates three sub-domains (inhibition, shifting and emotional control), and the Metacognition Index (MI), which incorporates five sub-domains (initiation, working, memory, planning/organisation, organisation of materials, and monitoring). Parents rate the frequency with which the behaviour described in each statement occurs. The three optional responses are converted into numbers (1–3), such that 3 represents a high frequency. The BRI and MI scores are combined to obtain an overall Global Executive Composite (GEC). A GEC of 50 represents the average standard score. A standard score of 65 and above ($>$ 1.5 *SD*) indicates a deficit. Established psychometric properties include convergent validity, internal consistency ($\alpha$ = .80–.98), inter-rater agreement ($r$ = .32), and test-retest reliability ($r$ = .81) (Josman et al., 2010).

## Procedure

Ethical approval was obtained from the local National Health Service Ethics Board (Helsinki Committee) and the University of Haifa's Ethics Committee. Following the formal diagnosis by a paediatrician and the scoring of the Connors' Parent Rating Scale–Revised: Short Form (CPRSR-SF; Conners, 1997), parents signed an informed consent. Children of parents who approved their participation completed the Wechsler subtests and Do-Eat tasks, while their parents completed the study questionnaires (the demographic questionnaire, the BRIEF, the CHAS, and the Do-Eat questionnaire).

Controls were recruited from a similar location and were matched to the research group by age, gender and socioeconomic status. Their parents obtained and signed consent forms and performed the same procedures as described above, including the completion of the CPRSR-SF questionnaire.

## Statistical analysis

Descriptive statistics were used to describe the sample and the main study variables.

Cronbach's alpha coefficient was used to compute internal consistency for Do-Eat components as well as the test as a whole. Differences between the groups were examined by the Mann-Whitney for non-parametric variables (non-normal distribution of the dependent variables) and effect sizes were computed (Field, 2005, p. 532). Correlations for establishing concurrent validity of the Do-Eat with the CHAS-P, CTRSR-SF and BRIEF questionnaires were calculated using Spearman's analysis for non-parametric variables. Discriminant analyses were conducted to determine which variables best predict group membership.

# RESULTS

## Preliminary results: Internal consistency of the Do-Eat

Internal consistency was evaluated for each of the three components of the Do-Eat based on the data from all participants, yielding satisfactory results. Acceptable internal consistency was obtained for performance skills across the three tasks ($\alpha = .73$). High internal consistency was found for sensorimotor skills ($\alpha = .87$), EF skills ($\alpha = .87$) and for the parents' questionnaire ($\alpha = .89$). Specifically, an internal consistency of $\alpha = .83$ was determined for these four items (Barkley, 1997; Barkley et al., 2008; Spiliotopulou, 2009; Wilens & Dodson, 2004) in part A of the parent questionnaire relating to EF skills required for daily functioning ("my child is tidy and organised"; "performs daily tasks independently"; "solves problems", and "remembers instructions").

### *Comparison of scores on the Do-Eat between children with and without ADHD*

Significant group differences were found in the final performance scores as well as for the sensory-motor, EF and cue scores. As presented in Table 2, medium to high effect sizes were found for all the test scores (ranging from $r = .41$ to $r = .69$), while the highest effect sizes were found for the EF skills score (.69) and the total Do-Eat score (.65).

A detailed description of the results for each task is presented in Table 3. The findings indicate that although both groups performed within the high score range, i.e., from M = 4.19 ($SD = 0.40$) to $M = 4.93$ ($SD = 0.99$), significant group differences were found in the performance of "making a sandwich" and "preparing chocolate milk". The sensorimotor and EF abilities were significantly different in all three tasks, whereas the cue score was significant only for the "preparing chocolate milk" and the "certificate" tasks.

High effect sizes were found for the executive skill scores of all three tasks (ranging from $r = .62$ to $r = .70$) as well as for the "preparing chocolate milk" task performance score ($r = .61$).

### *A comparison of the Do-Eat sensorimotor and executive function scores to those of standardised tools in each group (ADHD versus controls) – Concurrent validity*

*ChAS-P final score, the Do-Eat parent questionnaire, the Do-Eat sensory-motor component performance score.* In the ADHD group, a significant moderate correlation was found between the final scores of all the questionnaires ($r = .53$, $p < .05$), whereas no significant correlation was found in the control group. No significant correlations were found between the ChAS-P final score and the sensorimotor component of the Do-Eat performance score in either of the groups.

*BRIEF indexes scores (BRI and MI), Do-Eat parent questionnaire.* No significant correlation was found in the control group, whereas a significant negative correlation was found between the BRIEF meta-cognition index and the Do-Eat parent questionnaire in the ADHD group ($r = -.62$, $p < .001$).

TABLE 2
A comparison between the ADHD and control groups for the Do-Eat scores: Task performance, sensorimotor, EF, cueing and parents' questionnaire scores

| *Do-Eat Components* | *ADHD children* (n = *23)* *Mean* (SD) | *Control group* (n = *24)* *Mean* (SD) | *U* | *Z* | *r* |
|---|---|---|---|---|---|
| Task performance | 12.89 (0.94) | 13.89 (0.57) | 101 | −3.72*** | 0.54 |
| Sensorimotor skills | 13.25 (1.64) | 14.52 (0.52) | 117 | −3.41*** | 0.49 |
| EF skills | 12.63 (0.13) | 14.17 (1.02) | 52 | −4.77*** | 0.69 |
| Final cue score | 3.25 (0.68) | 3.88 (0.67) | 144 | −2.84** | 0.41 |
| Total Do-Eat score | 42.02 (3.19) | 46.45 (1.97) | 64.50 | −4.49** | 0.65 |
| Final score for Do-Eat parents' questionnaire | 3.45 (0.74) | 4.5 (0.51) | 118.50 | −2.90** | 0.42 |

**$p \leq .01$; ***$p \leq .001$; $r = .1$ small size, .3 medium size, .5 large size.

TABLE 3
A detailed comparison between the ADHD and control groups for each of the Do-Eat tasks related to performance, sensorimotor, EF and cue scores

| | *ADHD* (n = *23)* *Mean* (SD) | *Control group* (n = *24)* *Mean* (SD) | *U* | *Z* | *r* |
|---|---|---|---|---|---|
| Making a sandwich | | | | | |
| Task performance (8) | 4.19 (0.40) | 4.49 (0.32) | 144.50 | −2.81* | .41 |
| Sensory motor (7) | 4.39 (0.42) | 4.76 (0.29) | 124.50 | −3.27*** | .47 |
| EF (9) | 4.24 (0.30) | 4.65 (0.22) | 77.50 | −4.28*** | .62 |
| Cue score | 2.52 (0.95) | 3.00 (1.10) | 199.50 | −1.75 | .25 |
| Preparing chocolate milk | | | | | |
| Task performance (8) | 4.22 (0.44) | 4.74 (0.24) | 78.00 | 4.23*** | .61 |
| Sensory motor (7) | 4.49 (0.54) | 4.89 (0.15) | 130.00 | −3.23*** | .47 |
| EF (9) | 4.22 (0.40) | 4.79 (0.22) | 51.50 | −4.80*** | .70 |
| Cue score | 2.91 (1.12) | 3.96 (1.23) | 147.00 | −2.85** | .41 |
| Certificate task | | | | | |
| Task performance (3) | 4.49 (0.41) | 4.65 (0.35) | 205.00 | −1.54 | .22 |
| Sensory motor (7) | 4.57 (0.45) | 4.87 (0.19) | 158.00 | −2.44* | .35 |
| EF (9) | 4.36 (0.45) | 4.93 (0.99) | 44.00 | −4.85*** | .70 |
| Cue score | 4.30 (1.02) | 4.65 (0.93) | 193.00 | −1.99* | .29 |

*$p < .05$; **$p \leq .01$; ***$p \leq .001$. $r = .1$ small size, .3 medium size, .5 large size.

*BRIEF indexes scores (BRI and MI), Do-Eat (performance), Do-Eat EF component final score.* No significant correlations were found in the control group. However, a significant correlation was found between the BRIEF (MI) score and the Do-Eat (performance) and EF component final scores ($r = .48$, $p = .05$) in the ADHD group.

When analysing the correlation between the BRIEF subscale scores (BRI and MI) and the EF scores for each of the Do-Eat tasks individually (sandwich, chocolate milk, certificate), no significant correlations were found in the control group. In contrast, significant correlations were found in the ADHD group between both the BRI and the MI of the BRIEF, and the EF Do-Eat score for "preparing chocolate milk" ($r = .49$, $p < .05$; $r = .47$, $p < .05$, respectively).

### *Ecological validity: The Do-Eat final performance score and the score for the Do-Eat parent questionnaire – part A, in each of the groups*

Significant moderate correlations were found in the control group between the parent questionnaire final score and the Do-Eat performance final score ($r = .52$, $p < .05$), as well as with the mean score of the four EF items ($r = .45$, $p < .05$). No significant correlations were found for these scores in the ADHD group.

TABLE 4
Discriminant analysis structure matrix predictors' loading values

| | *Function* |
|---|---|
| The EF final score of the "preparing chocolate milk" task | .63 |
| The performance score of the "preparing chocolate milk" task | .58 |
| Mean score of the four EF items in the parent questionnaire | .56 |
| Final cue score | .32 |



Further analysis of the final parent questionnaire and the various task scores revealed significant correlations between the sensorimotor score of the "chocolate milk task" ($r = .45$, $p < .05$) and the mean score of the four EF items ($r = .50$, $p < .05$) among the controls. In the ADHD group, significant correlations were found between the sensorimotor score of the "chocolate milk task" and the final parent questionnaire score ($r = .51$, $p < .05$), as well as with the mean score of the four EF questions ($r = .48$, $p < .05$).

### *Predictive validity: Certain Do-Eat scores best predict group membership (ADHD versus controls)*

One discriminant function was found for group classification of participants (Wilks' Lambda = .46, $p < .001$). The variable providing the greatest contribution to group membership was the EF score of the "preparing chocolate milk" task (loading = .63) (see values for all measures in Table 4). Based on this function, 95.5% of the study participants were classified correctly into their groups solely through four of the Do-Eat variables (100% of the controls and 90.9% of the children with ADHD). A Kappa value of .90 ($p < .0001$) was calculated, demonstrating that group classification did not occur by chance.

## DISCUSSION

The objectives of the present study were to explore the unique performance characteristics of real world daily tasks among children with ADHD, and to establish the internal consistency, and validity (i.e., construct, concurrent, ecological and predictive) of the Do-Eat assessment among children with ADHD.

Internal consistency analyses revealed an acceptable to high degree of correspondence between the items in each category of the assessment and the parent questionnaire. All scales displayed alpha values $\geq .80$, except for the performance scale.

The Do-Eat scores significantly distinguished between children with ADHD and typical controls and the medium to high effect sizes found establish its construct validity. These findings enable us to draw meaningful conclusions regarding the general daily functioning of these children, which is especially pertinent in light of the dearth of performance-based assessment tools for children in general (Rocke, Hays, Edwards, & Berg, 2008), and for children with ADHD in particular (Prudhomme-White & Mulligan, 2005).

Significant group differences were found in the performance of two of the three Do-Eat tasks – "making a sandwich" and "preparing chocolate milk", but not in "preparing a certificate". A closer examination of the scores shows that the ADHD participants performed this task similarly to the controls, but, interestingly, the certificate appeared to be the easiest task for them to perform. In addition, the certificate task was performed after the two other tasks, suggesting that some degree of learning had occurred. This result is promising not only regarding treatment, but also with respect to the potential for improvement in the daily functioning of children with ADHD. It suggests that although they need assistance and remediation of their daily functioning, their performance can be enhanced given therapy and support. Thus, implementing the Do-Eat may serve as a key for fulfilling a meaningful two-way interactive rehabilitation process which addresses individual needs and everyday activities (Wilson, 2011).

It is important to note that due to its structure, the Do-Eat assessment affords indications of the negative impact of executive dysfunction on daily task performance. For example, although no significant difference was found between the groups in the performance of the certificate task, the ADHD group scores showed significantly poorer EF (with high effect size) and sensorimotor abilities related to the performance of this task. This may reflect the enormous mental and physical effort that these children exert in order to complete the certificate task, which has important implications for the children's quality of life and self-esteem and reinforces the importance of early identification and intervention (Tough et al., 2008). Perhaps if these functional deficits could be revealed earlier, it would result in more focused intervention and prevention of functional impairments/disability in adulthood, including those affecting academic performance (Daley & Birchwood, 2010), employment, and the quality of relationships with important others (Biederman et al., 2006).

In accordance with previous research findings (e.g., Kadesjo & Gillberg, 1998; Pitcher et al., 2003) the Do-Eat also revealed significant sensorimotor ability differences between children with and without ADHD. Some researchers suggest that these deficits result from impairments in EF and/or in cognitive neuro-mechanisms responsible for motor planning and motor control (Barkley, 2005; Doyle et al., 1995; Klimkeit et al., 2005). If so, the motor deficits shown by children with ADHD result from difficulties in movement preparation and reaction time as a result of their attentional impairment, rather than from motor/movement problems or motor planning per se (Doyle et al., 1995; Klimkeit et al., 2005). Since children with DCD often present with impaired executive and attentional functions, the latter view supports the phenomenon of comorbidity between ADHD and DCD (Barnett, Maruff, & Vance, 2005; Querne et al., 2008; Vance et al., 2007).

The current study results showed that the children with ADHD received high Do-Eat scores on all three of the Do-Eat tasks, indicating that they have the necessary abilities and skills to perform ADL and learning tasks. However, their cue score suggests that they required "direct verbal assistance" (cue level 2), in which the tester provides them with a choice between two options or repeats the instructions (e.g., "Now, do you need to cut or fold the slice of bread?"/"Please cut"), to guide their performance. It is important to note that the cue levels needed decreased as the assessment progressed. Hence, both groups needed the same cue level to perform the first task (level 2), but only level 4 cues were needed for the third task (i.e., open questions to help the child focus on the task). In contrast to the controls, the participants with ADHD still required cueing for this task, mostly because of EF deficits. Further, a large degree of variation was found within the ADHD group in addition to significant between-group differences.

Another potential advantage of the Do-Eat is afforded by its unique design, which includes both task performance and a parent questionnaire. Thus, the instrument may enable a more in depth examination of the nature of the difficulties of children with ADHD. Since the child's performance is measured through the use of three very structured tasks, it may diminish the influence of deficient EF on motor control (Barkley, 2005; Doyle et al., 1995). In contrast, the parent questionnaire enables the clinician to acquire data concerning the children's ability to function in the context of their real-life environments (Gioia, Isquith, Kenworthy, & Barton, 2002; Rosenblum, 2006). Parental involvement in the evaluation process is of particular importance in light of previous evidence indicating that parents do not always discern their child's behaviour to be atypical and therefore do not seek clinical support (Maniadaki, Sonuga-Barke, Kakouros, & Karaba, 2007).

The Do-Eat was also shown to be a valid measure of sensorimotor and EF abilities via the significant correlations found between the parents' questionnaire and the ChAS-P (sensorimotor) and BRIEF scores (EF), thus establishing its concurrent validity. Further, the ecological validity of the Do-Eat is demonstrated by the correlations found between the Do-Eat scores and the parents' questionnaire in both groups. Researchers emphasise the need for tools with ecological validity that are representative of children's real world performance, as well as the skills needed for performance, including sensorimotor and EF abilities (Burgess et al., 2006).

Finally, the establishment of criterion validity for the Do-Eat is an important study finding, which is meaningful in terms of the evaluation process. Discriminant analysis revealed one discriminant function that classified a high percentage (93.2%) of the children into their appropriate groups. The four variables that contribute to the assessment of function – the performance score of the "preparing chocolate milk" task, the overall performance score, the score in the functional part of the Do-Eat parent questionnaire and the final cue score – reflect the various factors that should be considered during intervention; the performance itself and the internal and external factors related to the client's abilities (WHO, 2004). Hence, these four variables highlight the conformance of the Do-Eat assessment to the WHO frame of reference.

However, this study has several limitations that need to be taken into account. As mentioned earlier, due to the constrains of the recruitment process, the evaluator was not blind as to the status of the children (ADHD vs. controls). Furthermore, although the process of diagnosis with the Do-Eat provides a useful performance profile of children with ADHD, it is a demanding one, which requires both a performance-based evaluation and the administration of a parent questionnaire. Although significant differences with medium to high effect size were found between the groups in their Do-Eat scores, further studies employing larger study samples would be necessary to describe the clinical significance of group differences in Do-Eat scores. Consequently, we hope to conduct further studies to examine the specific relationships between developmental milestone delays found among children with ADHD and their performance characteristics, as reflected by the Do-Eat.

In conclusion, the findings of this preliminary study indicate the benefits of using the Do-Eat as an ecological evaluation that captures the daily functional characteristics of children with ADHD as manifested through children's actual performance and validated by their parents' report.

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