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Parent-based diagnosis of ADHD is as accurate as a teacher-based diagnosis of ADHD

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Abstract

Objective—To review the literature evaluating the psychometric properties of parent and teacher informants relative to a gold-standard ADHD diagnosis in pediatric populations.

Method—We included studies that included both a parent and teacher informant, a gold-standard diagnosis, and diagnostic accuracy metrics. Potential confounds were evaluated. We also assessed the ‘OR’ and the ‘AND’ rules for combining informant reports.

Results—Eight articles met inclusion criteria. The diagnostic accuracy for predicting gold standard ADHD diagnoses did not differ between parents and teachers. Sample size, sample type, participant drop-out, participant age, participant gender, geographic area of the study, and date of study publication were assessed as potential confounds.

Conclusion—Parent and teachers both yielded moderate to good diagnostic accuracy for ADHD diagnoses. Parent reports were statistically indistinguishable from those of teachers. The predictive features of the ‘OR’ and ‘AND’ rules are useful in evaluating approaches to better integrating information from these informants.

Keywords

parent; teacher; ADHD; diagnosis; informant; accuracy

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Declaration of Interests

Dr. Joseph Biederman has a financial interest in Avekshan LLC, a company that develops treatments for attention deficit hyperactivity disorder (ADHD). His interests were reviewed and are managed by Massachusetts General Hospital and Partners HealthCare in accordance with their conflict of interest policies. His program has received departmental royalties from a copyrighted rating scale used for ADHD diagnoses, paid by Ingenix, Prophase, Shire, Bracket Global, Sunovion, and Theravance; these royalties were paid to the Department of Psychiatry at MGH. In 2016, he received honoraria from the MGH Psychiatry Academy and InQuill Medical Communications for tuition-funded CME courses, and from Alcobra and APSARD. He is on the scientific advisory board for Arbor Pharmaceuticals. He is a consultant for Akili and Medgenics. He has a US Patent Application pending (Provisional Number #61/233,686) through MGH corporate licensing, on a method to prevent stimulant abuse. The authors have no other relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript apart from those disclosed.

1. Introduction

The use of parent and teacher information for diagnosing attention deficit hyperactivity disorder (ADHD) has evolved considerably over the prior decades. Historically, ADHD evaluations relied heavily on teacher reports because, in part, many clinicians viewed ADHD as primarily a disorder of school. Medication trials initially focused on medicating children only during school hours [1] and as teachers are typically the only informant available to observe children in school, they were considered by some to be the most desirable informants for monitoring treatment response [2]. Many large scale studies, however, have shown that children with ADHD are markedly impaired in environments other than school which suggests that many effects of ADHD symptoms could not be detected by teachers [3]. Moreover, while parents do not observe their children during school hours, they typically can provide information pertaining to school based on their interactions with teachers, reports from their children and their review of school report cards.

The Diagnostic Statistical Manual of Mental Disorder, 5th edition (DSM-5), defines ADHD with a list of nine hyperactive-impulsive and nine inattentive symptoms, of which children must manifest six, or more, in one or two of the symptoms domains, to a degree that they substantially interfere with functioning in two or more settings to render the diagnosis. DSM-5 states that diagnostic assessments of ADHD cannot be “done accurately without consulting informants who have seen the individual” in multiple “settings” and that multiple informants are “beneficial” though *not required* in formulating the diagnosis [4]. For children, the pertinent informants are often interpreted to mean a parent/caregiver and a teacher [3].

Comments on the use of informant data have also been proffered by professional organizations. The ADHD practice parameter of the American Academy of Child and Adolescent Psychiatry (AACAP) recommends that the parents of patients undergoing evaluations for ADHD “complete one of many standardized behavior rating scales” and states that it is “advisable,” though not required, for clinicians to “obtain similar rating scales from the patient’s teachers.” The AACAP practice parameter cautions against formulating a diagnosis only from such rating scales, stating “such rating scales do not by themselves diagnose ADHD” and in situations in which obtaining teacher reports are not possible “then material from school” may be reviewed in place of a report [5]. The American Academy of Pediatrics (AAP) provides a more general recommendation that “information should be obtained primarily from reports from parents or guardians, teachers and other school and mental health clinicians.” The AAP does not recommend a specific approach, such as a rating scale, academic record review, or interview, to achieve this goal and states “information should be obtained primarily from reports from parents or guardians, teachers, and other school and mental health clinicians involved in the child’s care” [6]. A review of 1,098 charts of ADHD patients treated by pediatricians found that parent scales were used in the diagnostic assessment for 57% of cases and teacher scales in 56% of cases [7]. The DSM, AACAP, and AAP all recognize the value of collecting information from parents and teachers, but provide no clear guidance about how to approach situations in

which teacher reports are unavailable or difficult to obtain, and how best to integrate parent-teacher reports when both are available.

The ambiguity of current recommendations reflects the state of the empirical literature. Early studies of parent and teacher reports focused on the degree to which these informants agreed on the presence of individual symptoms. A substantial body of literature has shown that there is a relatively poor correlation between parents and teachers on the individual symptoms of ADHD, (mean r values = 0.2, 0.31, 0.19, 0.2, 0.25) [8–12]. These findings remain true even when assessing cross-informant agreement for ADHD's two symptoms domains (HA mean r = 0.39, 0.19, 0.41, 0.29, 0.27) (IA mean r = 0.25, 0.19, 0.22, 0.22, 0.34) [9–14]. In contrast to the poor correlation between parents and teachers on the individual symptoms of ADHD the informant agreement on the ADHD diagnosis is relatively high [15–18].

Despite strong evidence of negative outcomes including social, academic, and occupational impairment, increased risk of co-morbid psychiatric illness, and later life substance use disorders [19–24] far less is known about the predictive validity of the different informants or combinations of informants. These combinations have mostly been assessed comparing four options: parent only, teacher only, parent *and* teacher (the “AND rule”), and parent *or* teacher (the “or” rule). A number of studies have found parents as good, or better, than teachers at predicting treatment response [12 25] and comorbid mood disturbance [26] while others showed teachers to be better at predicting poor peer socialization and later life criminal behavior [27].

In clinical practice the ADHD diagnosis is sometimes made with a single informant report. Parents reports are typically readily available, and at times used in the absence of a teacher report, when formulating the diagnosis [16 18]. In situations in which a teacher report is also obtained, it is typically acquired with some effort on the part of the clinician and parent. The first practice of using only a parent report, leaves some uncertainty as to whether the patient satisfied the diagnostic criteria for ADHD. The second, of obtaining a teacher report in addition to that of a parent, necessarily delays making a diagnosis and initiating an appropriate treatment to manage the patient's symptoms.

As the above review indicates, the answer to the question “Do parents and teachers agree on the diagnosis of ADHD?” depends upon whether one refers to individual symptoms, the symptoms within each domain specifically, total symptom counts, the diagnostic construct or a derivative feature such as medication response, comorbid illness, or later life failure. While this work has usefully documented the range of parent-teacher agreement, it does not speak directly to two key clinical questions: 1) is one informant more accurate than the other and 2) should one seek out two informants and, if so, how should that information be integrated? This information is essential for clarifying the relative value of parent and teacher reports and methods of combining these reports. To address this issue, we conducted a literature review of studies that have assessed the diagnostic accuracy of parent and teacher reports by assessing their sensitivity, specificity and negative and positive predictive powers as predictors of gold standard ADHD diagnoses. In this article we use the term “gold

standard” to refer to a diagnostic interview administered by a clinician or by a trained interviewer.

2. Methods

A PubMed literature search identified ADHD parent-teacher informant studies that met the following criteria: 1) Assessed individuals diagnosed with ADHD; 2) Included a parent-based informant diagnosis; 3) Included a teacher-based informant diagnosis and 4) Included a gold-standard diagnosis of ADHD by a mental health clinician. We used the following search algorithm: parent teacher ADHD (agree OR disagree OR disagreement OR: agreement OR concordance OR informant OR validity OR reliability). We reviewed studies generated from this search and only included those reports that were available in the English language and were published as articles in peer-reviewed journals. We only selected studies that presented the PPV, NPV, sensitivity, and specificity of each informant with respect to a gold standard diagnostic interview. In addition to the above metrics, we extracted the following, when available, from the selected studies: sample size, percentage drop-out, mean age, percent of participants that were male, the approach to diagnostic evaluation/gold-standard (interview type), the predictor utilized, geographic region in which the study was conducted, and sample type (enriched for ADHD vs selected from the community).

To assess the effects of informant and potential confounds on sensitivity, specificity, NPV and PPV, we first transformed these proportions with the logit transformation and then used them as dependent variables in regression models. These models were weighted by the number of participants in the study providing the accuracy statistics. Each study provided more than one assessment of diagnostic accuracy due to the use of multiple samples, different informants or algorithm or different cutpoints on predictors. To address this lack of statistical independence between data points, we used robust standard errors [28]. All analyses used STATA 14.0 [29].

3. Results

The initial search yielded two-hundred-and-thirty four candidate articles of which eight met our inclusion criteria. Figure 1 describes our selection of studies using the preferred reporting items for systematic reviews and meta-analyses (PRISMA) format. The eight studies are described in Table 1. They were published between 2004 and 2015 with sample sizes ranging from 151 to 1221. The percentage dropout, reported in five of the eight studies, ranged from 2.1% to 63.9%. The mean age of participants, reported in seven of the eight studies, ranged from 7.4 to 10.9 years of age. The gender make-up, described in seven studies, ranged from 42% to 100% male. All studies used either a structured or semi-structured clinical interview for their gold standard diagnostic assessment. The measures used to collect parent and teacher data for predicting gold standard diagnoses included the Vanderbilt ADHD diagnostic rating scale (VADRS), ADHD rating scale (ARS), strengths and difficulties questionnaire (SDQ), impairment rating scale (IRS), global assessment scale (GAS), Connors child behavioral checklist (CBCL), comprehensive parent rating scale (CPRS), teacher report form (TRF), Connors teacher rating scale (CTRS), disruptive behavior disorder rating scale (DBD) and the behavioral assessment system for children

(BASC). The studies were conducted in five nations and three regions within the United States. Four of the studies selected participants from community samples; the selected participants from samples enriched for ADHD (e.g., clinical samples).

The studies employed various means of establishing their gold-standard ADHD diagnoses and corresponding parent, teacher, or combined diagnosis. Fabiano et al. [30] used the impairment rating scale (IRS) as the predictor. Their gold standard was a semi-structured interview employing the diagnostic interview schedule for children (DISC) and the SNAP-IV with a positive symptom established if endorsed by both informants. Wolraich et al, used a comprehensive parent interview employing the DISC as the gold standard diagnosis. Their predictor was the VADRS [31]. Pineda et al. [32] used a comprehensive diagnostic interview as a gold standard. The predictor used was the BASC. Tripp et al. [33] used a semi-structured clinical interview of both the parent and teacher as their gold standard. The predictor consisted of the combined score from the CBCL and CPRS for parents and the TRF and CTRS for teachers [33]. Shemmashian et al, [34] used the DISC for gold standard diagnoses. The predictor was the DBD. Shemmashian et al. [35] used a clinical interview employing the DISC as a gold-standard. They used a modified DISC as the predictor for parents and the DBD for teachers. Park et al. [36] used the DISC as a gold standard. The predictor was the ARS. Johnson et al. [37] used a semi-structured diagnostic interview and telephone report of the parent and teacher respectively as their gold standard diagnosis. The SDQ was used as the predictor.

All eight studies provided a parent and a teacher informant while three also assessed the “*parent AND teacher*” rule and two assessed the “*parent OR teacher*” rule. Four studies provided an AND rule, one by considering a symptom positive only if endorsed by both informants [34] and the others by considering a diagnosis only if the score was reported to be abnormal by both informants [33 35 36 38]. The OR rule was provided in two of the studies, one by deeming a symptom positive if endorsed by either informant [34], and the other by considering a diagnosis if the score of either informant report was abnormal [38]. The eight studies provided data from eleven samples. Because several informant rules were applied to the eleven samples and some authors examined multiple cutpoints on their predictor, a total of seventy data points were available for analysis. We adjusted for the non-independence of data points within samples as described in Methods.

Figure 2a plots the sensitivity versus the false positive rate for each informant group relative to the gold-standard diagnosis. The diagonal line is the line of zero accuracy (LZA). The accuracy of a point increases with its distance from the LZA. From Figure 2a it is clear that the AND rule lowers the false positive rate at the expense of reducing sensitivity and the OR rule has the reverse effect. The Figure does not suggest any clear superiority of parent or teacher reports when compared with one another. Figure 2b plots the results for each study. We see clear differences among studies with the best results being obtained by Fabiano et al. [30] and Pineda et al. [32] and the worst results being reported by Tripp et al. [33] and Park et al. [36].

Table 2 presents the means of sensitivity, specificity, PPV, and NPV for each of the informants and combinations of informants. For sensitivity, the effect of informant was

statistically significant ($F_{3,7} = 35.7$, $p = 0.0001$). Four pairwise comparisons were statistically significant: '*or vs and*', '*parent vs and*', '*teacher vs and*', and '*parent vs or*' ($t_7 = 9.5$ $p < 0.001$, $t_7 = 5.8$ $p = 0.001$, $t_7 = 3.2$ $p = 0.02$, and $t_7 = -2.6$ $p = 0.04$, all others $p > 0.10$). The '*OR rule*' had the highest mean sensitivity, followed by the *parent*, then the *teacher*, and lastly the '*AND rule*' (Table 2). Analyses of potential confounds found male gender and date of publication to be statistically significant ($F_{1,6} = 11.9$, $p = 0.01$, $F_{1,6} = 10.8$, $p = 0.02$, $F_{1,7} = 11.09$, $p < 0.0127$). The effect of informant on sensitivity remained significant after correcting for the significant confounds ($F_{3,6} = 9.9$, $p = 0.01$).

We found that informant significantly predicted specificity ($F_{1,7} = 8.1$ $p = 0.01$). Only the '*teacher vs AND rule*' pairwise comparison was significant ($t_7 = 2.5$ $p = 0.04$, all others $p > 0.05$). As for confounds, sample type and percentage dropout were significantly associated with specificity such that specificity was greater for enriched samples over community samples and for studies having a lower dropout rate ($F_{1,7} = 9.38$ $p = 0.02$; $F_{1,6} = 43.8$ $p = 0.003$). All other potential confounds did not significantly alter specificity (all $p > 0.12$). The effect of informant on specificity remained significant after correcting for the significant confounds ($F_{3,7} = 31.3$, $p = 0.0002$).

When evaluating PPV the effect of informant was not significant ($F_{3,7} = 0.99$ $p = 0.45$). For NPV, the effect of informant was significant ($F_{3,7} = 24.7$ $p = .0004$) with pairwise comparisons showing significant differences between the '*OR rule vs AND rule*' and the '*parent vs AND rule*' but not the others ($t_7 = 2.7$ $p = 0.03$, $t_7 = 4.9$ $p = 0.002$, all others $p > 0.14$). The '*OR rule*' displayed the greatest mean NPV, followed by the *parent*, the *teacher*, and lastly the '*AND rule*' (Table 2). The only confound predictive of NPV was age ($t_7 = 4.1$ $p = 0.006$; all other p 's > 0.14).

4. Discussion

Results from our review show that the literature on the subject is very small and that few studies assessed the accuracy of parent or teacher diagnoses of ADHD in reference to a gold standard diagnosis. Our most important finding is the lack of difference in the accuracy of parents and teachers as reporters of gold standard diagnoses. This is seen in the means accuracy statistics in Table 2. Consistent with this finding, teacher and parent reports have also been shown to be similar for assessing response to medication, duration of response, degree of improvement [25–39] and dose response relationships [12.]

These means, however, obscure a good deal of variability between studies. Inspection of Figure 2b shows three samples with fairly large differences in accuracy favoring parents over teachers [34–36] and one favoring teachers over parents [31]. Those studies showing the highest levels of accuracy [30–32] show very similar results for parents and teachers. From Table 2 we see that these two studies had the highest fraction of male subjects and both used enriched samples. These features, which we found to predict better sensitivity, are likely to select ADHD patients with higher levels of severity, which may explain the better accuracy results from those two studies. Arguing against this idea are the data from Tripp et al. [33], which show a low level of accuracy despite using an enriched sample with a high proportion of male subjects.

When evaluating the clinical implications of these findings, we refer to the typical clinical context where a parent report is readily available and one wonders if a teacher report would be worthwhile. Some direction is given by the expected effects we observed for the AND and OR rules. Compared to single informants, the AND rule decreased both sensitivity and the false positive rate whereas the OR rule increased both of these measures. Because the only value of the AND rule is to decrease false positives, it should only be used when the clinician is concerned that the parental diagnosis may be false. The OR rule is useful when one is concerned with low sensitivity. This idea is consistent with the clinical approach suggested by Power et al. [40] who suggested that one obtain a teacher report (i.e., use the AND rule) when skeptical of a positive report by the parent or in situations in which the parent remains equivocal about the child's symptoms or impairments. The AND rule would also be appropriate for parents who are unreliable reporters due to intelligence, mental state or psychopathology or for parental reports that just exceed the threshold of diagnosis. How common such scenarios are will depend on the clinical setting. Under the OR rule, clinicians would not seek teacher diagnoses when parental diagnoses were positive. Teacher diagnoses would only be sought when an evaluation raised concerns about low sensitivity. One example is when the parent provides data that just miss the symptomatic or age at onset criteria for a child that is massively impaired.

These considerations suggest that teacher reports will not be *routinely* essential when parent reports are available. Consistent with this conclusion, Biederman et al. [17 18] reported that when a parent report indicated a positive diagnosis of ADHD, the teacher report confirmed the diagnosis in the large majority of cases. Although we conclude that teacher reports are not *essential* for diagnosing ADHD or monitoring treatment response, the use of teacher reports for concerns beyond the diagnosis of ADHD must be considered. Formulating psychosocial treatment plans, and targeting trouble areas present only in the school environment may benefit from teacher reports about school-based behaviors. Teacher reports are clearly essential for school-based treatment programs [41 42].

Our study has several limitations. The small number of studies reviewed, eight meeting our inclusion criteria, limited the amount of data available for analysis. There was also a substantial diversity between the studies reviewed with variations in participant age, gender, percentage fall-out, sampling, and region. Despite these limitations, which likely decreased our power, we were able to detect significant effects of informants and of potential confounds. In all studies, parents provided both the interview data for the gold standard assessment and a parent reported rating scale. Thus, it is possible that measures of parent to gold standard agreement are inflated. We could also not fully address the value of the AND and OR rules given the limited amount of data.

5. Conclusion

Despite these limitations, our review has clarified the relative utility of parent and teacher reports. In contrast to claims that parents reports are better than teacher reports, or vice-versa, our analyses found no significant differences in diagnostic accuracy between informants. Given these findings, along with the typical clinical context in which parent reports are available, we provide a framework for deciding when the additional burden of

acquiring teacher reports is warranted. That said, the small number of studies available on this key clinical issue calls for additional research.

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1. Articles identified per PubMed search.
2. Article title or abstract but not full text were available in English.
3. ADHD mentioned in context unrelated to the broader nature of the article.
4. Articles either did not address diagnosis of ADHD or used a diagnosis, such as estimated community prevalence, in place of more conventional diagnosis.

The n-values for the individual criteria exceeds the number included in the qualitative review as some articles lacked more than one of the criteria listed.

Figure 1.

Study flow diagram. Based on preferred reporting items for systematic review and meta-analysis (P.R.I.S.M.A.).

Figure 2.

a: Sensitivity and False Positive Rates of Informant Reports Relative to Gold Standard Diagnoses

b: Sensitivity and False Positive Rates of Informant Reports Relative to Gold Standard Diagnoses Broken Down by Study

Table 1

Characteristics of the Studies Reviewed

Author	Pub Date	Sample Size	% Drop Out	Mean Age	Gender Distribution	Predictor	Geographic Region	Sample Type
Wolraich	2013	366	2.1%	8	53% σ'	VADRS	Oklahoma	Community
Shemmassian	2015	195		7.4	70% σ'	DBD	Los Angeles	Community
Park	2014	3085 R	63.9%			ADHD-RS	South Korea	Community
Shemmassian	2014	151		7.4	70% σ'	DBD	Los Angeles	Community
Johnson	2014	219	29%	10.92	42% σ'	SDQ	England	Enriched
Fabiano Q	2006	252		9.34	83–100% σ'	$T_{IRS/P-GAS}$	Buffalo, NY	Enriched
Tripp	2006	184	10%	7.8	76.4% σ'	CBCL/CPRS, TRF/CTRS	New Zealand	Enriched
Pineda	2004	344	42%	7.8	79.9% σ'	BASC-IV	Columbia	Enriched

Denotes author did not report this information.

R : Author studied three participant pools compromised of 1221, 961, and 903 participants.

Q : Author used an initial pool of participants and then a subset of this pool later in same clinical study.

T : Authors used various cut-offs for the IRS including scores of 1, 2, 3, 4, 5, and 6.

σ' : Signifies male gender.

Predictors

VADRS: The Vanderbilt ADHD diagnostic rating scale.

DBD: The disruptive behavior disorder rating scale.

ADHD-RS: The ADHD rating scale.

SDQ: The strengths and difficulties questionnaire.

IRS/P-GAS: The impairment rating scale/parent-global assessment scale.

CBCL: The Connors child behavioral checklist

CPRS: Connors parent rating scale.

TRF: Teacher Report Form.

Author Manuscript

Author Manuscript

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CTRS: Conners Teacher Rating Scale
BASC-IV: The behavioral assessment system for children-fourth edition.

Table 2

Pooled Sensitivity, Specificity, PPV and NPV of the Studies Reviewed

	Sensitivity	Specificity	PPV	NPV
Parent	0.74	0.76	0.75	0.77
Teacher	0.78	0.81	0.78	0.82
'Or' Rule ^a	0.86	0.67	0.50	0.90
'And' Rule ^b	0.38	0.91	0.77	0.65

^a: Two studies, Shemmassian 2015 and Johnson 2014, reported '*OR*' rule data.

^b: Four studies, Shemmassian 2015, Park 2014, Johnson 2014, and Trip 2006 reported '*AND*' rule data

PPV: Positive predictive value.

NPV: Negative predictive value.