Comparison of the PSC-17 and Alternative Mental Health Screens in an At-Risk Primary Care Sample

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ABSTRACT

Objective: To validate the 17-item version of the Pediatric Symptom Checklist (PSC-17) as a screen for common pediatric mental disorders in primary care. **Method:** Patients were 269 children and adolescents (8–15 years old) whose parents completed the PSC-17 in primary care waiting rooms. Children were later assessed using the Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime version (K-SADS-PL). The PSC-17's subscales were compared with K-SADS-PL diagnoses and measures of anxiety, depression, general psychopathology, functioning, and impairment. **Results:** In receiver operating characteristics analyses, the PSC-17 subscales performed as well as competing screens (Child Depression Inventory, the parent and child Screens for Child Anxiety-Related Disorders) and Child Behavior Checklist subscales (Aggressive, Anxious-Depressed, Attention, Externalizing, Internalizing, and Total) in predicting diagnoses of attention-deficit/hyperactivity disorder, externalizing disorders, and depression (area under the curve $\geq$0.80). The instrument was less successful with anxiety (area under the curve = 0.68). None of the screens were highly sensitive, many were insensitive, and all would have low positive predictive value in low-risk primary care populations. **Conclusions:** The PSC-17 and its subscales are briefer than alternative questionnaires, but performed as well as those instruments in detecting common mental disorders in primary care. Continued research is needed to develop brief yet sensitive assessment instruments appropriate for primary care. *J. Am. Acad. Child Adolesc. Psychiatry,* 2007;46(5):611–618. **Key Words:** screening, primary care, mental health assessment.

Mental disorders are common chronic conditions among children and adolescents (Briggs-Gowan et al., 2000; Costello et al., 1988a; Goldberg et al., 1984; Haggerty et al., 1975; Kelleher et al., 2000). The primary care setting is important for identifying and managing these disorders (Burns et al., 1995, 1997) because most children make at least one primary care visit each year. Moreover, those with psychosocial problems are more likely to see generalists than mental health specialists. Unfortunately, children frequently do not receive appropriate mental health treatments or referrals to specialists from the primary care clinician (PCC) (Costello et al., 1988b; Gardner et al., 2002b; Hoagwood et al., 2000; Horwitz et al., 1992). One reason why children do not receive appropriate care is underidentification and inaccurate diagnosis by the PCC (Angold et al., 2000; Costello, 1986; Kelleher et al., 1997).

Several authors recommend the use of screens or brief assessment tools to improve the identification and assessment of pediatric mental disorders in primary care (Cassidy and Jellinek, 1998; Grayson and Carlson, 1991). However, previous work with a nationally representative sample of youths seen in primary care offices showed that PCCs rarely use diagnostic tools or apply standard psychiatric diagnostic criteria to their

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patients (Gardner et al., 2003, 2004). When such tools are used, it is generally to confirm the PCC's initial impression or to monitor treatment outcomes. Moreover, despite primary care being specifically targeted as a site to improve pediatric mental health services, little work has been done to validate available psychosocial screens in that setting using standardized psychiatric interview assessments, the current diagnostic gold standard.

The Pediatric Symptom Checklist (PSC; Jellinek et al., 1979, 1986, 1988, 1999) is a parent-completed scale developed as a measure of child functioning, and subsequently used as a screen for symptoms of emotional and behavioral disorders. The PSC-17 (Gardner et al., 1999) is a short form of the PSC with three subscales measuring common childhood Attention, Externalizing (i.e., disruptive behavior), and Internalizing (i.e., depression and anxiety) problems. The PSC-17 has been used successfully in primary care (Borowsky et al., 2003). It has also been validated in specialty mental health settings against established self- and parent-report questionnaires (Gardner et al., 1999).

This study examined whether the 17-item PSC (PSC-17), when completed by parents in a primary care setting, detected common pediatric mental health problems diagnosed using a standardized psychiatric research interview. We also examined how well the PSC-17 identified youths with psychosocial impairment, in which impairment was rated by either a psychiatrist or a parent. We evaluated the PSC-17 by comparing it against the performances of other widely accepted instruments.

METHOD

Participants/Subjects

We used a convenience sample of 269 children and adolescents ages 8 to 15 years who consecutively presented at primary care offices for well-child care, the evaluation of recurrent abdominal pain, or the assessment and management of other minor illnesses (e.g., nonfebrile viral illnesses, minor injuries, rashes). Youths were seen in five practices (two rural, two suburban, and one urban) operating at seven sites, all participating in a western Pennsylvania practice-based research network.

The subjects were participants in two studies that used a common screening methodology and assessment battery approved by the Human Rights Committee of the Children's Hospital of Pittsburgh. The first study (N = 151), Anxiety and Recurrent Abdominal Pain, examined the association between pediatric recurrent abdominal pain and psychopathology. The second study, Effectiveness of On Site Mental Health Services in Pediatric Primary Care (N = 118), assessed mental health service use by youths considered at risk of anxiety or depression.

Procedure

Recruitment procedures and psychiatric research assessments for the two studies were virtually identical and were completed by the same research team. While waiting for a primary care office visit, the parent completed a screening packet that included the PSC-17 as part of routine care. About 2 weeks after the initial screen, subsamples of families were called by a research associate and invited to participate in the study. Families either returned to the practice or came to our research office. "At risk" in the Effectiveness of On Site Mental Health Services in Pediatric Primary Care study meant that the child had screened positive on the Short Mood and Feelings Questionnaire or on the five-question version of the Screen for Child Anxiety Related Emotional Disorders (SCARED) or parents had checked "yes" when asked whether they were worried that their child was anxious or depressed. There they provided an informed consent, completed a semistructured psychiatric interview, and completed several child- and parent-report questionnaires. The research interviewer was blind to PSC-17 screening status and interviewed the parent(s) first, then the child alone, followed by meeting with parent(s) and child to resolve any areas of discrepancy.

Families were selected for the two studies based on positive screening results for the conditions of interest for each study: children with abdominal pain and normal controls in study 1 (Campo et al., 2004, 2006) and children at risk for anxiety and depression in study 2. Therefore, our sample includes more children with psychosocial problems, particularly anxiety and depression, than would be found in an unselected primary care sample.

Across the two studies, 5,566 children were screened. Children were recruited to participate either because they had health problems that qualified them for the studies (study-eligible children) or to serve as pain-free controls in the abdominal pain sample. Based on the screen, 354 children were study-eligible (6.4% of those screened) and 2,140 were eligible to serve as controls in the abdominal pain sample (38.5% of those screened). We were able to contact 243 study-eligible children about participation in the research (68.6% of study-eligible), of whom 52 either refused participation or did not show up for their interviews (21.4%). Hence, 191 study-eligible patients participated. Unfortunately, we are unable to provide information on approaches and refusals for the 78 participants who served as controls within the abdominal pain sample. We could not locate data documenting approaches and refusals for these patients, although it was our impression that contact and refusal rates were similar to those for other patients in this study.

Measures

Screens. In addition to the PSC-17 and its subscales (Gardner et al., 1999), the study included other self- and parent-report measures of child psychopathology that have been used for screening. The SCARED (Birmaher et al., 1997; Hale et al., 2005) is a 41-item instrument with child self-report and parent proxy-report versions. Symptom severity is rated over the prior 3 months on a 3-point (0–2) rating scale. The SCARED was completed at the time of the psychiatric assessment interview. To define a positive screen result, we used a SCARED ≥25 (Boris Birmaher, M.D., developer of the SCARED, personal communication, 2005). The Children's Depression Inventory (CDI; Kovacs, 1985) is a 27-item self-report inventory of depressive symptoms in children. The CDI was

completed by the child at the time of the psychiatric interview. To define a positive screen result, we used CDI score ≥19 (Kovacs, 1992). Finally, the Child Behavior Checklist (CBCL; Achenbach, 1997) is a 118-item parent-report questionnaire generating many scaled scores. In this study we used the Aggressive Behavior, Anxious-Depressed, Attention Problems, Externalizing, Internalizing, and Total Problems scores. To define a positive screen result, we used the *T* score value of ≥67, which defines a borderline clinical case in the CBCL scoring manual.

Psychiatric Diagnosis. Diagnoses were determined using the Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime version (K-SADS-PL; Ambrosini, 2000; Kaufman et al., 1997). The K-SADS interviewers were bachelor's degree–level staff trained by senior staff at the Advanced Center for Intervention and Services Resources for Early-Onset Mood and Anxiety Disorder at the Department of Psychiatry at the University of Pittsburgh, where the K-SADS was developed. Interviewers were trained using standard videotapes maintained by the Advanced Center for Intervention and Services Resources. Reliability meetings were held monthly, again using standard videotapes. The K-SADS involves an interview with the child and parent, and then the formation of a consensus diagnosis based on both. Dr. Campo reviewed all of the interviews and met with the interviewers to determine the consensus diagnoses. K-SADS-PL diagnoses were "definite," meaning that subjects needed to meet full diagnostic criteria according to the *DSM-IV* (American Psychiatric Association, 2000).

Psychiatric Impairment. The clinician who administered the K-SADS-PL interview also rated current global mental health functioning using the Children's Global Assessment Scale (Shaffer et al., 1983). The parent also completed the 13-item Columbia Impairment Scale (Bird et al., 1993).

Data Analysis

All of the analyses were based on combining results from five imputations of missing data using the Rubin EM algorithm method (Rubin, 1976; Schafer, 1997) implemented in the SAS procedures MI and MIANALYZE. We used receiver operating characteristics (ROC) curve analyses to assess the accuracy with which current K-SADS diagnoses were identified by the PSC-17 subscales and the comparison screens (McNeil and Hanley, 1984; Swets, 1988). For each possible cut score on a screen, we calculated the true positive rate (i.e., the sensitivity or the proportion of cases as defined by the K-SADS that were also identified by the screen) and the false-positive rate (i.e., specificity or the proportion of noncases as defined by the K-SADS that were identified as cases by the screen). The ROC curve is the line defined by this set of pairs. We used SAS PROC LOGISTIC to calculate the area under the curve (AUC) for the ROC curve. AUC = 1.0 is perfect prediction, whereas AUC = 0.5 is chance-level prediction. The ROC analyses assessed how well the screens functioned across the spectrum of possible cut scores defining positive cases.

We also calculated the sensitivity, the proportion of K-SADS-PL–diagnosed cases that screened positive, that is, $\hat{P}(S^+|D^+)$, and specificity, the proportion of children without a given diagnosis that screened negative, that is, $\hat{P}(S^-|D^-)$, of each screen. We evaluated each screen at the cut score identified by the screen's developer as identifying a positive case. By definition, these statistics are independent of the prevalence, $P(D^+)$, of a disorder in a sample.

Finally, we estimated the positive predictive value (PPV, the proportion of cases screening positive that have a diagnosis) and the negative predictive value (NPV, the proportion of cases screening negative that lack the diagnosis) of each test. The PPV and NPV will vary depending on the prevalence of a diagnosis in a population. Because our sample includes more positive cases than would typically be found in primary care, the PPVs and NPVs calculated directly from our data are biased estimates of their values in unselected primary care samples. Therefore, instead of reporting our sample estimates of PPV and NPV, we calculated projected values by combining our estimated sensitivities and specificities with prevalences of disorders that were more likely to be found in primary care:

$$PPV = \hat{P}(D^+|S^+) = \frac{P(D^+)\cdot\hat{P}(S^+|D^+)}{P(D^+)\cdot\hat{P}(S^+|D^+) + (1-P(D^+))\cdot(1-\hat{P}(S^-|D^-))}$$

$$NPV = \hat{P}(D^-|S^-) = \frac{(1-P(D^+))\cdot\hat{P}(S^-|D^-)}{(1-P(D^+))\cdot\hat{P}(S^-|D^-) + P(D^+)\cdot(1-\hat{P}(S^+|D^+))}.$$

We calculated projected PPV and NPV for prevalence levels ranging from 5% to 15%, reflecting the range of prevalences for attention-deficit/hyperactivity disorder (ADHD), major depression, conduct disorder, or oppositional defiant disorder reported in epidemiological studies (see Figure 1 in Costello et al., 2005).

RESULTS

Table 1 presents sample demographics, means, and SDs for the screens, the rates of diagnoses, and rates of missing data for each measure. Thirty percent of children had a positive PSC-17 Total score, 15% were positive on the Attention subscale, 20% on the Externalizing subscale, and 36% on the Internalizing subscale. The PSC-17 was normed to generate 10% positive cases on each subscale in an unselected primary care sample (Gardner et al., 1999). The rates of missing data were higher for the CBCL subscales primarily because it was the last item of an extensive research interview and some families were unable to stay until the end of the interview.

Table 2 presents our scheme for partitioning K-SADS-PL diagnoses into categories that correspond to the global screening objectives of the PSC-17.

AUCs for the ROC Curves for K-SADS-PL Disorders

Table 3 presents the AUCs (and 95% CIs around the AUCs) for the prediction of global categories of K-SADS-PL diagnoses using the PSC-17 and the comparison screens. For each K-SADS-PL diagnosis, the PSC-17 and the comparison screens performed similarly. The only statistically significant difference was that for the K-SADS-PL Anxiety Disorder subscale, the AUC for the parent-completed SCARED was greater than the PSC-17 Internalizing AUC. In general,

TABLE 1
Sample Demographics and Clinical Data

Variable	Frequencies or Mean, SD	% Missing Data
Demographics		
Age	$\bar{X}$ = 8.1 y, SD 2.1	<1
Race	90% white, 6% black, 4% other	<1
Gender	53% female	<1
PSC-17 score		
Total	$\bar{X}$ = 11.4, SD 7.3	3
Attention	$\bar{X}$ = 3.6, SD 2.8	3
Externalizing	$\bar{X}$ = 3.9, SD 3.2	3
Internalizing	$\bar{X}$ = 3.8, SD 2.8	3
Other screens		
CDI	$\bar{X}$ = 7.8, SD 7.6	4
SCARED Child	$\bar{X}$ = 17.9, SD 13.1	3
SCARED Parent	$\bar{X}$ = 15.9, SD 12.4	5
Impairment scales		
CGAS	$\bar{X}$ = 70.7, SD 16.8	3
CIS	$\bar{X}$ = 10.1, SD 9.2	5
CBCL *T* scores		
Anxious/Depressed	$\bar{X}$ = 57.5, SD 8.8	14
Attention Problems	$\bar{X}$ = 55.2, SD 9.0	14
Aggressive Behavior	$\bar{X}$ = 55.2, SD 8.4	15
Externalizing	$\bar{X}$ = 49.8, SD 12.2	15
Internalizing	$\bar{X}$ = 55.9, SD 12.8	16
Total score	$\bar{X}$ = 53.1, SD 12.8	16

Note: PSC-17 = Pediatric Symptom Checklist-17 item version; CDI = Child Depression Inventory; SCARED = Screen for Child Anxiety-Related Emotional Disorders; CGAS = Children's Global Assessment Scale; CIS = Columbia Impairment Scale; CBCL = Child Behavior Checklist.

the AUCs for K-SADS-PL ADHD and Externalizing Disorder were greater than the AUCs for K-SADS-PL Depression, Anxiety, and Internalizing Disorder.

Sensitivities, Specificities, PPVs, and NPVs

Table 4 presents the sensitivity, specificity, PPV, and NPV for each screen at the clinical cutoffs specified by the screen's developer. The sensitivities of all of the screens were moderate to low. Among the PSC-17 subscales the Attention subscale had particularly low sensitivity. Because the PSC-17 Attention and Externalizing subscales had strong AUCs, we wondered whether the low sensitivity may result from too high a cut score. We therefore calculated sensitivities and specificities for the PSC-17 subscales using lower cut scores, and Table 4 presents the resulting increased sensitivities.

For low-risk primary care populations, the projected PPVs were low, but they increased for higher risk populations. The projected NPVs of tests were high (usually ≥0.97) when the primary care population was low risk (prevalence 5%) and fell to about 0.90 in high-risk populations (prevalence 15%). Increasing the sensitivity of the PSC-17 subscales by lowering their cut scores further reduces further reduces their PPVs.

Correlation With Impairment Measures

The PSC-17 Total score correlated with the Columbia Impairment Scale (r = 0.74; 95% CI 0.67–0.79) as well as the CBCL Total Score with the Columbia Impairment Scale (r = 0.72; 95% CI 0.65–0.77); the difference between these correlations was not statistically different (p = .10). Similarly, the PSC-17 Total score correlated with the CGAS (r = −0.64; 95% CI −0.71 to −0.55) as well as the CBCL Total Score (r = −0.60; 95% CI −0.67 to −0.52); again, the correlations were not statistically different (p = .11).

DISCUSSION

No single statistic captures the psychometric quality of an instrument. This is true in part because psychometric quality is multidimensional and, in part, because the utility of an instrument varies depending on the context in which it is deployed. Our results showed that the screens that we examined varied in their sensitivity, specificity, PPV, and NPV. By examining these results, clinicians can identify the instrument that is most useful for their specific patient population.

With some important caveats, these results supported the validity of the PSC-17 as a screen for several common pediatric mental disorders in primary care. The PSC-17 Externalizing subscale performed well in detecting externalizing disorders in the pediatric primary care setting. The PSC-17 Attention subscale had low to moderate sensitivity and higher specificity in detecting ADHD. In addition, the PSC-17 Total score was as good a predictor of functional status and impairment associated with mental health problems as the CBCL Total score.

The PSC-17 Internalizing subscale also performed well as a screen for depression. This was especially striking given that it is parent completed. Counter to our expectations that youth self-report would prove superior, the parent-completed PSC-17 Internalizing

TABLE 2
K-SADS-PL Global Diagnostic Categories Defined in Terms of K-SADS-PL Diagnoses, With Frequencies of Cases

Category	K-SADS-PL Diagnoses	Frequency
Depressive disorders	Major depressive disorder, dysthymia, or depressive disorder NOS	61 (23%)
Anxiety disorders	Panic disorder, separation anxiety disorder, avoidant disorder of childhood, simple phobia, social phobia, agoraphobia, overanxious disorder, generalized anxiety disorder, obsessive compulsive disorder, or posttraumatic stress disorder	112 (42%)
Internalizing disorders	Depressive disorders and/or anxiety disorders	129 (48%)
Externalizing disorders	Conduct disorder, oppositional defiant disorder, adjustment disorder with disturbance of conduct, adjustment disorder with mixed mood and conduct	49 (18%)
ADHD	ADHD	36 (13%)
No. of diagnoses		
0		118 (44%)
1		81 (30%)
2		43 (16%)
≥3		27 (10%)

Note: K-SADS-PL = Schedule for Affective Disorders and Schizophrenia for School-Age Children–Present and Lifetime version; NOS = not otherwise specified; ADHD = attention-deficit/hyperactivity disorder.

TABLE 3
AUCs for the Identification of K-SADS-PL Diagnoses Using Screens

Diagnosis	Screen	AUC	CI	*p*
ADHD	CBCL Attention	0.88	0.80–0.96	.88
	PSC-17 Attention	0.86	0.78–0.94	—
Externalizing disorders	CBCL Aggressive	0.90	0.84–0.96	.55
	CBCL Externalizing	0.90	0.84–0.96	.63
	PSC-17 Externalizing	0.87	0.80–0.93	—
Anxiety disorders	SCARED (Parent)	0.79	0.73–0.84	.045
	CBCL Internalizing	0.76	0.70–0.82	.17
	CBCL Anxious-Depressed	0.76	0.69–0.82	.20
	SCARED (Child)	0.74	0.68–0.80	.22
	PSC-17 Internalizing	0.68	0.62–0.75	—
Depression	PSC-17 Internalizing	0.80	0.73–0.88	—
	CDI	0.78	0.70–0.85	.74
	CBCL Anxious-Depressed	0.77	0.69–0.85	.63
Internalizing disorders	SCARED (Parent)	0.78	0.72–0.83	.27
	CBCL Internalizing	0.78	0.73–0.84	.28
	CBCL Anxious-Depressed	0.77	0.71–0.83	.40
	PSC-17 Internalizing	0.73	0.67–0.79	—
	CDI	0.73	0.67–0.79	.86
	SCARED (Child)	0.73	0.67–0.79	.77
Any diagnosis	CBCL Total	0.78	0.72–0.84	—
	PSC-17 Total	0.74	0.68–0.80	.47

Note: AUC = area under the curve; PSC-17 = Pediatric Symptom Checklist-17 item version; SCARED = Screen for Child Anxiety-Related Emotional Disorders. The *p* value is the significance of the comparison of the screen's AUC to the PSC-17's AUC for that diagnosis. For all of the screens, the test of H_0: AUC = 0.5 was significant, $p < .0001$.

TABLE 4
Sensitivities, Specificities, PPVs, and NPVs

				PPV		NPV	
K-SADS Dx	Screen	Sens	Spec	5%	15%	5%	15%
ADHD	PSC-17 Attention (≥7)[a]	0.58	0.91	0.25	0.53	0.98	0.92
	PSC-17 Attention (≥6)[b]	0.67	0.82	0.17	0.40	0.98	0.93
	PSC-17 Attention (≥5)[b]	0.88	0.72	0.14	0.36	0.99	0.97
	CBCL Attention	0.68	0.90	0.26	0.55	0.98	0.94
Anxiety	PSC-17 Internalizing (≥5)[a]	0.52	0.74	0.10	0.26	0.97	0.90
	PSC-17 Internalizing (≥4)[b]	0.65	0.62	0.08	0.23	0.97	0.91
	SCARED (Child)	0.44	0.89	0.17	0.41	0.97	0.90
	SCARED (Parent)	0.44	0.92	0.22	0.49	0.97	0.90
	CBCL Internalizing	0.42	0.88	0.16	0.38	0.97	0.90
	CBCL Anxious/Depressed	0.37	0.92	0.20	0.45	0.97	0.89
Depression	PSC-17 Internalizing (≥5)[a]	0.73	0.74	0.13	0.33	0.98	0.94
	PSC-17 Internalizing (≥4)[b]	0.86	0.61	0.10	0.28	0.99	0.96
	CBCL Anxious/Depressed	0.61	0.87	0.20	0.45	0.98	0.93
	CBCL Internalizing	0.58	0.87	0.19	0.44	0.98	0.92
	SCARED (Child)	0.50	0.83	0.13	0.34	0.97	0.90
	SCARED (Parent)	0.44	0.83	0.12	0.31	0.97	0.89
	CDI	0.27	0.96	0.26	0.54	0.96	0.88
Internalizing	PSC-17 Internalizing (≥5)[a]	0.54	0.80	0.12	0.32	0.97	0.91
	PSC-17 Internalizing (≥4)[b]	0.67	0.67	0.10	0.26	0.97	0.92
	SCARED (Child)	0.42	0.91	0.20	0.45	0.97	0.90
	CBCL Internalizing	0.41	0.91	0.19	0.45	0.97	0.90
	SCARED (Parent)	0.40	0.93	0.23	0.50	0.97	0.90
	CBCL Anxious/Depressed	0.36	0.95	0.27	0.56	0.97	0.89
	CDI	0.16	0.97	0.22	0.48	0.96	0.87
Externalizing	PSC-17 Externalizing (≥7)[a]	0.62	0.89	0.23	0.50	0.98	0.93
	PSC-17 Externalizing (≥6)[b]	0.73	0.83	0.18	0.42	0.99	0.96
	PSC-17 Externalizing (≥5)[b]	0.83	0.68	0.12	0.31	0.99	0.96
	CBCL Aggression	0.50	0.95	0.34	0.64	0.97	0.92
	CBCL Externalizing	0.46	0.95	0.33	0.62	0.97	0.91
Any Dx	PSC-17 Total (≥15)[a]	0.42	0.86	0.14	0.35	0.97	0.89
	PSC-17 Total (≥14)[b]	0.50	0.83	0.13	0.33	0.97	0.90
	PSC-17 Total (≥13)[b]	0.57	0.78	0.10	0.26	0.97	0.91
	CBCL Total	0.31	0.96	0.29	0.58	0.96	0.89

Note: Dx = diagnosis; Sens = Sensitivity; Spec = Specificity; PPV = positive predictive value; NPV = negative predictive value. SCARED = Screen for Anxiety-Related Emotional Disorders; PSC-17 = Pediatric Symptom Checklist-17 item version. The columns for 5% and 15% indicate the range of PPV and NPV values associated with these prevalences of disorders.

[a] PSC-17 Attention ≥7, PSC-17 Internalizing ≥5, PSC-17 Externalizing ≥7, and PSC-17 Total ≥15 are the standard cut scores for a positive screen.

[b] These are alternative PSC-17 cut scores for positive screens.

subscale performed as well as the child-completed CDI as a screen for depressive disorders. The PSC-17 was less accurate for anxiety disorders. The most likely explanation is that only one question in the PSC-17 is directed toward "worry."

In summary, although many screening measures have been developed for specific psychiatric disorders such as anxiety or depression, most have not been extensively studied or validated in the primary care setting. Among the strengths of our study is that patients were recruited from and screened in working pediatric primary care offices. Moreover, although the original PSC has been administered and validated in primary care settings, it had not been validated using a standardized psychiatric interview assessment as the criterion standard. Our criterion measure was a widely accepted diagnostic interview, the K-SADS-PL, that was performed blind to completed screens and that incorporated information

from both the child and parent. The present study supports the validity of the PSC-17 as a screen for youth psychosocial impairment in primary care, but it also supported the ability of this brief 17-item screen and its subscales to identify youths with ADHD, disruptive behavior disorders, and depression in primary care. This is noteworthy because the PSC-17 asks fewer questions than most disorder-specific screens.

There are some important caveats to our endorsement of the PSC-17. All of the screens evaluated were less sensitive than we expected, including the PSC-17. Although we believe that routine screening in primary care settings would improve practice, some children with disorders would still be missed. One reason for the screens' lack of sensitivity is that parents are sometimes poorly informed about their children's problems or unwilling to acknowledge or disclose them (similar concerns apply to screens based on child self-reports). These problems produce many false-negative cases. The sensitivity of the PSC-17 scales can be improved by using lower screening cut scores, but with a cost in specificity and PPV. We stress that these alternate cut scores are merely suggestions. Further research is required to develop efficient yet accurate assessment tools.

When the prevalence of disorders is low, deficits in either sensitivity or specificity will result in low PPV, meaning that many children identified as positive by screen would not be confirmed as positive by diagnostic interview. Low PPV is a significant problem in primary care practice because practitioners must use screens to make decisions about the use of scarce or expensive referrals to specialists. Bennett and Offord (2001) have further argued that a low PPV is problematic because it means that many identified children will be false-positive errors who are unnecessarily exposed to the risks of being labeled. This concern is valid; however, its implication for practice is that positive screening results should lead clinicians to further evaluate children, not to give them diagnostic labels.

Primary care is a demanding environment for screening because although assessments must be brief, low sensitivity or specificity in the context of low to moderate prevalence of disorders will result in low PPV. One strategy for improving the sensitivity and specificity of screens is computerized adaptive testing, in which the questions asked to parent or child are tailored to the respondent based on the answers previously given (Gardner et al., 2002a; Wainer, 2000). Adaptive tests ask few questions when patients are clearly classifiable as positive or negative cases, and conduct detailed questioning when patients are harder to classify.

Limitations

Unfortunately, diagnostic interviews such as the K-SADS-PL are themselves fallible indicators of child mental illness. When the gold standard is fallible, it degrades the apparent performance of the screen. In addition, this study analyzed data originally collected for other purposes, using participants in two studies that oversampled participants having an anxiety or depressive disorder. This selection bias meant that we could not estimate the PPVs or NPVs of the screens in primary care directly from the data. Instead, we projected the PPVs and NPVs that would occur for plausible values of the prevalence of disorder in primary care. Our patients did not include any 6- or 7-year-old children, even though the PSC is commonly used with children this young. Our sample was 90% white, which limits the generalizability of our findings to the nonwhite population. Finally, the study cannot tell us whether screening for mental health problems with the PSC-17 will lead to improved outcomes or cost-effective treatments. Similarly, we did not address whether existing mental health services in primary care could absorb or appropriately manage youths with identified mental disorders.

Clinical Implications

Our data show that the PSC-17 can screen for the most common pediatric mental disorders in primary care. Moreover, it measures child psychosocial impairment in a manner comparable to the widely accepted CBCL. It is less accurate for anxiety disorders. The brevity of the PSC-17 is advantageous because a collection of disorder-specific instruments or the comprehensive but long CBCL may be impractical to administer and score in primary care.

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REFERENCES

Achenbach TM (1997), *Child Behavior Checklist for Ages 4–18*. Burlington: University of Vermont, Department of Psychiatry

Ambrosini PJ (2000), Historical development and present status of the Schedule for Affective Disorders and Schizophrenia for School-Age Children (K-SADS). *J Am Acad Child Adolesc Psychiatry* 39:49–58

American Psychiatric Association (2000), *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV)*. Washington, DC: American Psychiatric Association

Angold A, Erkanli A, Egger HL, Costello EJ (2000), Stimulant treatment for children: a community perspective. *J Am Acad Child Adolesc Psychiatry* 39:975–984

Bennett KJ, Offord DR (2001), Screening for conduct problems: does the predictive accuracy of conduct disorder symptoms improve with age? *J Am Acad Child Adolesc Psychiatry* 40:1418–1425

Bird HR, Shaffer D, Fisher P et al. (1993), The Columbia Impartment Scale (CIS): pilot findings on a measure of global impairment for children and adolescents. *Int J Methods Psychiatr Res* 3:167–176

Birmaher B, Khetarpal S, Brent D et al. (1997), The screen for child anxiety related emotional disorders (SCARED): scale construction and psychometric characteristics. *J Am Acad Child Adolesc Psychiatry* 36:545–553

Borowsky IW, Mozayeny S, Ireland M (2003), Brief psychosocial screening at health supervision and acute care visits. *Pediatrics* 112:129–133

Briggs-Gowan MJ, Horwitz S, Schwab-Stone ME, Leventhal JM, Leaf PJ (2000), Mental health in pediatric settings: distribution of disorders and factors related to service use. *J Am Acad Child Adolesc Psychiatry* 39:841–849

Burns B, Costello E, Angold A et al. (1995), Children's mental health service use across service sectors. *Health Aff* 14:147–159

Burns B, Costello E, Erkanli A, Tweed D, Farmer E, Angold A (1997), Insurance coverage and mental health service use by adolescents with serious emotional disturbance. *J Child Fam Studies* 6:89–111

Campo JV, Bridge J, Ehmann M et al. (2004), Recurrent abdominal pain, anxiety, and depression in primary care. *Pediatrics* 113:817–824

Campo JV, Bridge J, Lucas A et al. (2007), Physical and emotional health of mothers of youth with functional abdominal pain. *Arch Pediatr Adolesc Med* 161:1–7

Cassidy LJ, Jellinek MS (1998), Approaches to recognition and management of childhood psychiatric disorders in pediatric primary care. *Pediatr Clin North Am* 45:1037–1052

Costello EJ (1986), Primary care pediatrics and child psychopathology: a review of diagnosis, treatment, and referral practices. *Pediatrics* 78: 1044–1051

Costello EJ, Costello AJ, Edelbrock C et al. (1988a), Psychiatric disorders in pediatric primary care: prevalence and risk factors. *Arch Gen Psychiatry* 45:1107–1116

Costello EJ, Edelbrock C, Costello AJ, Dulcan MK, Burns BJ, Brent D (1988b), Psychopathology in pediatric primary care: the new hidden morbidity. *Pediatrics* 82:415–424

Costello EJ, Egger H, Angold A (2005), 10-year research update review: the epidemiology of child and adolescent psychiatric disorders: I. Methods and public health burden. *J Am Acad Child Adolesc Psychiatry* 44: 972–986

Gardner W, Kelleher KJ, Pajer KA (2002a), Multidimensional adaptive testing for mental health problems in primary care. *Med Care* 40:812–823

Gardner W, Kelleher KJ, Pajer KA, Campo JV (2003), Primary care clinicians' use of standardized tools to assess child psychosocial problems. *Ambul Pediatr* 3:191–195

Gardner W, Kelleher KJ, Pajer KA, Campo JV (2004), Primary care clinicians' use of standardized psychiatric diagnoses. *Child Care Health Dev* 30:401–412

Gardner W, Murphy M, Childs G et al. (1999), The PSC-17: a brief Pediatric Symptom Checklist including psychosocial problem subscales. A report from PROS and ASPN. *Ambul Child Health* 5:225–236

Gardner W, Pajer KA, Kelleher KJ, Scholle SH, Wasserman RC (2002b), Child sex differences in primary care clinicians' mental health care of children and adolescents. *Arch Pediatr Adolesc Med* 156:454–459

Goldberg I, Roghmann K, McInerny T, Burke J (1984), Mental health problems among children seen in pediatric practice: prevalence and management. *Pediatrics* 73:278–293

Grayson P, Carlson G (1991), The utility of a DSM-III-R-based checklist in screening child psychiatric patients. *J Am Acad Child Adolesc Psychiatry* 30:669–673

Haggerty RJ, Roghmann KJ, Pless IB (1975), *Child Health and the Community*. New York: Wiley

Hale WW 3rd, Raaijmakers Q, Muris P, Meeus W (2005), Psychometric properties of the Screen for Child Anxiety Related Emotional Disorders (SCARED) in the general adolescent population. *J Am Acad Child Adolesc Psychiatry* 44:283–290

Hoagwood K, Kelleher K, Feil M, Comer D (2000), Treatment services for children with ADHD: a national perspective. *J Am Acad Child Adolesc Psychiatry* 39:198–206

Horwitz SM, Leaf PJ, Leventhal JM, Forsyth B, Speechley KN (1992), Identification and management of psychosocial and developmental problems in community-based, primary care pediatric practices. *Pediatrics* 89:480–485

Jellinek MS, Evans N, Knight RB (1979), Use of a behavior checklist on a pediatric inpatient unit. *J Pediatr* 94:156–158

Jellinek MS, Murphy JM, Burns B (1986), Brief psychosocial screening in outpatient pediatric practice. *J Pediatr* 109:371–378

Jellinek MS, Murphy JM, Little M, Pagano M, Comer DM, Kelleher KJ (1999), Use of the Pediatric Symptom Checklist to screen for psychosocial problems in pediatric primary care: a national feasibility study. *Arch Pediatr Adolesc Med* 153:254–260

Jellinek MS, Murphy JM, Robinson J, Feins A, Lamb S, Fenton T (1988), Pediatric symptom checklist: screening school-age children for psychosocial dysfunction. *J Pediatr* 112:201–209

Kaufman J, Birmaher B, Brent D et al. (1997), Schedule for affective disorders and schizophrenia for school-age children-present and lifetime version (K-SADS-PL): initial reliability and validity data. *J Am Acad Child Adolesc Psychiatry* 36:980–988

Kelleher KJ, Childs GE, Wasserman RC, McInerney TK, Nutting PA, Gardner W (1997), Insurance status and recognition of psychosocial problems: a report from PROS and ASPN. *Arch Pediatr Adolesc Med* 151:1109–1115

Kelleher KJ, McInerny TK, Gardner W, Childs GE, Wasserman R (2000), Increasing identification of psychosocial problems: 1979–1996. *Pediatrics* 105:1313–1321

Kovacs M (1985), The Children's Depression Inventory (CDI). *Psychopharmacol Bull* 21:995–998

Kovacs M (1992), *Children's Depression Inventory*. North Tonawanda, NY: Multi-Health Systems

McNeil BJ, Hanley JA (1984), Statistical approaches to the analysis of receiver operating characteristic (ROC) curves. *Med Decis Making* 4:137–150

Rubin DB (1976), Inference and missing data. *Biometrika* 63:581–592

Schafer JL (1997), *Analysis of Incomplete Multivariate Data*. Boca Raton, FL: Chapman & Hall

Shaffer D, Gould MS, Brasic J et al. (1983), A Children's Global Assessment Scale (CGAS). *Arch Gen Psychiatry* 40:1228–1231

Swets JA (1988), Measuring the accuracy of diagnostic systems. *Science* 240:1285–1293

Wainer H (2000), *Computerized Adaptive Testing: A Primer*, 2nd ed. Hillsdale, NJ: Lawarence Erlbaum Associates