Soc Psychiatry Psychiatr Epidemiol (2002) 37: 553–560 DOI 10.1007/s00127-002-0561-8

ORIGINAL PAPER

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Dimensional measures of psychopathology
The probability of being classified with a psychiatric disorder using empirically derived symptom scales

Accepted: 5 April 2002

Abstract *Objectives* We sought to develop a ranking scheme that assigns a probability of having one of four psychiatric disorders to children based on their scores on a symptom scale. We then estimated the impact of each scale symptom on the prevalence of the disorder in the population. *Method* Logistic regressions were specified for ADHD, ODD, depressive, and conduct disorders using all the individual symptoms in the pertinent scale as predictors. Individual fitted values from the regression function then served as a probability scale measure. We combined the prevalence and influence of each scale symptom to calculate its overall impact on the prevalence of the disorder. *Results* Probability distributions had a wide range of values and discriminated between cases and non-cases. Those having a disorder were consistently associated with higher probabilities in the scale. The estimated probability corresponds to the empiric prevalence of the diagnosis in a group of persons sharing the same estimated probabilities. Symptoms varied on their impact on the prevalence of the disorder. *Conclusions* We recommend the estimated probability of the disorder based on the empirically defined scales as dimensional measures that complement prevalence of the disorder. Different symptoms are identified as targets for screening when selection is based on their impact on the prevalence of the disorder than when selection is based on the strength of the association with the disorder. We recommend using a common nosology with different classification schemes; the categorical definition of the disorder, the probability of having the disorder, and the impact of each symptom in the prevalence. Different measures serve different purposes.

Key words diagnosis – dimensional measures – probability of a disorder – symptom impact

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Introduction

There are trade-offs between dichotomous and dimensional approaches to the classification of psychiatric disorders. In this paper, we develop a classification scheme that acquiesces advantages associated with both types of classifications. The suggested method is a dimensional measure that tags a propensity score (the probability of having a disorder) to each child given their score on a scale. Furthermore, we also bring forth a measure of the relative importance of each symptom in predicting the disorder.

Disorders have been defined by the standard nosologies as dichotomous constructs. This definition restrains the classification to presence or absence of a disorder. There is no differentiation between subjects with no symptoms of the disorder and sub-threshold cases who meet most criteria. Thus, disregarding that there is a continuum of psychopathology in the population that is not captured by the use of these categorical measures of disorder. A system based on dimensional measures has the advantage of allowing a classification that can distinguish different levels within the same disorder and describe the path towards developing a diagnosis.

We believe that the concept of the probability of a disorder provides a budge between the dichotomizing nosology and the need for dimensional scales that can describe the spectrum of the disorder that is observed in the population. Moreover, with this approach it is also possible to capture the subtlety of disease evolution.

Furthermore, by keeping the information at a more desegregated level the impact of each symptom on the odds of having the disorder can also be estimated. The symptom impact measure combines strength of the as-

sociation and frequency of occurrence in the population to determine the extent to which each symptom affects the probability of the disorder in the population.

There are advantages to the nosological description of psychiatric disorder as a well-defined construct that is dichotomous in nature. A person has or does not have the disorder of interest. Psychiatrists in their clinical practice must provide the person with a diagnostic classification for treatment and for insurance purposes. But it is also important to acknowledge that everyone is potentially at risk of having a psychiatric disorder and some individuals have a higher probability than others for each specific disorder. There are signs and symptoms which are precursors or prodromal features of disorders that tell us how close a person is to meeting full diagnostic criteria.

Availability of a dichotomous classification does not obviate the need for dimensional measures. The field can now benefit from a combination of related dichotomous and dimensional measures that complement each other. There is no need to depart from the standard nosology to attain the degree of specificity provided by a continuous measure. Relating dimensional and categorical measures *of the same diagnostic entity* can improve our understanding of the psychopathology under study.

Researchers have used different approaches to address limitations in the dichotomous classification of mental health status. Kessler et al. (1997) suggested an ordinal approach to describe adult depression. They defined three distinct categories of the disorder based on the number of symptoms required for meeting criteria; namely, minor depression, intermediate major depression, and a higher level of major depression. Others have combined dichotomized scales with diagnostic classification (Jensen et al. l999).

Lack of a classification scheme that assigns a probability of having a psychiatric disorder can be explained by the dearth of paired continuous and dichotomous measures related to the *same* latent nosological construct. The field of psychiatric epidemiology depended, for a long time, on the use of scales to describe the mental health status of a population (Murphy 1995). There are several scales that serve as dimensional measures of psychopathology in children. The more widely used are those in the Child Behavioral Symptoms Checklist (Achenbach 1991). These are empirically defined scales for a set of items related to childhood psychopathology. However, each specific scale does not necessarily tap one specific disorder as described in the standard psychiatric nosologies. As a result, classification based on these scales generates disparity between clinical practice and population descriptions. Furthermore, prevalence estimates with continuous measures require a decision about a cut-off point. Different cut-off points generate different prevalence estimates.

A major breakthrough in the field was the development of structured diagnostic instruments which provide a classification for each individual based on a standard nosology. The first of these instruments was the Diagnostic Interview Schedule (DIS) (Robins 1981) followed by other structured instruments such as the Composite Diagnostic Interview (CIDI) (WHO 1993), and the Diagnostic Instrument for Children (DISC) (Shaffer 1996). However, these instruments, just as the nosology, provide a dichotomous classification. Individuals who meet *all* criteria for a specific disorder are classified as cases. Those who meet *some* criteria, or even *most* criteria, and those who *do not meet any* criteria are classified as non-cases.

Scales that tap unique diagnostic categories have been developed using DISC items.The first are empirically defined scales of symptoms that cluster together within a diagnostic category, without any a priori relation to the youth's final diagnostic status (Rubio-Stipec et al. 1996). They can be considered dimensional measures of a specific nosological construct. The disorder is the latent construct that each cluster of symptoms describe. On the other hand, the predictive scales, developed by Lucas et al., are defined as the symptoms that best predict the DISC disorder with impairment. The predictive scales perform well as a Quick-DISC (Lucas et al. in press). They produce a dichotomous classification with the minimum number of DISC symptoms required to maximize sensitivity.

In this paper, we will use the term "probability of a disorder" to mean the prevalence of the disorder in a group of persons who share an identified value in some relevant classification scheme. Thus, probability of a disorder as we use it depends crucially on the classification system. To the extent that for other similarly classed persons the suggested classification denotes an individual's prognosis, the probability of a disorder can help estimate a person's chance of reaching a specific diagnostic status and establish the degree of belief that a latent characteristic (the disorder) is present. We develop a ranking scheme that assigns a probability of having a psychiatric disorder to each child based on his/her score on a scale. We also estimate the impact of each scale symptom on the prevalence of the disorder.

Subjects and methods

Sample

The Methodological Epidemiology Catchment Area (MECA) was sponsored by the National Institute of Mental Health (NIMH) to study the psychometric properties of the Diagnostic Interview Schedule for Children (DISC), and related measures. Collaborating sites were Georgia, New Haven, New York, and Puerto Rico. Children were randomly selected in their household from specific communities in each site. The same survey and interviewing methods were used in the four sites. Lahey and colleagues (1996) describe these samples and the study's methodology in detail. Children and their primary caretakers were interviewed in their native language, either Spanish or English, by lay interviewers using a computer-assisted version of the NIMH Diagnostic Interview Schedule for Children (DISC 2.3) (Shaffer et al. 1996). The DISC is now the most widely used diagnostic instrument for children; it provides a diagnostic classification as defined in DSM nosology. At the time of the study, the DSM nosology was in its third

revised edition. The protocol used also included child's age, gender, family income, and the Children Global Adaptive Functioning Scale (CGAS) as a measure of the child's level of adaptive functioning. Table 1 describes the demographic characteristics of the total sample and Table 2 shows the diagnostic distribution, the mean values of the global impairment measure (CGAS), and the empirically defined scales in the sample.

The scales

To determine whether a child meets criteria for a disorder, the DISC elicits DSM symptoms with a set of questions, some of which are contingent upon a skip pattern. Using the questions from the DISC 2.3 that are not contingent upon a skip pattern, four empirically defined scales have been developed (Rubio-Stipec et al. 1996). The scales relate to depressive, ADHD, ODD, and conduct disorders. Anxiety disorders were not included, at this time, because the original empirical scales excluded them. The scales are available both for parents and children as informants and include the same symptoms independent of informant (scale symptoms appear in Tables 4–7). Each symptom in the scale is coded as either 0 (absent), or 1 (present); a strategy for coding the scale is the subject of this paper.

Table 1 Sample description

Characteristics	N	%
Gender		
Males	681	53
Females	604	47
Ages		
9–12	593	46.15
13–17	692	53.85
Annual household income		
< $10,000	195	15
$10,000 – $24,000	224	18
$25,000 – $64,000	533	42
$65,000 – $99,000	219	17
> $100,000	98	8
Primary Caretaker		
Biological mother	1,161	90.35
Other	124	9.65

Table 2 Sample description: diagnostic related measures

DISC Disorders	N	%
Conduct; parent informant	18	1.4
Conduct; youth informant	56	4.4
ADHD; parent informant	58	4.5
ADHD; youth informant	28	2.2
Oppositional defiant; parent informant	56	4.3
Oppositional defiant; youth informant	28	2.2
Depression; parent informant	40	3.1
Depression; youth informant	62	4.9
Dysthymia; parent informant	26	2.0
Dysthymia; youth informant	28	2.7
Continuous measures	**mean**	**sd**
Global assessment scale (CGAS)	85	12
Empirically defined scales		
Conduct; parent informant	0.2	0.6
Conduct; youth informant	0.6	1.1
ADHD; parent informant	3.0	5.0
ADHD; youth informant	3.9	4.9
Oppositional defiant; parent informant	1.4	1.9
Oppositional defiant; youth informant	1.5	2.0
Depressive; parent informant	2.9	3.6
Depressive; youth informant	4.9	4.6

Predicted probability

Each child was assigned a score for each disorder. This was his/her fitted probability of having the disorder. The value was drawn from a logistic regression in which all the pertinent scale values were predictors.

Statistical analyses

Logistic regressions were specified for each outcome (specific disorder) with all the individual symptoms in the pertinent scale as predictors. At first, all symptoms that define the scale were entered in the equation. Next, under the assumption that the presence of symptoms should increase, and never decrease, the probability of disorder, and symptoms with a negative association with the disorder were removed from the model and the regressions were re-estimated. To assess the predictive value of our model, the sample was jack-knifed at the individual level by removing one subject at a time, re-estimating the regression and predicting the probability of disorder for the omitted subject.

Finally, to estimate the role of each scale symptom in the prediction as a function of the strength of the association and prevalence in population samples, the impact of each symptom from the final regression coefficients was estimated using a formula analogous to that for attributable fraction in etiologic studies calculated $\{I = p(OR-1)/[p(OR-1)+1]\}$ where "I" is the impact, "p" is the prevalence of the symptom in the population, and "OR" is the anti-log of the corresponding regression coefficient (Kleinbaum et al. 1982).

Results

In Table 3, we describe the range of values of the predicted probability distributions and the prevalence of disorders at different values of the distribution. Most children had a low probability of the disorder. The distribution of the estimated probabilities of having the disorder ranged in value from 0.00 to 0.95 for ADHD and oppositional defiant disorder, when the parent was the informant, and from 0.00 to 0.67, when the youth was the informant. Wider ranges of values were observed for conduct and depressive disorders for both parents' and youths' estimated probabilities. Some children had probabilities for these disorders as low as 0.00, while for others the probabilities reached as high as 0.99.

The probability distribution discriminates between cases and non-cases. Lower prevalence rates of the disorder are observed at the lower end of the probability distribution and the percent of cases increases at higher levels of the probability score (Table 3). For example, there were 25 children who, based on the parent's report on ADHD, had a probability for the disorder between 0.25 and 0.50; actually 32 % of these children had ADHD (prevalence $9/25 = 0.32$). Children with a probability greater than 0.75 ($n = 29$) had a prevalence of the disorder of 0.72 (21/29)

Regressions with the probability scale as the dependent variable and known predictors of the disorder as independent variables produced similar findings as

Table 3 Range of values of the predicted probabilities of disorder and percent of cases at different levels of the estimated probability for each informant

Range of values of the predicted probabilities in the scale	Conduct		ADHD		ODD		Depressive	
	Parent	Youth	Parent	Youth	Parent	Youth	Parent	Youth
	0.0–0.99	0.0–0.99	0.0–0.95	0.0–0.68	0.0–0.95	0.0–0.67	0.0–0.99	0.0–0.99
Percent of cases at each level of the predicted probabilities								
Predicted probability values*	Conduct		ADHD		ODD		Depressive	
	Parent % (n)	Youth % (n)	Parent % (n)	Youth % (n)	Parent % (n)	Youth % (n)	Parent % (n)	Youth % (n)
0.00 < 0.01	0.4 (1,142)	0.4 (862)	0.0 (1,014)	0.4 (1,043)	0.0 (1,108)	0.2 (1,108)	0.1 (997)	0.1 (836)
0.01 < 0.25	2.9 (136)	5.8 (329)	11.4 (210)	6.5 (184)	13.5 (126)	9.8 (123)	8.4 (237)	8.3 (324)
0.25 < 0.50	50.0 (6)	32.5 (40)	32.0 (25)	27.3 (22)	27.3 (11)	25.9 (27)	39.1 (23)	42.9 (49)
0.50 < 0.75	75.0 (4)	53.3 (15)	31.3 (16)	50.0 (12)	36.8 (19)	41.7 (12)	45.0 (20)	40.6 (32)
0.75 +	66.7 (6)	78.6 (14)	72.4 (29)	– (0)	93.6 (31)	– (0)	72.2 (18)	75.0 (20)

* For each subject the predicted probability was based on a score derived from all other subjects

when the outcome was the disorder (data not shown). An exception was the probability of depression that failed to identify a gender effect with the parent's report.

Probabilities

Tables 4–7 describe the probability associated with each scale symptom in the absence of others and their estimated impact on the prevalence of the associated disorder. To guide the reader through our calculations we also show the estimated regression coefficients, the odds ratio, and prevalence rate of each scale symptom. We start by describing the predicted probabilities.

For conduct disorders (Table 4), symptoms with the highest associated probabilities were "robs" (both parent's and youth's report), "belongs to gangs" (parent's report), "initiates fights" (youth's report). For example, on average a child whose only conduct symptom is "robs", as reported by the parent, has a probability of 0.082 of having the disorder. Based on the child's report, "robs" has an associated probability which is lower than the parent's [0.018], but "robs" is still the symptom that most increases the probability of conduct disorder independent of the informant. For the remaining disorders results can be interpreted in a similar way.

For ADHD (Table 5), the items included in the final equation varied with the informant. Based on the parent's report, those with higher probabilities were "inattention at school", "restless", "cannot remain seated"; for the youth, they were "inattention at school", "squirms", and "restless". The probability of having ADHD given that the child's only symptom is inattention at school is 0.0169 based on the parent and 0.0738 based on the child.

For ODD (Table 6), the symptoms with higher associated probabilities were "refuses request", "loses temper" (both informants), "liar" (parent's report), and "resentful" (youth's report). The salient symptom in terms of the probability of ODD is "refuses a request", independent of the informant.

For depressive disorders (Table 7), "attention problems" followed by "feeling sad" were the symptoms with highest associated probabilities, whether the report was based on the parent or on the youth. The probability associated to attention problems was 0.006 when the informant was the parent and 0.002 when the informant was the youth. But for both informants attention prob-

Table 4 Regression coefficients, implied probability, odds ratios and impact* of each symptom in the conduct scale: parent and youth as informants

Informant	Parent					Youth				
Symptom	Regression coefficient	Implied probability	Odds ratio	Prevalence rate (%)	Impact %	Regression coefficient	Implied probability	Odds ratio	Prevalence rate (%)	Impact %
no symptom	–6.33	0.002	–	–	–	–5.49	0.004	–	–	–
robs	3.83	0.082	46.20	0.9	28.9	2.31	0.018	10.12	3.9	26.2
initiates fights	1.99	0.008	7.32	9.7	38.0	1.89	0.007	6.60	25.6	58.9
uses drugs	0.95	0.003	2.60	1.5	2.3	0.21	0.001	1.23	3.8	0.9
belongs to gangs	3.37	0.031	29.10	1.2	25.2	1.09	0.003	2.96	6.6	11.5
suspended	1.69	0.006	5.44	7.1	24.0	0.41	0.002	1.51	9.4	4.6
trouble if police found out	2.29	0.010	9.86	1.4	11.0	2.29	0.016	9.87	10.2	47.5

* in the absence of other symptoms

Table 5 Regression coefficients, implied probability, odds ratios and impact* of each symptom in the ADHD scale: parent and youth as informants

Informant	Parent					Youth				
Symptom	Regression coefficient	Implied probability	Odds ratio	Prevalence rate (%)	Impact %	Regression coefficient	Implied probability	Odds ratio	Prevalence rate (%)	Impact %
no symptom	−5.61	0.0036	–	–	–	−4.07	0.0168	0.02	–	–
squirms	0.08	0.0040	1.09	9.5	0.8	0.92	0.0411	2.51	25.8	28.0
fidgety	0.69	0.0073	2.01	9.7	8.9	0.40	0.0248	1.49	16.1	7.3
restless	1.18	0.0119	3.29	11.7	21.1	0.58	0.0296	1.79	23.2	15.4
cannot remain seated (school)	0.51	0.0061	1.68	8.6	5.5	0.41	0.0251	1.51	13.3	6.3
cannot remain seated (home)	1.36	0.0142	3.93	15.8	31.7	0.42	0.0253	1.52	6.8	3.4
easily distracted (school)	0.54	0.0047	1.28	18.2	4.9	**	**	**	–	**
easily distracted (home)	0.78	0.0080	2.20	15.8	16.0	0.10	0.0185	1.05	21.0	2.2
difficulty with instructions (school)	0.39	0.0054	1.49	12.0	5.6	0.20	0.0204	1.22	8.7	1.9
difficulty with instructions (home)	0.89	0.0089	2.46	16.3	19.2	0.25	0.0215	1.28	17.2	4.7
inattention (school)	1.54	0.0169	4.71	17.6	39.5	1.54	0.0738	4.66	13.5	33.1
stops and starts (school)	0.05	0.0038	1.06	7.4	0.5	**	**	**	**	**
loses things (school)	0.79	0.0080	2.20	11.9	12.5	0.56	0.0300	1.73	26.5	16.3
loses things (home)	0.13	0.0042	1.15	7.0	1.0	**	**	**	–	**
loses track (home)	0.21	0.0045	1.25	7.6	2.78	0.23	0.0201	1.26	10.7	2.7

* in the absence of other symptoms; **not in the final equation

Table 6 Regression Coefficients, Implied Probability, Relative Odds Ratios and Impact* of Each Symptom in the ODD Scale: Parent and Youth as Informants

Informant	Parent					Youth				
Symptom	Regression coefficient	Implied probability	Odds ratio	Prevalence rate (%)	Impact %	Regression coefficient	Implied probability	Odds ratio	Prevalence rate (%)	Impact %
no symptom	−11.3	0.00001	–	–	–	−10.7	0.00001	–	–	–
loses temper	2.41	0.00014	11.09	16.8	62.9	1.60	0.00005	5.0	18.8	42.6
argumentative	0.74	0.00003	2.09	31.0	25.3	1.35	0.00005	3.9	30.9	46.6
refuses request	3.98	0.00066	53.5	20.0	91.3	3.83	0.00006	46.1	21.2	99.9
bothers deliberately	2.00	0.00009	7.38	14.9	48.7	0.75	0.00003	2.1	17.2	16.11
blames others	1.71	0.00007	5.55	19.7	47.3	**	**	**	13.5	**
resentful	1.22	0.00004	3.38	22.1	34.5	1.95	0.00006	7.0	29.4	64.0
liar	1.82	0.00008	6.18	2.9	13.1	0.62	0.00003	1.9	5.5	4.5
spiteful	1.44	0.00005	4.21	4.8	13.4	1.21	0.00004	3.4	8.1	16.0
gets others in trouble	1.25	0.00004	3.48	3.7	8.4	0.08	0.00001	1.1	5.6	2.0

* in the absence of other symptoms; ** the item was not in the final equation

Table 7 Regression coefficients, implied probability, relative odds ratios and impact* of each symptom in the depressive scale: parent and youth as informants

Informant	Parent					Youth				
Symptom	Regression coefficient	Implied probability	Odds ratio	Prevalence rate (%)	Impact %	Regression coefficient	Implied probability	Odds ratio	Prevalence rate (%)	Impact %
no symptom	−7.18	0.001	0.00	–	–	−6.79	0.001	–	–	–
sad	1.64	0.004	5.14	32.0	57.0	1.54	0.005	5.87	40.5	59.8
anhedonia	1.55	0.004	4.74	9.7	26.6	1.53	0.005	4.26	16.0	36.7
hypersomnia	0.97	0.002	2.64	11.4	15.7	0.25	0.001	1.29	35.4	9.2
talkative	0.63	0.001	1.88	6.6	5.5	0.70	0.002	2.02	20.2	17.1
loss of energy	1.10	0.002	2.13	19.0	17.7	0.74	0.002	5.30	25.1	21.6
guilty	1.06	0.001	1.85	9.2	7.2	1.22	0.004	2.67	17.4	29.3
tearful	1.2	0.001	1.92	24.2	18.2	1.02	0.003	3.34	32.4	36.4
attention problems	2.02	0.006	7.39	24.1	60.6	0.80	0.002	10.58	31.5	27.7

* in the absence of other symptoms

lems was the symptom with the highest associated probability.

Impact

For conduct disorder (Table 4) the symptom with the highest impact is "initiates fights". The symptom with the highest associated probability is "robs", but this symptom does not occur frequently, prevalence is less than 1 %. On the other hand, "initiates fights" has a much lower associated probability (0.082 vs. 0.008, parent's report; 0.018 vs 0.007, youth's report), but it has a higher prevalence in the population (9.8 %; both reports). The impact on prevalence of the "initiates fights" symptom is much higher than for "robs", whether the report is based on the parent or on the youth (38 % vs. 29 %, parent's report; 59 % vs. 26 %, youth's report).

The symptom with the highest impact on the prevalence of ADHD was the same for both informants: "inattention at school" (Table 5). Estimated at approximately 40 % when based on the parent's report and approximately 33 % when based on the youth's report. For ODD (Table 6), "refuses a request" was the symptom with the highest impact whether based on the parent's report (91 %) or the youth's (99 %).

For depressive disorders (Table 7), "attention problems" weighed more on the probability when the report was based on the parent (60 %), and "feeling sad" when the report was based on the youth (60 %). Contrary to the parent's report, when the report was based on the youth, the symptom with the highest impact was not the one with the highest associated probability.

Discussion

We recommend the use of dimensional measures to supplement the prevalence of disorders when describing childhood psychopathology in a population. The predicted probabilities are short, simple tools that can be used in psychiatric epidemiology to describe the mental health status of children and to study the natural history of disorders. They correspond to the empiric prevalence of the diagnosis in a group of children sharing the same probability values. Furthermore, these estimated probabilities show concurrent validity, which increases our confidence that the latent construct behind the probability distribution is truly the disorder.

All symptoms in these scales add to the chance of having the disorder. The estimated probabilities identify those symptoms which constitute a bigger element in reaching a diagnostic status. Symptoms with higher estimated probabilities are those which in their absence more of other symptoms are required to qualify for the disorder. A person with many symptoms can have a lower probability of disorder than a person with only one symptom, if these were symptoms weakly associated with the disorder.

Our findings show distributions of estimated probabilities compatible with what is to be expected in a community sample; most children have low probabilities of having a disorder. In addition, those having a disorder are consistently associated with higher probabilities in the scale.

The probability distributions show a wide span of values. Had we found that there were just two sets of probabilities, very low (close to zero) and very high (close to 1), there would be no advantages associated to this new classification approach. As it is, we found that inquiring about few selected items in the DISC schedule provided adequate capacity to estimate the probability of the disorder. However, for children's report of ADHD and ODD in this sample, there were no patterns of responses that gave a high probability of these disorders. These findings are consonant with those reported by Jensen and Rubio-Stipec (1999) when they reviewed agreement between informants. Diagnoses confirmed by a single informant all reflected meaningful clinical conditions. Exceptions were child-only identified ODD and ADHD where caution is suggested as they might not reflect the full diagnostic condition. Our findings for these two scales based on the youth's report could also be interpreted as suggestive of scales that stay short of meeting full diagnostic criteria.

We also studied the effect that each symptom has on the prevalence of a disorder (symptom impact). When making public health decisions for the population, characteristics that seldom appear in the population are not very important even if they are highly predictive when they do appear. Characteristics which are highly prevalent but mildly predictive are also of lesser importance. An ideal measure should combine both properties. A measure of the impact of each symptom in accounting for the overall prevalence of the disorder in the population incorporates in its estimation both the prevalence of the disorder and the predictive capacity of the symptom. When children with these symptoms are identified and adequately treated, prevalence of the disorder can be notably reduced.

Symptoms have a big impact when they are highly prevalent in the population and strongly associated with the disorder. The impact measure is best seen as a guide to the importance of symptoms. Because many symptoms co-exist in the same person, and are correlated on a population level, and because multiple symptoms and signs are required to meet criteria for diagnosis, it is mathematically possible for the impacts of different symptoms to sum more than 100 %. In this respect, our use of symptom impact is exactly analogous to attributable fraction in the study of disease etiology.

The impact of each symptom within a diagnosis varied with disorder and with informant. For ADHD and ODD, selecting children based on the probability of disorder or on the attributable impact would have resulted in the same decision because symptoms with high associated probabilities were also highly prevalent in the population. However, measuring the symptom impact

on the prevalence of the disorder is still useful because it generates an estimate of the percent of children that would have been left out if the selection had excluded that symptom.

"Inattention" (based on the parent's report) is the symptom with the highest impact on depression. While for the child "feeling sad" weighs more on the prevalence of depression, it could be that a parent perceives as inattentive a child that is feeling sad. When screening for depressive children, if the respondents are children, we should focus on those reporting feeling sad, and when interviewing parents we should concentrate upon those reporting their children as inattentive.

A single symptom can appear as having high impact on more than one diagnosis. Cautionary note should be taken in clinical practice when making treatment decisions based on the presence of a specific symptom. For example, in our data set "inattention" was a symptom with high impact on two diagnoses, ADHD and depression. Medication should then be guided by the diagnosis and follow-up outcome and not solely by the presence of a symptom with high impact on prevalence.

Our analyses are hampered by lack of longitudinal data. We can only suggest a classification scheme for use in longitudinal studies. When longitudinal data are available, the proposed classification scheme can help us identify true prodromal symptoms among a set of precursors (Eaton et al. 1996). Another limitation is the lack of an additional sample to replicate our findings. However, we did not re-use the same individual in the regression that predicts his/her diagnostic status, we jackknifed at the individual level to reduce bias in assessing "predictiveness" of the model.

The discussion about the merits of using a categorical or a dimensional classification system has tended to assume an "either/or" character. However, dimensional measures can only be considered as inherently superior to categorical measures if the underlying construct is dimensional in nature (Shaywitz et al. 1992). When the nosology conceptualizes the diagnosis as a dichotomous construct, but the process towards developing a disorder as dimensional, the use of both classification systems can enhance our knowledge about the mental health status of children. A full description of mental health status of children should contain not only dichotomous measures, such as the diagnostic status, but dimensional measures such as the probability of reaching a specific diagnostic status.

These dimensional measures can be used in field trials to determine effects of treatment and to contrast outcomes of one vs. another intervention. They can provide us with a measure of change that is not dependent on a cut-off point. Quality of care can be seen as the change in the probability of having a disorder. In this instance, better treatment can be defined as that which generates greater reduction in the probability of having the disorder. Being short, and sensitive to small changes, they are suitable for longitudinal developmental studies. They could be the ideal measure for researchers.

Those making public health policies would be more interested in the estimation of the impact of each symptom in the prevalence of disorders. Their screening programs could focus on the symptoms that have the highest impact on prevalence. The symptom impact measure would make the most efficient determination of the target population for prevention.

Contingent on replication in other samples and other disorders, our findings suggest that researchers, public health officials, and practicing psychiatrists can base their decision-making on the same nosology. However, the classification scheme could use different approaches. Researchers would use the probability of having the disorder, decision-makers in public health would be interested in the symptom impact, and practicing psychiatrists the disorder.

We recommend using a common nosology with different classification schemes; the categorical definition of the disorder, the probability of having the disorder, and the impact of each symptom in the prevalence. Different measures serve different purposes.

Acknowledgements This research was supported by a grant (MH46732) from the National Institute of Mental Health (NIMH) as part of a collaborative methodologic epidemiologic study of children and adolescents (MECA) between Columbia University, Emory University, the University of Puerto Rico, Yale University, and the NIMH.

The MECA Program is an epidemiologic methodology study performed by four independent research teams in collaboration with staff of the Division of Clinical Research, which was reorganized in 1992 with components now in the Division of Epidemiology and Services Research and the Division of Clinical and Treatment Research, of the NIMH, Rockville, MD. The NIMH Principal Collaborators are Darrel A. Regier, MD, MPH, Ben Z. Locke, MSPH, Peter S. Jensen, MD, William E. Narrow, MD, MPH, and Donald S. Rae, MA; John E. Richters, PhD, Karen H. Bourdon, MA, and Margaret T. Rooper, MS. The NIMH Project Officer was William J. Huber. The Principal Investigators and Co-investigators from the four sites are as follows: Emory University, Atlanta, Georgia, UO1 MH46725: Mina K. Dulcan, MD, Benjamin B. Lahey, PhD, Donna J. Brogan, PhD, Sherryl Goodman, PhD, and Elaine W. Flagg, PhD; Research Foundation for Mental Hygiene at New York State Psychiatric Institute (Columbia University), New York, NY, UO1 MH46718: Hector R. Bird, MD, David Shaffer, MD, Myrna Weissman, PhD, Patricia Cohen, PhD, Denise Kandel, PhD, Christina Hoven, DrPH, Mark Davies, MPH, Madelyn S. Gould, PhD, and Agnes Whitaker, MD; Yale University, New Haven, Connecticut, UO1MH46717: Mary Schwab-Stone, MD, Philip J. Leaf, PhD, Sarah Horwitz, PhD, and Judith H. Lichtman, MPH; University of Puerto Rico, San Juan, Puerto Rico, UO1 MH46732: Glorisa Canino, PhD, Maritza Rubio-Stipec, Sc D, Milagros Bravo, PhD, Margarita Alegría, PhD, Julio Ribera, PhD, Sarah Huertas, MD, Michel Woodbury, MD, and Jose Bauermeister, PhD.

Dr. Garrett Fitzmaurice was fundet in part by NIMH grant R01-MH54693.

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