Psychiatric disorders in preschoolers: The structure of DSM-IV symptoms and profiles of comorbidity

Lars Wichstrøm

Department of Psychology

Norwegian University of Science and Technology

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NTNU Social Science

&

St. Olavs Hospital, Trondheim University Hospital

Turid Suzanne Berg-Nielsen

Faculty of Medicine

Norwegian University of Science and Technology

Address correspondence to Lars Wichstrøm, Department of Psychology, NTNU, N-7491, Trondheim, Norway. E-mail: lars.wichstrom@svt.ntnu.no.

Keywords: DSM-IV; preschool; psychiatric disorders; factor analysis; latent profile analysis

Short title: DSM-IV and preschoolers

Abstract

Psychiatric disorders have been increasingly recognized in preschool children; at present, however, we know comparatively less about how well current diagnostic manuals capture the symptoms described in this age group and how comorbidity is patterned. Therefore, this study aimed to investigate whether the symptoms defined by the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV) load on their respective disorders, examine whether individual symptoms exist that load particularly high or low on the disorder they allegedly define, and analyze how comorbidity clusters in individual children. Parents of a community sample of Norwegian 4-year olds (N=995) were interviewed using the Preschool Age Psychiatric Assessment. A confirmatory factor analysis (CFA) and a latent profile analysis (LPA) were performed on the symptoms of seven DSM disorders: attention-deficit/hyperactivity disorder (ADHD), oppositional defiant disorder, conduct disorder, major depressive disorder, generalized anxiety disorder, social phobia, and separation anxiety disorder. The results showed that the CFA solution that closely resembled the disorders delineated in the DSM-IV fitted the data best. However, vegetative symptoms did not define preschool depression. The LPA identified nine symptom profiles among preschoolers, of which four showed evidence of psychopathology: comorbid MDD/GAD + ADHD combined type, comorbid MDD/GAD + ADHD hyperactive/impulsive type, separation anxiety only, and social phobia only. In conclusion, the symptoms observed in preschoolers fit the DSM-IV well, and comorbidity followed specific patterns.

The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) [1] has no lower age limit with regard to when a diagnosis can be given, and studies that have applied DSM-IV diagnoses to preschoolers are steadily emerging [2,3]. Nevertheless, our knowledge concerning the nosology of preschool psychopathology lags far behind that of older children and adolescents. One of the key questions that arises is whether the diagnoses listed in the DSM-IV are applicable to very young individuals. Historically, many DSM diagnoses and their corresponding symptoms have been formulated from psychopathology in adults, adolescents and school-age children. As Egger and colleagues [3-5] summarized, several objections have been raised questioning the applicability of the DSM-IV to preschoolers. First, the rapid and simultaneous changes that occur in multiple domains during the preschool period preclude the reliable or valid clustering of symptoms. Second, normal variations in age-typical behavior (e.g., initiating physical fights) may wrongly be classified as symptoms (in this case of conduct disorder) and are therefore expected to correlate poorly with other age-atypical and supposedly genuine symptoms of the same disorder (e.g., physical cruelty to animals). Hence, certain symptoms that are appropriate for older children and adolescents may not work well for preschoolers. Third, the high comorbidity observed in preschoolers might indicate that syndromes are less differentiated at this age. Therefore, one might expect broad clusters of syndromes rather than specific disorders to emerge.

These objections can be addressed empirically. Previous research has demonstrated that psychiatric disorders can be reliably assessed in preschoolers [6-8], and other research suggests that these assessments have concurrent and predictive validity [9-11,7,12]. However, the second and third objections remain. The general findings from two previous factor analyses on U.S. preschoolers. [13,14] were that most DSM-IV symptoms loaded above the conventional criterion of .40 with regard to their respective disorders. Sterba et al. used data from a pediatric sample, and Strickland et al. used a mixed preschool and pediatric sample of 4-year-olds. However, evidence exists that the prevalence of mental disorders may be considerably lower among European preschoolers compared with U.S. preschoolers, at least in Scandinavia [8]. Because it has not been tested, we do not know whether the DSM-IV is equally applicable to European and U.S. samples. Therefore, additional studies must corroborate the findings from the U.S., preferably using community samples from other cultures, before a firm conclusion can be drawn concerning how well individual symptoms indicate the presence of these disorders in preschoolers.

One way of addressing the third objection (broad clusters versus narrowly defined disorders) is to investigate whether the symptoms of the various disorders listed in the DSM-IV load on their respective disorders in the way that the manual describes, whether syndromes appear undifferentiated, or do syndromes emerge in other age-typical ways? Using a semi-structured and interviewer-based diagnostic interview the Preschool Age Psychiatric Assessment; PAPA) [6], Sterba et al. found that the symptoms of major depressive disorder (MDD) and generalized anxiety disorder (GAD) could not be empirically separated and that the inattentive and hyperactive/impulsive symptoms of attention-deficit/hyperactivity disorder (ADHD) identified separate factors; otherwise, the factor structure inherent in DSM-IV

was replicated. Using a questionnaire that addressed DSM-IV symptoms, Strickland et al. basically replicated these findings, with the exception that MDD and GAD were differentiated. However, research using clinical samples of children with ADHD [15] has not confirmed the factor structure found in the above samples, thus which highlights the need to investigate the structure of DSM-IV symptoms in other than U.S. pediatric samples.

Comorbidity seems to be common among preschoolers, with as many as half of those with a disorder evidencing at least one other disorder [3]. Comorbidity is typically assessed as the co-occurrence of pairs of disorders. One study used a pairwise approach and found that when co-morbidity was present, oppositional defiant disorder (ODD) was typically involved [3], but this pattern was not replicated in another study [7]. However, children often suffer from more than two disorders [3]. In addition, the presence of symptoms at subclinical levels might increase the risk of one or several other disorders, an association that traditional comorbidity research does not capture. Although the problems are not severe enough to warrant a diagnosis, a child who has multiple problems may in fact experience considerable distress and impairment [16]. Hence, traditional pairwise comorbidity research must be supplemented with research regarding the broader patterns of comorbidity, including symptomatology at a subclinical level.

Traditional comorbidity research is *variable-oriented* and typically addresses the covariation between pairs of variables. An alternate way to investigate heterogeneity in syndromes is a *person-oriented* approach in which the focus is upon detecting specific groups of individuals [17]. Using statistical techniques such as cluster analysis, latent class analysis or latent profile analysis, researchers have addressed whether subgroups of older children and adolescents can be identified among those who have a specific *single* disorders such as attention-deficit/hyperactivity disorder (ADHD) [18], depression [19], eating disorders [20], and disruptive disorders [21]. However, such studies cannot determine the typical pattern of disorders at any given developmental period because only a narrow band of problems is addressed. Nevertheless, one study of school-aged children predominantly with ADHD measured other problems as well and identified six symptom profiles [22]. At present, no study has investigated the comorbidity profiles observed in preschoolers apart from those on pairwise associations between disorders.

Using a large, representative community sample of 4-year-olds, we first sought to determine whether a confirmatory factor analysis using the symptoms of MDD, GAD, social phobia (SOP), separation anxiety disorder (SAD), ADHD, ODD, and conduct disorder (CD) revealed a factor structure consistent with the DSM-IV. Second, we examined whether individual symptoms appeared to be weakly or unrelated to the respective underlying disorder. Third, using latent profile analysis we examine the typical patterning of co-occurrence of symptoms and determine the extent to which the children in the resulting groups are impaired by their symptoms as well as experience problems with peers and reduced prosocial behavior.

Methods

Participants and recruitment. All children born in Trondheim, Norway, from 2003 to 2004 and their parents were invited to participate. A letter of invitation and the Strengths and Difficulties Questionnaire (SDQ) [23] was sent to their homes (N=3,456). The overwhelming majority (n=3,358) attended their scheduled health checkup appointment for 4-year-olds at the city's well-child clinics. Parents without the proficiency in Norwegian needed to complete the SDQ screening were excluded (n=176). The health nurse at the well-child clinic informed the parents of the study using the procedures that the Regional Committee for Medical and Health Research Ethics approved and obtained written consent to participate. The staff at the well-child clinics missed asking 166 families to participate. In all, 2,475 of the 3,016 eligible parents consented to participate (82.1%). The SDQ scores on the symptom scales (20 items) were divided into four strata (cut-offs: 0-4, 5-8, 9-11, and 12-40). Using a random number generator, defined proportions of the parents in each stratum were drawn to participate in a structured diagnostic interview about their child's mental health (n=1,250). We interviewed 995 of these parents (79.5%). The drawing probabilities increased with increasing SDQ scores. The dropout rate after consenting at the well-child clinic did not differ across the four SDQ strata (χ^2=5.70, df=3, NS) or gender (χ^2=0.23, df=1, NS). For those children who were in center-based daycare (95.0%), the person who knew the child best at the daycare was asked to complete the SDQ (response rate=87.4%). The mean age of children was 53.0 months (range=46.3-63.0, SD=2.1). The biological mother was most often the informant (84.8%) at the interview, 58.3% had a college degree or higher, and all parents had at least completed compulsory education (i.e., the 9th grade). Parents were predominantly of Norwegian (93.0%) or Western (2.7%) origin. A majority (87.3%) of parents were married or had lived together for more than 6 months. The family's gross income was above 120,000 EUR in 26.7% of the cases, whereas 3.3% were below 30,000 EUR. The sample was compared with register information from Statistics Norway concerning all parents of 4-year-olds in Trondheim in 2007 and 2008. The sample contained significantly more divorced parents (7.6%) than the population (2.1%). Their educational level was virtually identical to that of the population.

The Preschool Age Psychiatric Assessment (PAPA)

The PAPA is a semi-structured psychiatric interview of parents about their 2- to 6-year-old children and covers a wide range of psychiatric disorders.[6] The PAPA uses a protocol with required questions and probes as well as optional follow-up questions. In addition, the interviewer ensures that the parents understand the questions and inform about the symptoms. Interviewers will continue to probe until there is enough information to decide whether the symptom is present at pre-specified level of severity. A three month primary period is used. In the DSM-IV, all ODD and some CD symptoms rely on normative evaluations of frequency (e.g., "Often argues with adults"). "Often" was defined *post hoc* as the highest 10% of the present population as determined by frequency counts. Symptoms deemed age-inappropriate are not asked (e.g., "Forced someone into sexual activity").

Interviewers (n=7) held at least a bachelor's degree in a relevant field. Regular meetings with the master coders and observations of the interviews behind two-way mirrors were conducted to ensure that all interviewers adhered to the

interview guide and avoided rater drift. On average, the interviews lasted for 2.25 hours (SD=.67). Blinded raters recoded 9% of the audio files containing interviews. The multivariate inter-rater reliabilities between pairs of raters were measured using intra-class correlations (ICCs) and are listed as follows: attention-deficit/hyperactive disorder, predominantly inattentive type (ADHD-I, 9 symptoms)=.94; attention-deficit/hyperactive disorder, predominantly hyperactive-impulsive type (ADHD-HI, 9 symptoms)=.97; ODD (8 symptoms)=.97; CD (8 symptoms)=.91; MDD (8 symptoms) =.90, GAD (7 symptoms)=.93; SOP (2 symptoms) =.95; and SAD (6 symptoms)=.90.

Ratings of impairment, peer problems and prosocial behavior

The SDQ contains an impact supplement and degree of distress. Both parents (alpha=.95) and daycare personnel (alpha=.98) completed this impact supplement. In addition, the PAPA includes an assessment of impairment (disability) across 19 areas of functioning that resulted from each group of symptoms, based on the World Health Organization's International Classification of Functioning, Disability and Health [24]. When a symptom was recorded present the potential resulting disability was evaluated in three different settings (home, day-care or other settings). An impairment score was computed to denote the number of settings with impairments (ICC=.86). The SDQ also contained rating scales of peer problems (parents α=.41; daycare personnel α=.62) and prosocial behavior (parents α=. 61 and daycare personnel α=.77)

Statistical analysis

Because we collected a stratified sample, all of the results were weighted back to represent true population estimates, and robust confidence intervals were obtained using the Huber-White sandwich estimator. All applicable symptoms for the eight syndromes (ADHD-I, ADHD-HI, ODD, CD, MDD, SOP, SAD, and GAD) were subjected to a confirmatory factor analysis (CFA) with categorical indicators (each symptom being present or absen) using a robust weighted least square estimator (WLSMV). Hence, the correlations are tetrachoric. Seven models were compared in the following order: 1) *Factor unity model*: a unity model in which all symptoms loaded onto one common factor; 2) *Internalizing versus externalizing model*: symptoms of anxiety loaded onto an internalizing factor, and symptoms of ADHD, CD and ODD loaded onto an externalizing factor; 3) *Externalizing and undifferentiated anxiety model*: one externalizing factor, one anxiety factor, and one MDD factor; 4) *Externalizing and differentiated internalizing model*: one externalizing factor, MDD and GAD loaded onto one factor, whereas SAD and SOP loaded on another factor; 5) *Externalizing and differentiated anxiety model*: one externalizing factor, MDD and SAD loaded onto one factor, whereas SOC and SEP loaded onto their respective factors; 6) *DSM-IV model with MDD and GAD combined*: all symptoms loaded onto their respective factors except MDD and GAD, which loaded onto a common factor; 7) *DSM-IV model with MDD and GAD combined, inattention and hyperactivity/impulsivity loading on separate factors*: similar to Model 6, except that inattention symptoms loaded onto one factor and hyperactivity/impulsivity symptoms loaded onto another; and 8) *overlapping symptoms model*: similar to Model 7, except that symptoms with similar wordings were

allowed to correlate. A certain level of comorbidity was built into the DSM-IV, such that some symptoms are present in more than one disorder or the symptoms of different disorders partially overlap. This comorbidity applies to (i) MDD symptom A4 “insomnia or hypersomnia” and GAD symptom C6 “sleep disturbance”; (ii) MDD symptom A8 “diminished ability to think or concentrate”, GAD symptom C3 “difficulties concentrating”, ADHD symptom A1b “difficulty sustaining attention”, and ADHD symptom A1h “easily distracted”; (iii) ODD symptom A5 “often blames others for his or her mistakes or misbehavior” and CD symptom A11 “often lies to obtain goods or favors or avoid obligations (i.e., “cons” others)”, and (iv) MDD symptom A1 “irritable mood”, ODD symptom A6 “touchy, easily annoyed”, and GAD symptom C4 “irritability”. Model 8 allowed these overlapping items to correlate.

Each model’s fit to the data was evaluated using the following fit indices: χ^2, the change in χ^2 from the previous model ($\Delta\chi^2$), the Comparative Fit Index (CFI), the Tucker-Lewis Fit Index (TFI), and the Root Mean Square Residual of Approximation (RMSEA). The CFI and TFI should exceed or equal .95, and the RMSEA should be less or equal to 0.05 to indicate an acceptable fit to the data. The applicability of individual symptoms was examined by inspecting the standardized factor loadings. Standardized loadings exceeding 0.40 were considered adequate.

In the person-centered approach to comorbidity, *children* are optimally grouped using their scores on various syndromes. The traditional way to classify children has been cluster analysis. This procedure has no readily available way to determine the optimal number of clusters. Mixture modeling, however, provides statistical tests to aid decisions concerning the optimal number of clusters. Latent profile analysis (LPA), a specific type of mixture modeling, has outperformed cluster analysis in several Monte Carlo simulation studies [25]. LPA examines the latent variables that represent subpopulations in which membership is unknown but inferred from the data. The classes differ in their means on the variables. LPA assigns membership based on probabilities; thus, it can account for membership uncertainty (i.e., error) [26].

A scale was constructed for each of the syndromes identified using the CFA that consisted of the number of symptoms fulfilled. Syndromes were allowed to correlate, but these correlations were fixed to be similar in each class. LPAs with one to 10 classes of profiles were conducted in Mplus 6.1 [27] using a robust maximum likelihood estimator. The following fit indicators were taken into account: Akaike Information Criterion (AIC), Bayesian Information criterion (BIC), sample size adjusted BIC, and entropy (i.e., the share of persons correctly classified compared with the share of persons not correctly classified. At present goodness-of-fit indices for mixture modeling have not been sufficiently established. As in exploratory factor analyses, interpretability and the size of classes must add to the statistical criteria [28].

Because we were studying infrequent phenomena in the population, several small groups were expected. Comparisons between the mean scores of impairment, peer problems and prosocial behaviors in the resulting groups were examined using a general linear model that applied an incremental Scheffé’s test for multiple comparisons.

Results

Symptom factor structure

The results for the eight alternate CFA models are shown in Table 1 along with the basic model.

/Table 1/

As Table 1 shows, a statistical improvement in model fit for each nested model. Specifically, increasing diversification of factors increased model fit except for MDD and GAD, whose symptoms loaded onto the same factor. Importantly, splitting the ADHD factor into inattentive and hyperactive/impulsive factors also increased model fit. Analysing the ADHD-I and ADHD-HI symptoms in either a hierarchical or bifactoral fashion [29] (not shown in Table 1) did not improve the fit. Nevertheless, the overall model fit of a solution that resembled the DSM-IV (with the exceptions of MDD and GAD loading onto a common factor and the splitting of ADHD into two factors; Model 7) was modest. However, when items with very similar wording (non-specific symptoms) were allowed to correlate, this modified DSM-IV model did fit the data well.

Performance of individual symptoms

All but six symptoms had loadings > .40. Three of these loadings were recorded for the MDD and GAD factor: The weight problems/decreased appetite symptom that supposedly denoted MDD (Symptom A3, 9.2% prevalence) had a standardized loading of 0.17, and the insomnia irritability symptom of MDD (Symptom A4, 12.3% prevalence) had a standardized loading of .31. However, the sleep disturbance symptom of GAD (Symptom C6, 24.5% prevalence) had a standardized loading of .33 on the combined MDD and GAD factor. Moreover, the sleep refusal symptom of separation anxiety (Symptom A6, 10.6% prevalence) had a factor loading of .19, and two conduct disorder symptoms had loadings just below the threshold of .36 and .37 for often initiating physical fights (Symptom A2, 9.2% prevalence) and stealing without confronting a victim (Symptom A12, 5.2% prevalence), respectively.

Latent profiles

The syndromes identified in the CFA were subjected to an LPA, and the results from the model fitting procedure are shown in Table 2 for up to 10 profiles. Thus, the number of symptoms for each syndrome was used (i.e., ADHD-I).

/Insert Table 2 near here/

The AIC, BIC and the sample size adjusted BIC all decreased with as the number of profiles in the interval between one and four profiles increased, which suggests that fit increases with the number of profiles. The nine- and 10-profile solutions were the best fit of all the models. The entropy showed that, regardless of the number of profiles, children were almost perfectly allocated to their latent class when using their observed scores, which varied between 99% and 100% correct. Because the AIC, BIC and entropy provided few answers regarding the number of profiles, more weight was placed on the number of cases assigned to each profile when choosing between the two solutions with

the best fit (i.e., 9 or 10 profiles). The 10-profile solution resulted in very small classes and was discarded. Therefore, the 9-profile solution was preferred. This solution yielded three child profiles with low scores on all symptoms: the *Symptom free* profile (n=723, 72.8%), the *Healthy Limit Testing* profile (n=113, 11.4%) with a mean of approximately one ADHD-I, ADHD-HI, and ODD symptom, and the *Inattentive-Uneasy* (n=52, 5.2%) profile with slightly elevated mean scores of MDD/GAD (1.2 symptoms), ADHD-I (2.0 symptoms), ADHD-HI (1.5 symptoms) and ODD (1.3 symptoms). The mean symptom scores for the other six profiles are depicted in Figure 1. These profiles should be evaluated in the context of the diagnostic threshold for their respective disorders: SOC=2, SAD=3, ADHD-I=6, ADHD-HI=6, ODD=4, and CD=3. The threshold for MDD was five symptoms (three for minor depressive disorder), and GAD requires two symptoms for children (A/B and one C criterion).

/Figure 1/

A modestly sized group of children had inattention as their only problem (*Moderately Inattentive* profile) (n=32, 3.2%) and another group had hyperactivity as their main problem (*Moderately Hyperactive* profile) (n=17, 1.8%). The latter group also showed symptoms of ODD. Two other profiles had high MDD/GAD and ADHD scores as well as some oppositional and conduct problems. The *Comorbid MDD/GAD + ADHD Combined* (n=7, n=.7%) profile had inattention and impulsivity/hyperactivity scores that approached the diagnostic threshold as well as symptoms of MDD/GAD and ODD. The *Comorbid MDD/GAD + ADHD-HI* (n=8, .8%) profile had similar scores but lower inattention scores. In addition, two single-syndrome profiles existed: the *Social Phobia Only* (n=11, n=1.1%) profile and the *Separation Anxiety Only* profile (n=29, 3.0%).

/Table 3/

Table 3 shows the parent and daycare personnel rated incapacity, impact, peer problem and prosocial behaviour scores in the nine LPA groups. The Comorbid MDD/GAD + ADHD Combined group appeared to be the most troubled with the highest incapacity, impact and peer problems scores and the lowest scores on prosocial behavior according to both parents and teachers. The Comorbid MDD/GAD + ADHD-HI group had similar scores but only according to their parents. The Social Phobia Only group also evidenced high incapacity and problems impacted their daily functioning, according to their parents, whereas teachers noted low prosocial behaviour. The Moderate Hyperactive and Moderately Inattentive groups had similar scores. Although the latter group more clearly differed from the non-problematic groups. However, it should be remembered that the Moderately Inattentive group was almost twice as large as the Moderately Hyperactive group, thus involving greater power to demonstrate significant differences. The Separation Anxiety Only group appeared to be the less troubled group among the problem groups; they suffered little incapacity, had low scores on impact and peer problems, and they evidenced particularly high levels of prosocial behavior according to their daycare teachers.

Discussion

One of the principal findings from the current study was that preschoolers' symptoms cluster according to the disorders listed in the DSM-IV as shown by a good fit in a confirmatory factor analysis when the overlap between symptoms across disorders is adjusted for. With a few exceptions, the symptoms loaded highly onto their respective syndromes, which suggests that the DSM-IV defined symptoms tap the underlying pathology well. A second finding was that a latent profile analysis identified nine types of profiles: four low-symptom profiles, one intermediate profile and four problem profiles. These four problem profiles comprised one group of children with social phobia as their main problem who also were clearly impaired from their phobia and one group of children with separation anxiety that were to a lesser degree impaired and suffered fewer social problems. In addition, two separate groups of children predominantly with ADHD existed: one clearly impaired group with both ADHD-I and ADHD-HI symptoms (often combined with ODD, CD, and MDD/GAD) and one group of children with ADHD-HI symptoms (often combined with MDD/GAD and ODD). Both groups were moderately to highly impaired by their symptoms, whereas the combined group with hyperactive, impulsive and inattentive symptoms was highly impacted by their problems and suffered additional social difficulties.

These results should be considered in the context of several limitations. Although the present study involved the largest interview-based diagnostic sample of preschoolers to date, the low rate of serious pathologies in this sample implies that the groups identified via the LPA analysis were small. The statistical power to detect additional groups of children was therefore limited, and studies that recruit even larger samples might be able to identify additional subgroups of children. Furthermore, the PAPA interview does not cover the pervasive developmental disorders. Importantly, symptoms were identified solely from the interview of one parent. Parental checklist ratings of preschooler symptoms are only moderately high [30], whereas the agreement between parents and teachers ranged from low to moderately high [31]. Therefore, the factor structure as well as the type and number of the groups identified by the LPA might have been different if pervasive developmental disorders had been included and information from both parents and preschool teachers had been recorded.

The finding that the syndromes described in the DSM-IV represent the best-fitting model of preschool symptomatology is in accordance with Sterba et al. [13] and Strickland et al. [14]. The results are also in accordance with a recent study that used questionnaire data and showed that a differentiated model of preschool symptomatology (i.e., six or seven factors) was supported across a variety of countries [32]. The similarity of findings from the U.S. and the current study might attest to the robustness of the findings, despite several important differences between these samples. Sterba et al. analyzed a predominantly African American pediatric sample whose parents had low incomes and were on Medicaid. A majority of these children screened positive on CBCL. Strickland used questionnaire data from a mixed preschool and pediatric sample. The difference between these samples and ours is underscored by the fact that the questionnaire ratings of Scandinavian children have repeatedly shown lower problem scores compared

with US children [33-35], and the prevalence of mental disorders in Scandinavia is 3-4 times lower than in US samples [8]. Moreover, due to limited statistical power, the two studies above combined to show a low prevalence of symptoms, which implies that the applicability of these symptoms to define their respective disorders cannot be tested. However, the present study evaluated all relevant symptoms. Strickland and Sterba also separately examined the factorial validity within the two allegedly overarching dimensions of psychopathology, emotional and behavioural disorders, separately. This approach does not allow researchers to fully test the DSM-IV structure because the possibility that emotional symptoms also tapping into behavioral disorders (and *vice versa*) is not addressed. The present study did not impose this *a priori* structure and hence examined all symptoms simultaneously.

When the relevant symptoms were tested in one model (i.e., without parceling or the separate testing of emotional and behavioral symptoms/disorders), the overall structure of the DSM-IV was supported, albeit with two modifications addressed below. First, as outlined earlier, the symptoms listed in the DSM-IV (most notably sleep problems, attention problems, and irritability) do not exclusively identify a specific disorder; rather, they might indicate several possible disorders. It should be noted that non-specific symptoms are not unique to psychiatry. The presence of such non-specific symptoms has for long been acknowledged as a potential source of comorbidity in children. [36,37] As regards factor analysis of symptoms, each set of non-specific symptoms (e.g., concentration problems) is therefore expected to have something uniquely in common, which is not captured by the correlation between factors, (e.g., between ADHD and depression). Therefore, factor solutions that do not account for this non-specificity should show poor fits to the data. In previous research, this overlap among symptoms was built into the analyses from the outset by allowing for correlations between non-specific symptoms [13], so its importance has been difficult to discern. However, the present results showed that the effect of this *a priori* overlap between symptoms is substantial. The present research did not address the question of whether a symptom cannot/should not be a symptom of more than one disorder. However, our results suggest that the DSM-IV only fits preschooler data well when this symptom overlap is acknowledged. Second, MDD and GAD could not be distinguished from each other. A high comorbidity between these disorders has been found throughout the lifespan [38]. In Sterba et al.'s study of preschoolers, MDD and GAD symptoms loaded onto a single factor [13], whereas Strickland found that a better fit emerged when they loaded on separate factors [39]. Strickland et al. speculated that this discrepancy might be attributed to the fact that Sterba's participants were oversampled for behavioral problems and therefore most likely contained more comorbid conditions than in their own mixed pediatric and community sample. Although the present study oversampled for emotional and behavioral problems, the drawing probabilities were known, and the results were weighted to yield corrected estimates for the population; thus being a true community study. Nevertheless, MDD and GAD could not be separated. In another investigation that prospectively analyzed data from the large Great Smokey Mountains Study and covered participants aged 9 to 16 years, Sterba et al. found that MDD and GAD could not be separated before early

adolescence. [40] A lack of differentiation [41] or a particularly high covariation [42] between MDD and GAD has also been found in several studies of children and adolescents. Although more research is obviously needed to clarify whether MDD and GAD in fact represent the same underlying disorder in children, the current body of findings suggests that they do. Possibly, it is not before a greater cognitive maturity is achieved in adolescence that the hypothetical nature of worries that is crucial to GAD (e.g., "What if…?") emerges and thereby separates GAD from depression.

Sterba et al. did not find evidence that ODD and CD were separate constructs, whereas the present study did (Strickland did not measure CD). Of the behavioral disorders present in preschoolers, ODD has received the most attention; however, some studies suggest that CD is a valid diagnosis in preschool as well.[43,44] If ODD and CD were indistinguishable during the preschool years, there would be no need to attempt to make a CD diagnosis at this age. However, if even a partial overlap exists between CD and ODD, then children with CD without comorbid ODD may have their important treatment needs overlooked if CD is not considered. Previous studies of older children have identified CD symptoms as a separate construct from ODD symptoms,[44,41] and the present study indicates that this may also be the case for pre-school children. Therefore, the view that CD is part of a diagnostic progression beginning at ODD may not always be correct. [45]

A minority of symptoms (e.g., MDD weight and sleep problems) tapped their underlying syndrome poorly, which was not the result in the Sterba study. MDD and GAD items were heavily parceled in the Strickland study, making the evaluation of individual symptoms difficult. Studies on eating problems in preschoolers (e.g., picky eating, overeating or food refusal) have found that they are unrelated to symptoms of anxiety and depression [46], and appetite shows a strong, hereditary component. [47,48] Thus, research suggests that weight and sleep problems are fairly common among preschoolers and might reflect normal variations in eating and sleep behaviors rather than an underlying pathology. [49]

Although the CFA revealed a differentiated picture of preschool psychopathology with seven syndromes that corresponded to 21 potentially comorbid pairs, the LPA analysis showed that these syndromes tended to cluster in specific and a limited number of ways in individual children. This pattern of comorbidity yielded four groups of children with at least some pathology. Like the present study, CFA studies on the data of children with ADHD typically identify two *dimensions* in ADHD [29]. Interestingly, the LPA analysis also identified two *groups* of children with MDD/GAD + comorbid ADHD (i.e., a combined group and a hyperactive/impulsive group). The extensive comorbidity among preschoolers with ADHD has been noted in clinical [50] and epidemiological [3] samples. The findings from the present study match those from older children and young adults; specifically, this comorbidity is patterned. [22,51] Importantly, the combined group showed widespread comorbidity and marked impairment. This group resembled the subgroup of children with ADHD identified by Ostrander et al. [22] through LPA analysis termed

"Severe Mixed Pathology" that had widespread comorbidity. The extent of their comorbidity may place at least some of these children at risk for a life-course persistent course of conduct disorder.[52] The Comorbid MDD/GAD + ADHD-HI group, did evidence symptoms of MDD and ODD (but little CD or anxiety). This group bears some resemblance to another group in the Ostrander ADHD study termed "Moderately Disruptive".

Previous LPA research on older children and adolescents has often identified an inattentive ADHD group and a combined ADHD group [53,18]. In the present research, however, a group with severe inattention problems was not found. Rather, a group of children with predominantly moderate attention problems emerged. Attention-demanding tasks might be less frequent among preschool children compared with school-age children; therefore, their inattention is more difficult to discern. Moreover, inattention in preschoolers may be largely judged as age-appropriate by parents and not reported. With regard to the other groups, the Separation Anxiety Only group revealed limited comorbidity and impairment, which coincides with the findings from older children and youths. [54] The Social Phobia Only children, however, were perceived as more impaired, which mirrors findings from the general population. [55] However, comorbidity was limited in this group. This result differs from the findings on adolescents [56] and adults. [57] At least some of the comorbidity in older participants is likely to have developed as a complication due to lasting social anxiety. Perhaps the social phobia symptoms in our preschool sample have not been present long enough for these secondary problems to develop.

In sum, the present study clearly suggests that the DSM-IV is applicable even for 4-year-olds and refutes the opinion that preschooler psychopathology is so unspecific that diagnoses are of little value. Nevertheless, clinicians should be aware of the possibility that vegetative symptoms are not typical of preschool depression. The pattern of comorbidity depicted in the present study also suggests that preschoolers with ADHD are likely to show a configuration of comorbidity that consists of symptoms of depression, ODD and CD. This pattern might be of clinical interest as well.

Acknowledgement: Grants 170449/V50, 190622/V50, 185760/V50, and 175309/V50 from the Research Council of Norway and Grant 4396 from the Liaison Committee between the Central Norway RHA and NTNU funded this research.

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Figure legend:

Figure 1. The mean number of symptoms from seven psychiatric syndromes across six groups of preschoolers

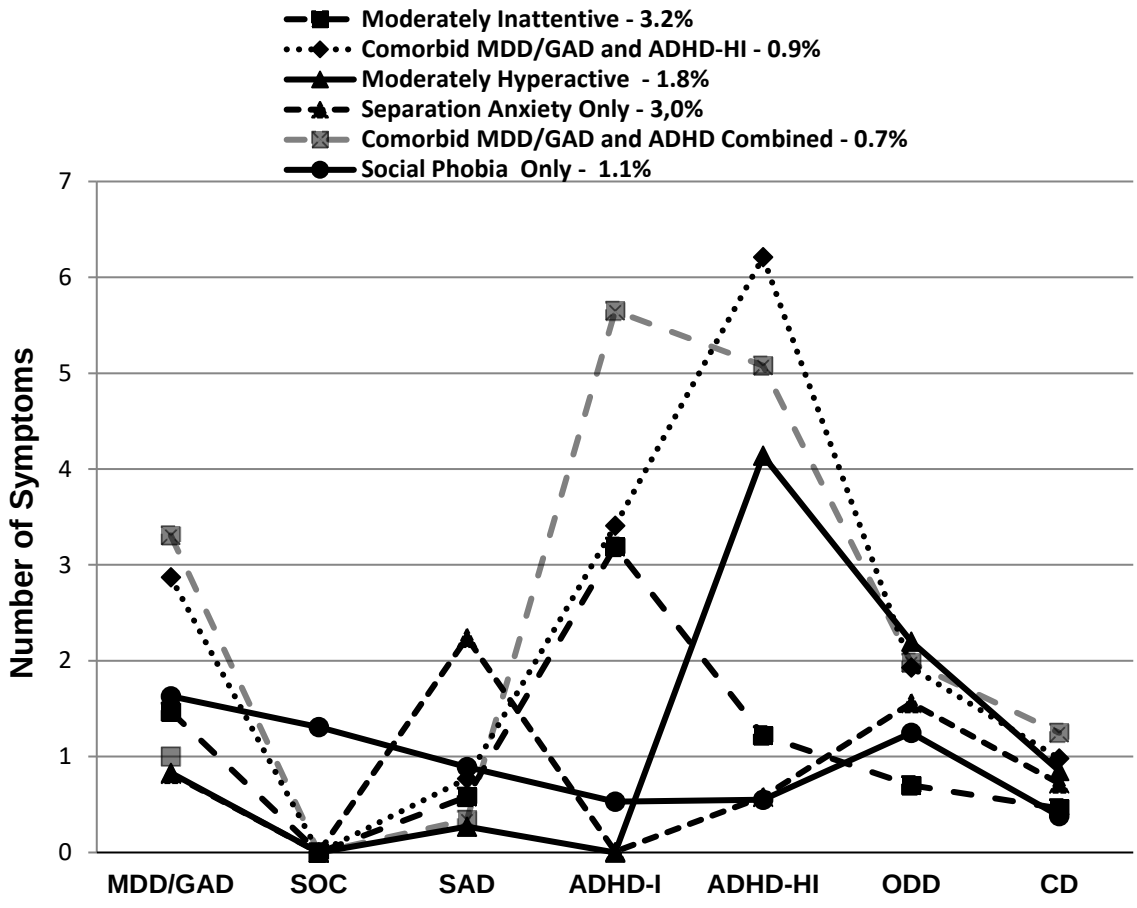

Table 1. Fit of alternative symptom cluster models: confirmatory factor analysis

	χ^2	DF	p-value	$\Delta\chi^2$	ΔDF	p-value	CFI	TLI	RMSEA
Emotional syndromes									
Model 0: Baseline model	9510.81	1540	<0.001						
Model 1: 1 factor unity model	2681.38	1485	<0.001	6829.43	45	<0.001	.850	.844	.028
Model 2: 2 factor model: internalizing vs. externalizing model	2672.71	1484	<0.001	8.67	1	.003	.851	.845	.028
Model 3: 3 factor model, two internalizing factors: anxiety vs. depression (EXT; SOC & GAD & SAD; MDD)	2643.61	1482	<0.001	29.10	2	<0.001	.854	.849	.028
Model 4: 2 factor model, two internalizing factors: anxiety vs. generalized anxiety and depression combined (EXT; SOC & GAD; MDD & SAD)	2628.20	1482	<0.001	15.41	0	NA	.856	.851	.028
Model 5: one externalizing factor, one internalizing factor with generalized anxiety and depression combined (EXT; SOC; GAD; MDD & SAD)	2419.67	1481	<0.001	208.53	1	<0.001	.854	.848	.026
Model 6: six factors (ADHD; ODD; CD; SOC; GAD; MDD & SAD)	2339.61	1470	<0.001	80.06	11	<0.001	.891	.896	.024
Model 7: seven factors (AD; HI; ODD; CD; SOC; GAD; MDD & SAD)	2272.37	1469	<0.001	67.24	11	<0.001	.899	.893	.024
Model 8: seven factors (AD; HI; ODD; CD; SOC; GAD; MDD & SAD), overlapping symptoms correlate	1825.07	1455	<0.001	447.30	14	<0.001	.954	.951	.016

Note: ADHD = attention-deficit/hyperactivity disorder, AD = attention-deficit symptoms of ADHD, HD=hyperactivity and impulsivity symptoms of ADHD, ODD = oppositional defiant disorder, CD = conduct disorder, MDD = major depressive disorder, GAD = generalized anxiety disorder, SOC = social phobia, SEP = separation anxiety disorder. Preferred models in bold. NA = not applicable

Table 2. Model fit indices for one to 10 solutions in the latent profile analysis of psychiatric disorder syndromes in 4-year-olds

Model	AIC	BIC	Adj. BIC	Entropy	Number of cases in each class
1	13187.675	13359.165	13248.004	NA	992
2	11149.978	11360.666	11224.096	1.00	11, 981
3	10470.492	10720.377	10558.399	1.00	11, 99, 882
4	9373.250	9662.334	9474.947	1.00	10, 55, 161, 766
5	9851.194	10179.476	9966.681	0.99	11, 16, 42, 75, 847
6	9588.997	9956.476	9718.273	0.99	11, 16, 33, 40, 75, 817
7	8948.765	9355.442	9091.831	0.99	6, 11, 18, 48, 50, 160, 699
8	9237.977	9683.852	9394.832	0.99	10,11, 16, 32, 32, 33, 72, 786
9	8536.763	9021.836	8707.408	0.99	7, 8, 11, 17, 29, 32, 52, 113, 723
10	8026.595	8550.865	8211.029	1.00	2,2, 6, 9, 11, 24,31, 37, 179, 692

Table 3. Impact and incapacity scores among children in nine groups of children defined by latent profile analysis of DSM-IVsymptoms

DSM-IV profiles	Incapacity score PAPA (95% CI)	SDQ impact score		Peer problems		Prosocial behavior	
	(Range: 0-11)	Parental report (95% CIs; range=0-10)	Daycare report (95% CIs; range=0-6)	Parental report (95% CIs; range=0-10)	Daycare report (95% CIs; range=0-10)	Parental report (95% CIs; range=0-10)	Daycare report (95% CIs; range=0-10)
1. Symptom free	0.10 [2-4,6-9] (0.07-0.12)	0.37[2-4,6-9] (0.31-0.42)	0.75 [2-4,9] (0.65-0.85)	.62 [4,8,9] (.56-.67)	.78 [4,9] (.69-87)	8.53 [4,9] (8.44-8.62)	7.94 [4,9] (7.80-8.08)
2. Healthy Limit Testing	0.30 [1,7,8,9] (0.21-0.40)	0.92[1,4,8,9] (0.71-1.14)	1.15[1,5, 9] (0.89-1.41)	.71 [4,8,9] (.58-.84)	.88 [4,9] (.69-1.08)	8.27 (8.09-8.45)	7.57 [5] (7.29-7.85)
3. Inattentive-Uneasy	0.46[1,7,9] (0.32-0.62)	1.14[1,8,9] (0.85-1.43)	1.32 [1,5] (0.91-1.74)	.76 [4,8,9] (.59-92)	.82 [4,9] (.50-1.14)	8.09 (7.77-8.41)	7.56 (7.08-8.04)
4. Moderately Inattentive	0.52 [1,7,9] (0.32-0.73)	1.74[1,2,5,9] (1.27-2.21)	1.88[1,5] (1.30-2.47)	1.28 [1-3] (1.00-1.57)	1.71 [1-3] (1.25-2.06)	8.05 [1] (7.72-8.41)	7.00 [1,5] (6.54-7.46)
5. Separation Anxiety Only	0.37[7-9] (0.06-0.85)	0.60[4,7-9] (0.24-0.96)	0.53 [2-4,7,9] (0.21-0.86)	.87 [8] (.58-1.16)	.94 [9] (.49-1.39)	8.44 (8.11-8.79)	8.81 [2-4, 6, 9](8.01-9.01)
6. Moderately Hyperactive	0.47 [1,7,9] (0.16-0.58)	1.65[1] (0.98-2.32)	1.14 (0.49-1.79)	.87 (.53-1.20)	1.29 (.53-2.06)	8.06 (7.60-8.51)	7.07 [5] (6.41-7.72)
7. Social Phobia Only	2.21[1-6] (1.23-3.21)	2.02[1,5] (1.18-2.87)	1.63 (0.87-2.39)	1.11 (.64-1.68)	1.91 (.96-2.86)	8.21 (7.77-8.66)	6.83 [5] (5.85-7.80)
8. Comorbid MDD/GAD + ADHD-HI	1.52[1,2,9] (0.85-2.20)	3.07[1,2,5,9] (2.13-4.01)	1.66 (0.82-2.51)	1.66 [1-3, 5,6] (1.13-2.19)	1.55 (.81-2.28)	7.97 (7.54-8.39)	7.96 (7.25-8.66)
9. Comorbid MDD/GAD + ADHD Combined	2.06[1-6] (1.28-2.85)	3.59[1-6] (2.42-4.75)	2.66[1-3,5] (1.69-3.61)	1.61 [1-3] (1.00-2.21)	2.83 [1-3, 5] (1.77-3.90)	7.63 [1] (7.12-8.14)	6.40 [1,5] (5.42-7.37)

Note: Superscript numbers denote how the classes differ according to an incremental Scheffé's test ($p < .05$)