Comorbidity profile of mental disorders among adolescents: A latent class analysis

Cecilia A Essau[a,*], Alejandro de la Torre-Luque[b]

[a] Department of Psychology, Whitelands College, University of Roehampton, Holybourne Avenue, London SW15 4JD, UK
[b] Centre for Biomedical Research in Mental Health (CIBERSAM), Universidad Autónoma de Madrid, Spain

ARTICLE INFO

ABSTRACT

The aim of this study was to identify the number of comorbidity profiles among adolescents. Sociodemographic factors associated with the comorbidity profiles were also examined. Latent class analysis was conducted using data from the National Comorbidity Survey Adolescent Supplement (NCS-A), a representative sample of adolescents ($N = 10,123$) in the United States. Latent classes were derived from 26 lifetime mental disorders which were assessed using the World Health Organization Composite International Diagnostic Instrument (CIDI). A three-class solution provided the best fit for the data, with classes labelled as *comorbid emotional disorders* (Class I), *comorbid behavioural disorders* (Class II), and *normative* (Class III). Class I (15.62% of the participants) included adolescents with a high probability of having anxiety, depressive, and intermittent explosive disorder. Class II (6.97%) was characterised by adolescents with a high probability of having substance use, behavioural disorders, and major depression. Class III (77.41%) was characterised by adolescents with a low probability of having any mental disorders. Characterising comorbid profile of mental disorders using person-based approach yields a higher-order classification that could have important clinical implications.

1. Introduction

The presence of comorbid disorders is the norm among adolescents with mental disorders (Nottelmann and Jensen, 1999). As reported in numerous studies, as high as 60% of adolescents with a mental disorder not only have one, but multiple disorders (Essau et al., 2000; Lewinsohn et al., 1997; Rohde et al., 1991). These findings have been interpreted as providing support for the latent general structure of mental disorders, indicating the presence of general psychopathology factor that underly symptoms of psychopathology (Caspi et al., 2014; Widiger and Clark, 2000). According to this view, the shared variance among all forms of psychopathology may to some extent, share a common etiology, or may represent dynamic processes in which one disorder increases the risk of developing another disorder (Laceulle et al., 2015). However, other research has suggested that comorbidity may be accounted for by an overlap of core symptoms across mental disorders (e.g., Copeland et al., 2013). Until this controversy is resolved, understanding latent organisation of comorbid disorders is important as it could provide more insight into shared aetiology of mental disorders and may explain differences in treatment responses (El-Gahalawy et al., 2013).

Studies on the structure of comorbid disorders of adolescents

conducted over the last decade have largely relied on variable-centered approach (e.g., confirmatory factor analysis and latent growth curve) and have identified two factor structures of mental disorders, comprising emotional (internalising) and behavioural (externalising) disorders (Carragher et al., 2015; Cosgrove et al., 2011; Krueger, 1999; Krueger and Markon, 2006). However, variable-centered methodology may be inflexible and insufficient in providing information on that variability and heterogeneity of comorbidity profile among adolescents (Lanza and Cooper, 2016). In other words, variable-centered methods assume that all the individuals within a population show the same pattern of relationships between the variables of interest. This approach may lead to biased conclusions because it ignores the key premise of developmental psychopathology which emphasizes that the processes, functions, and development of behaviours are, in part, specific to individuals (McClelland et al., 2015; Weems, 2008).

Hence, an approach based on identifying common patterns among subgroups of adolescents might be a better alternative to accurately describe the comorbidity profiles. However, the few studies that used a person-centered approach (e.g., latent class analysis) have identified inconsistent comorbidity profiles. For example, in a study among adults, Kessler et al. (2005) examined the structure of 19 disorders using data from the National Comorbidity Survey Replication (NCS-R)

---

*Corresponding author.
E-mail address: c.essau@roehampton.ac.uk (C.A. Essau).

and reported 7-class solution that best fit the data. These classes are called unaffected respondents, pure internalising disorders, externalising disorders, comorbid internalising disorders, comorbid internalising-externalising disorders which is dominated by comorbid social phobia and ADHD, highly comorbid major depressive episode, highly comorbid bipolar disorder. Approximately, 7% of the participants were in the classes with high comorbidity, with almost half (43.6%) of serious cases being in these classes. Correlates of pure externalising disorders were being young, male, Hispanic, not low income, and living in a rural area. Correlates of pure internalising disorder include being female, married, high education, and living in suburbs of small metropolitan areas. In the reanalaysis of the NCS-R (Vaidyanathan et al., 2011), a 5-class solution was found to best fits the data, which they labelled as fear class (all phobias and panic disorder), a distress class (depression, generalised anxiety disorder, dysthymia), and externalising class (alcohol and drug dependence and conduct disorder), a multimorbid class (highly elevated rates of all disorders), and a few-disorders class (very low probability of having any disorders). In a study by Olino et al. (2012), four classes of comorbidity profile were found: (a) one class (62.5% of the sample) which included individuals with the lowest rate of mental disorders; (b) an internalising class (16.4%) with elevated rates of internalising disorders; (c) an externalising class (16.9%) which were largely characterised by externalising disorders; and (d) a comorbid internalising and externalising disorders class (4.2%) which was characterised by both disorders. Individuals in the class with externalising disorders were likely to be men, whereas those in the class with internalising disorders were likely to be women. While informative, all these studies were focused on adult samples, and thus the findings might not be generalizable to adolescents.

Only a handful of studies have been conducted in the adolescent population. Based on the Child Behaviour Checklist (CBCL), Bianchi et al. (2016) found four classes of psychopathology symptom profile: (a) the internalising problems which is characterized by a high probability of being in the clinical range for anxious/depressed scale (15.68% of participants), (b) the attention/hyperactivity class which has elevated probability of being in the clinical range for attention problems (10.19%), and (c) low problem class which included participants with a low probability for each CBCL syndrome scale (66.32%) and (d) the severe dysregulated class which included participants with an elevated probability of being in the clinical range for all CBCL scales except for somatic complaints and rule-breaking behaviour (7.82%). A major problem with Bianchi et al.'s study is that the data were based on parent report and may not represent a true report of adolescent's emotional (internalising) and behavioural (externalising) problems. As reported in several studies, there exists a lack of agreement between self- and parent-report (Cantwell et al., 1997; Gould et al., 1993), where self-report ratings of anxiety and depressive synptoms have been found to be higher than parent ratings (Essau and Petermann, 2001).

Van Lang et al. (2006) conducted a symptom-level study (based on Youth Self Report) in order to identify comorbidity patterns between anxiety and depression among early adolescents. Five distinct groups appeared to provide the best fit for the data. However, almost all their participants (99%) had comorbid symptoms, with very small number of them having only anxiety or only depression. A major problem with Van Lang et al.'s study was the narrow inclusion of age groups (10–12 years old) and that only symptoms of anxiety and depression were measured. These limitations are important to address in future studies because as argued by some authors (Lanza and Cooper, 2016), psychopathology is manifested through various developmental pathways in adolescence, leading to the emergence of different disorders at the same time in the same individual.

Studies that use person-centered methods and robust assessment protocols (i.e., diagnostic interview) and cover a wide range of mental disorders are needed to provide a more accurate picture of comorbidity profiles in adolescence. Thus, the main aim of the present study is to identify the number of comorbidity profiles of mental disorders (based on DSM-IV criteria) among adolescents. Another aim is to analyse the relationships between these comorbidity profiles and sociodemographic variables.

2. Methods

2.1. Sample

The present study used data from the National Comorbidity Survey Adolescent Supplement (NCS-A), which is a nationally representative survey of 10,123 adolescents between 13 and 18 years of age in the United States (51.07% girls, mean age = 15.18, *SD* = 1.51); its predecessor, the National Comorbidity Survey Replication (NCS-R), is a nationally representative survey of 9282 English-speaking household residents ages 18 years and over in the United States.

The adolescents were recruited from a household (*N* = 904) and from a nationally representation school sample (*N* = 9244), with a combined response rate of 82.90%. Race was well represented among participants: Caucasian (55.66% of participants), black or African American adolescents (19.29% of sample), Latino adolescents (18.91%) and other races (6.14%). Most of the participants lived with their two biological parents (52.90%) and 37.51% of sample lived with one of their parent. Details of the NCS-A study design, sampling, and measures have been reported in several publications (Kessler et al., 2009; Merikangas et al., 2009).

All the participants provided a written consent to participate into the study. The study was approved by the institutional review boards at the University of Michigan and Harvard University.

2.2. Measures

The adolescents were administered a fully-structured diagnostic interview, the World Health Organization Composite International Diagnostic Instrument (CIDI), which was modified to simplify language and to use examples that are more of relevance to adolescents (Merikangas et al., 2009). The major classes of DSM-IV disorders included in the CIDI are mood disorders (major depressive episode/dysthymia, mania/hypomania), anxiety disorders (panic disorder with or without agoraphobia, agoraphobia, social anxiety disorder, specific phobia, generalized anxiety disorder [GAD], posttraumatic stress disorder [PTSD], separation anxiety disorder), behaviour disorders (attention deficit/hyperactivity disorder [ADHD], oppositional defiant disorder [ODD], intermittent explosive disorder, conduct disorder [CD]), eating disorders (anorexia nervosa, bulimia nervosa, binge-eating behaviour), and substance use disorders (alcohol and drug abuse and dependence, nicotine dependence).

2.3. Data analysis

Statistical analyses were conducted in two stages. First, the structure of comorbidity profiles of mental disorders was examined using latent class analysis (LCA) approach. LCA allows for modelling latent variable solutions comprising finite number of mutually exclusive groups (i.e., classes), which were formed by means of common profiles of diagnoses (Lanza and Cooper, 2016). In this study, clustering variables were the lifetime diagnoses of 26 mental disorders based on DSM-IV criteria (American Psychiatric Association, 1994). Latent class enumeration was conducted without covariates in order to prevent problems related to class overestimation (Lubke and Luningham, 2017; Vermunt, 2010).

Comparative model fit was measured using the following conventional indices: loglikelihood value of model convergence, conditional χ^2 test statistic (G^2), Akaike's information criterion (AIC) and sample-adjusted Bayesian information criterion (SABIC) (Nylund et al., 2007; Tofighi and Enders, 2008). Entropy R^2 was used to determine the extent to which the participants were accurately classified. Lower values on

AIC and SABIC, and scores higher than 0.70 in the classification accuracy criterion, entropy R^2, support a better model fit (Boeschoten et al., 2016). Furthermore, the mean of posterior probabilities of belonging to the assigned class should be greater than 0.70, and a meaningful percentage of cases (at least 5%) should be classified into every identified class. LCA was conducted by means of poLCA R package.

Second, to measure predictors of class membership, multinomial regression analysis was conducted. Membership to classes identified in the LCA was considered as criterion. Class with the highest proportion of participants (usually called normative class) was the reference category. Age, gender, race, parents' education, household income, urbanicity, and living arrangement were added to the logistic model in order to explore the variables which significantly predicted class membership.

Maximum likelihood methods were used to estimate parameters. Model fit was compared to an unconditional model (intercept model or a model without predictors) by means of AIC and the residual deviance (RD) from the saturated model (lower values in both indexes reflect a better fit to data). Wald's test was used to check whether estimated parameters had factorial loadings significantly different from zero. Multinomial logistic regression was conducted using nnet R package.

3. Results

The sociodemographic characteristics of all the participants and the lifetime prevalence of mental disorders are shown in Tables 1 and 2, respectively. The goodness-of-fit indices for the one-to 10-class models are shown in Table 3. The AIC and SABIC decreased for all models up to the third class solution. The 3-class solution was retained due to the low AIC and SABIC and acceptable entropy R^2 value, and meaningful

Table 1
Sociodemographic characteristics of the participants (N = 10,123).

Sociodemographic variable	Percentage	χ^2 (df)	V
Age		454.03 (2)**	0.21
Early (13–14 years)	38.14		
Mid (15–16 years)	38.49		
Late (17–18 years)	23.36		
Gender		4.68 (1)*	0.02
Boy	48.93		
Girl	51.07		
Race/Ethnicity		5541.50 (3)**	0.74
White	55.66		
Hispanic	18.94		
Black	19.26		
Other	6.14		
Parents' education		782.37 (3)**	0.28
< High school	16.70		
High school graduate	30.46		
Some college	19.71		
College graduate	33.13		
Household income[a]		716.52 (3)**	0.27
Low	16.97		
Low-average	19.97		
High-average	30.66		
High	32.40		
Urbanicity		721.41 (2)**	0.27
Census major metropolitan area	44.54		
Other urbanised county	32.66		
Rural county	22.80		
Biological parents living with adolescent		2921.90 (2)**	0.54
No parents	9.63		
One parents	37.54		
Both parents	52.83		

Note. χ^2 tests for between-category differences and related effect size estimates (Cramer's V) are presented. The percentages were based on crude estimates. df = degrees of freedom.
  [a] Levels based on poverty line.
  * $p < .05$.
  ** $p < .01$.

Table 2
Lifetime prevalence of DSM-IV disorders among adolescents.

DSM-IV disorder	Prevalence
Attention deficit/hyperactivity disorder	4.26
Agoraphobia with/without panic disorder	2.89
Alcohol abuse	6.68
Alcohol dependence	1.12
Anorexia nervosa	0.33
Binge-eating disorder	5.24
Bipolar I disorder	1.34
Bipolar II disorder	0.94
Bulimia nervosa	0.90
Conduct disorder	5.77
Drug abuse	8.67
Drug dependence	1.86
Dysthymia	3.30
Generalised anxiety disorder	2.94
Hypomania	3.74
Intermittent explosive disorder	13.69
Major depressive episode	13.21
Minor depressive disorder	1.34
Oppositional defiant disorder	10.32
Panic disorder	2.34
Premenstrual syndrome	0.63
Posttraumatic stress disorder	3.82
Separation anxiety disorder	7.61
Social phobia	14.13
Specific phobia	19.65
Nicotine dependence	7.03

Note. Lifetime prevalence rates were based on crude estimates.

proportion of participants (> 5%) in all the identified classes.

Table 4 shows the probability of having DSM-IV disorders according to the class profile. Class I ($n = 1581$; 15.62%) was characterised by adolescents displaying high probabilities of reporting anxiety (social phobia and specific phobia) and depressive disorders, as well as intermittent explosive disorder (Table 4, in bold face). This class was labelled comorbid emotional disorders class. The total number of disorders in this class (Fig. 1) was 4.45 ($SD = 1.97$). Class II was characterised by adolescents ($n = 706$; 6.97%) with high probabilities of reporting substance use disorders (alcohol, illegal drugs and nicotine), externalising disorders (conduct disorder, intermittent explosive disorder and oppositional defiant disorder), and major depression. This class was labelled as comorbid behavioural disorders class. The number of diagnoses in this class was 6.03 ($SD = 2.77$). Class III was characterised by adolescents ($n = 7836$; 77.41%) with low probabilities of reporting any mental disorders. This class was labelled the normative class. Most participants in Class III had either no (54.89%) or one mental disorder (26.92%). The number of comorbid disorders in these classes was significantly different, $F (2, 10,120) = 9680.01, p < .01$, $\eta^2_{partial} = 0.66$.

Regarding the multinomial logistic regression, the regression model comprising the predictors showed a better fit than the unconditional model, in terms of AIC (AIC of the logistic model = 12,749.71; AIC of the unconditional model = 13,640.43) and RD (RD of the logistic model = 12,681.71; RD of the unconditional model = 13,636.43). Table 5 shows the odds ratio and multinomial regression loadings of sociodemographic predictors by class membership. Intercepts were significant in predicting the comorbid emotional disorders class ($B = -1.76$, $SE = 0.07$; Wald test = -25.10, $p < .01$) and the comorbid behavioural disorders class ($B = -3.56$, $SE = 0.14$; Wald test = -24.76, $p < .01$), both in comparison to the reference (normative) class. Results indicated that adolescents in the comorbid emotional disorders class (in comparison to those from the normative class) were more likely to be girls, older, lived without their biological parents (in case of living with them, their parents showed lower levels of education). Adolescents in the comorbid behavioural disorders class were more likely to be boys and older and lived in urban metropolitan

Table 3
Latent class model fit. Model comparison table.

	1 class	2 class	**3 class**	4 class	5 class	6 class	7 class	8 class	9 class	10 class
LLiK	−51,125.56	−46,108.46	**−45,068.59**	−44,671.44	−44,378.48	−44,267.48	−44,014.19	−43,962.68	−43,790.46	−43,724.84
G^2	26,040.82	16,006.62	**13,926.87**	13,132.58	12,546.65	12,324.65	11,818.08	11,715.06	11,370.62	11,239.38
AIC	102,309.13	92,334.92	**90,315.18**	89,580.89	89,054.96	88,892.96	88,446.39	88,403.36	88,118.93	88,047.69
SABIC	102,426.49	92,573.71	**90,675.38**	90,062.50	89,657.98	89,617.40	89,292.25	89,370.64	89,207.62	89,257.79
Entropy R^2		0.76	**0.75**	0.69	0.68	0.65	0.70	0.64	0.68	0.65
%part	100	19.33–80.67	**7.05–77.33**	2.80–68.99	2.84–68.45	2.51–69.42	0.76–68.78	0.93–63.15	0.64–68.72	0.69–65.35

Note. Model with the best fit to data is displayed in bold face.
LLik = log-likelihood convergence value; G^2 = conditional χ^2 test statistic; AIC = Akaike information criterion; SABIC = sample-adjusted Bayesian information criterion; %part = range of percentage of participants in classes.

Table 4
Probability of having any mental disorders by class profile.

	class 1 (EMOT)	class 2 (BEHAV)	class 3 (NORM)
Attention deficit disorder	0.13	0.14	0.01
Agoraphobia with/without panic disorder	0.12	0.06	0.01
Alcohol abuse	0.03	**0.64**	0.02
Alcohol dependence	0	0.15	0
Anorexia	0.01	0.01	0.00
Binge disorder	0.16	0.13	0.02
Bipolar I disorder	0.05	0.05	0.00
Bipolar II disorder	0.04	0.03	0
Bulimia	0.04	0.02	0
Conduct disorder	0.09	**0.40**	0.02
Drug abuse	0.05	**0.79**	0.02
Drug dependence	0	0.25	0
Dysthymia	0.15	0.10	0
Generalised anxiety disorder	0.11	0.08	0.01
Hypomania	0.13	0.12	0.01
Intermittent explosive disorder	**0.33**	**0.38**	0.07
Major depressive episode	**0.47**	**0.34**	0.03
Minor depressive disorder	0.02	0.02	0.01
Oppositional defiant disorder	0.27	**0.34**	0.04
Panic disorder	0.08	0.08	0.01
Premenstrual syndrome	0.02	0.02	0.00
Posttraumatic stress disorder	0.14	0.13	0.01
Separation anxiety disorder	0.24	0.11	0.03
Social phobia	**0.42**	0.26	0.07
Specific phobia	**0.50**	0.28	0.12
Nicotine dependence	0.07	**0.58**	0.02

Note. Lifetime diagnosis according to the DSM-IV was considered for all disorders. Probabilities higher than 0.30 are displayed in bold face.
EMOT = comorbid emotional disorders class; BEHAV = comorbid behavioural disorders class; NORM = normative class.

areas. They were white, black or with other non-Hispanic races and lived without their biological parents; among adolescents who lived with their parents, their parents showed low education levels.

4. Discussion

To our knowledge, the present study was amongst the first to have examined the comorbidity profile of mental disorders using as person-centered approach in a nationally representative sample of adolescents. Consistent with previous studies (Carragher et al., 2015; Widiger and Clark, 2000), the comorbidity profiles consisted of an externalising (i.e., related to behavioural problems) and an internalising (i.e., related to emotional problems) profile. However, a close inspection of each class revealed some notable profiles. Specifically, the three-class solution best fits the data with the classes that are characterised by individuals with (a) high probability of emotional disorders, (b) high probability with behavioural disorders, and (c) with low probability of mental disorders.

In the class with comorbid emotional disorders (Class I), the most common mental disorders include two types of anxiety disorders (social and specific phobias), major depression, and intermittent explosive disorder (IED). The finding gives support to the high comorbidity between IED with substance use disorders (Coccaro et al., 2016) and with anxiety and depression (McCloskey et al., 2010). It should be noted that although IED is not considered as a mood disorder, it shows abnormalities in terms of affect and affect regulaton such as intensity and lability of affect (Coccaro, 2018).

Class II (comorbid behavioural disorder) was characterised by adolescents with substance use disorders, behavioural disorders (conduct disorder, IED, ODD) and major depression. This result can be interpreted as supporting Olino et al. (2012) finding which showed that participants who met the criteria for major depression had an increased rate of other emotional disorders and substance use disorders; these authors (Olino et al., 2012) interpreted their finding as supporting the use of substance to self-medicate among those with anxiety and depression. Class III had the lowest prevalence of mental disorder, which are much lower than those reported by Olino et al. (2012).

In line with previous studies (Lewinsohn et al., 1993; Letcher et al., 2012; Merikangas et al., 2010; Reinherz et al., 1993; Su et al., 2008), gender differences were found for comorbid emotional and comorbid behavioural disorders classes. Adolescents in the comorbid emotional disorders class, compared to those from the normative class, were more likely to be girls, whileas adolescents in the comorbid behavioural disorders class were more likely to be boys. While it is beyond the scope of this study to determine reasons for this gender difference, socialization practise that includes power and control, management of feelings has been described as a possible explanation (Petersen et al., 1991).

Furthermore, adolescents in the comorbid emotional and comorbid behavioural disorders classes were found to be more likely to live with their non-biological parents. The reason for this is not known, although it might be related to their family environment. As reported in numerous studies, emotional problems among adolescents were related to families characterised by a lack of parental support, high levels of conflict, poor communication, and rejection (Lau and Kwok, 2000; Nolan et al., 2003). Behavioural problems have been reported to be associated with parental rejection, frequent shifting of parental figures, large family size, and being exposed to inconsistent discipline practices that include harsh and discipline practices, poor monitoring and supervision of offspring, and low levels of positive involvement with offspring (Frick et al., 1992; Prinz and Jones, 2003).

Our findings need to be interpreted in light of some limitations. First, analyses were based on lifetime diagnoses which may be susceptible to recall bias leading to an underestimation of the prevalence of mental disorders. Factors such as the length of recall period and the number of comorbid conditions might influence recalling prior events (Eisenhower et al., 2004). Although special memory priming method was used to improve the accuracy of retrospective recalls (Knauper et al., 1999), recall bias is still a concern. Estimates on 12-month prevalence rates, as a proxy of (recent) current diagnosis, have been reported in Kessler et al. (2012). Second, because NCS-A is a cross-sectional study, it is not possible to understand the way in which mental disorders develop over time. Third, the NCS-A did not cover all the axis
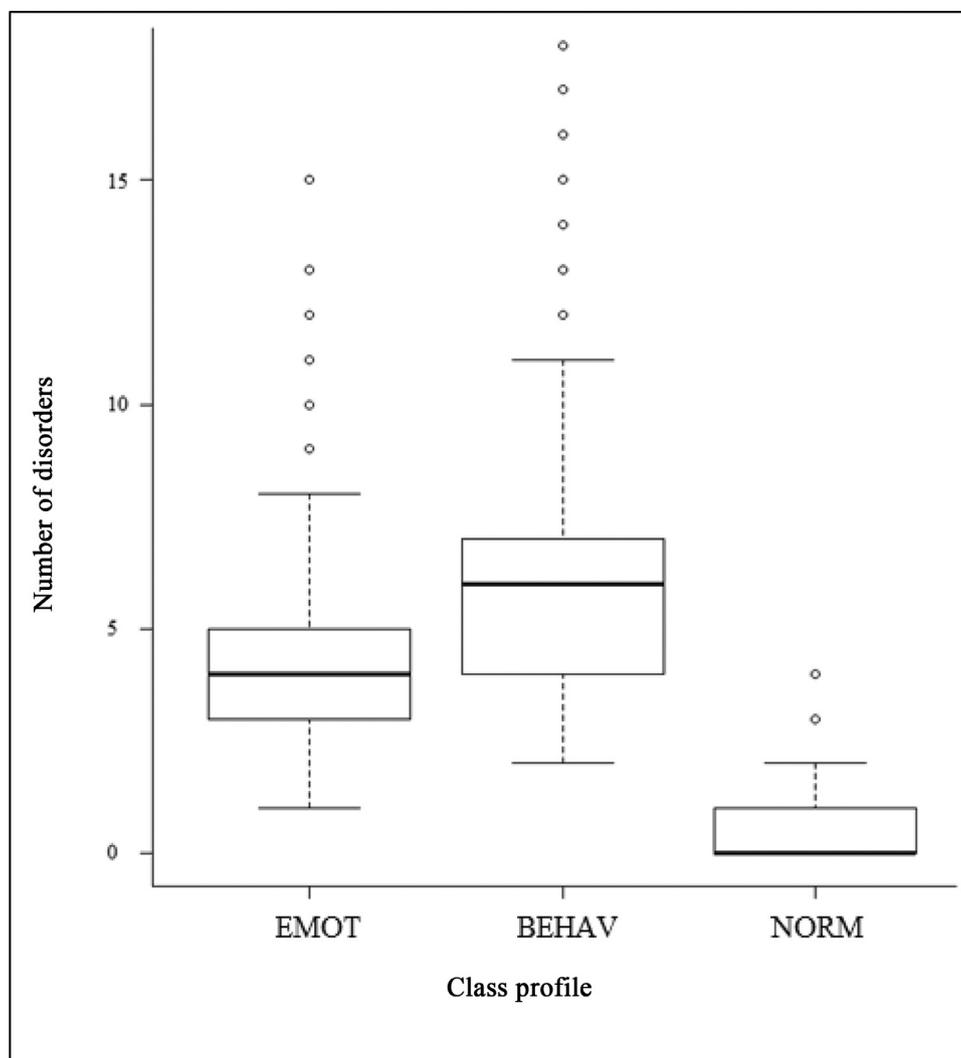
Fig. 1. Number of mental disorders by comorbidity profile.
Note. EMOT = comorbid emotional disorders class; BEHAV = comorbid behavioural disorders class; NORM = normative class.

I disorders which may provide additional information about the latent classification of psychopathology. Fourth, the diagnoses were based on the CIDI, which is a fully structured interview that was delivered by trained lay interviewers. Although the CIDI typically produces more reliable diagnoses than those based on semi-structured clinical interviews, fully structured interviews are unable to clarify symptom responses across disorders which could potentially lead to inflated estimates of comorbidity.

Future research should include a more comprehensive set of predictors from multiple domains (e.g., cognitive function, psychopathological and personality traits) to examine a wide range of factors that underpins comorbidity. At the same time, a symptom-level approach could be used to explore the way in which symptoms are connected to one another across comorbidity classes by using symptom network approach.

Findings of the present study could have clinical implications by raising awareness on the importance of personalised assessment and intervention protocols based on person-specific profiles of comorbidity. First, personalised protocols of assessments may help to uncover individual-specific markers which underpin disorder attenuation or exacerbation. Knowledge about comorbidity profile and related factors may provide therapeutic choices which in turn could influence treatment response and prognosis. Finally, identifying comorbidity profiles should lead to the development of new and more efficient

pharmacological and non-pharmacological treatments.

Human participant protection

The survey was administered by the professional staff of the Institute for Social Research at the University of Michigan. The recruitment and consent procedures were approved by the Human

Table 5

Odds ratio and multinomial regression loadings of sociodemographic predictors according to classes.

	EMOT				BEHAV			
	OR (CI$_{95}$)	B	SE	Z value	OR (CI$_{95}$)	B	SE	Z value
Age								
Early adolescence[a]	0.82 (0.73, 0.91)				0.14 (0.11, 0.19)			
Mid adolescence	1.18 (1.04, 1.33)	0.16	0.06	2.51*	4.55 (3.45, 6.00)	1.52	0.14	10.72**
Late adolescence	1.35 (1.17, 1.56)	0.30	0.07	4.05**	10.68 (8.12, 14.04)	2.37	0.14	16.97**
Gender								
Boy[a]	0.62 (0.56, 0.70)				1.27 (1.09, 1.49)			
Girl	1.62 (1.45, 1.81)	0.48	0.06	8.48**	0.78 (0.67, 0.92)	−0.24	0.08	−2.94**
Race/Ethnicity								
White[a]	0.72 (0.65, 0.81)				1.31 (1.12, 1.54)			
Hispanic	1.09 (0.93, 1.28)	0.08	0.08	1.05	0.64 (0.50, 0.82)	−0.44	0.12	−3.60**
Black	0.95 (0.82, 1.10)	−0.05	0.07	−0.63	1.89 (1.49, 2.41)	0.64	0.12	5.21**
Other	1.14 (1.00, 1.29)	0.13	0.06	1.96	2.23 (1.76, 2.81)	0.80	0.12	6.72**
Parents' education level								
College graduate[†]	0.72 (0.64, 0.81)				0.61 (0.51, 0.73)			
Less than high school	1.19 (1.06, 1.33)	0.17	0.06	3.01**	1.55 (1.31, 1.82)	0.44	0.08	5.21**
High school graduate	1.00 (0.89, 1.13)	0.00	0.06	−0.03	0.86 (0.72, 1.03)	−0.15	0.09	−1.64
Some college	1.13 (1.00, 1.27)	0.12	0.06	2.01	1.19 (1.00, 1.42)	0.18	0.09	1.99*
Household income								
High[a]	0.81 (0.72, 0.91)				1.15 (0.98, 1.35)			
Low	1.07 (0.96, 1.18)	0.07	0.05	1.24	0.95 (0.82, 1.10)	−0.05	0.08	−0.67
Low to average	0.96 (0.85, 1.08)	−0.04	0.06	−0.63	1.07 (0.90, 1.28)	0.07	0.09	0.77
High to average	1.13 (1.00, 1.28)	0.12	0.06	1.97	1.06 (0.88, 1.29)	0.06	0.10	0.60
Urbanicity								
Metropolitan area[a]	1.06 (0.95, 1.18)				1.39 (1.19, 1.62)			
Other urbanised county	1.07 (0.95, 1.22)	0.07	0.06	1.11	0.74 (0.61, 0.89)	−0.30	0.09	−3.18**
Rural county	0.79 (0.68, 0.92)	−0.23	0.08	−2.99**	0.59 (0.47, 0.74)	−0.53	0.11	−4.62**
Biological parents living with adolescent								
Both parents[a]	0.54 (0.48, 0.60)				0.46 (0.39, 0.54)			
No parents	1.43 (1.31, 1.56)	0.35	0.04	8.00**	1.80 (1.58, 2.04)	0.59	0.06	8.99**
One parent	0.64 (0.56, 0.73)	−0.45	0.07	−6.44**	0.52 (0.43, 0.62)	−0.66	0.09	−7.07**

Note. Estimates from multinomial regression were calculated considering the normative class as the reference category; that is, estimates for the INT and EXT classes were calculated in comparison with the normative class.

EMOT = Comorbid emotional disorders class; BEHAV = Comorbid behavioural disorders class; OR = odds ratio; CI$_{95}$ = 95% confidence interval; B = Multinomial regression loading; SE = Standard error; Z value = Statistic derived from the Wald's test.

  [a] Reference category for this predictor within the multinomial model (loadings from these categories were fixed within the model to ensure model convergence; Wald's tests were not computed, consequently).

  * $p < .05$.

  ** $p < .01$.

Subjects Committees of Harvard Medical School and the University of Michigan.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2019.06.007.

References

American Psychiatric Association, 1994. Diagnostic and Statistical Manual of Mental Disorders. 4. American Psychiatric Association, Washington, DC.

Bianchi, V., Brambilla, P., Garzitto, M., Colombo, P., Fornasari, L., Bellina, M., et al., 2016. Latent classes of emotional and behavioural problems in epidemiological and referred samples and their relations to DSM-IV diagnoses. Eur. Child Adolesc. Psychiatry. https://doi.org/10.1007/s00787-016-0918-2.

Boeschoten, L., Oberski, D.L., de Waal, T., 2016. Estimating Classification Error Under Edit Restrictions in Combined Survey-Register Data. Den Haag: Statistics, Netherlands (CBS Discussion paper 2016 | 12).

Cantwell, D.P., Lewinsohn, P.M., Rohde, P., Seeley, J.R., 1997. Correspondence between adolescent report and parent report of psychiatric diagnostic data. J. Am. Acad. Child Adolesc. Psychiatry 36, 610–619.

Carragher, N., Krueger, R.F., Eaton, N.R., Slade, T., 2015. Disorders without borders: current and future directions in the meta-structure of mental disorders. Soc. Psychiatry Psychiatr. Epidemiol. 50, 339–350 http://doi .org/10.1007/s00127-014-1004-z.

Caspi, A., Houts, R.M., Belsky, D.W., Goldman-Mellor, S.J., Harrington, H.L., Israel, S., et al., 2014. The p factor: one general psychopathology factor in the structure of psychiatric disorders? Clin. Psychol. Sci. 2, 119–137. https://doi.org/10.1177/2167702613497473.

Coccaro, E.F., 2018. DSM-5 intermittent explosive disorder: relationship with disruptive mood dysregulation disorder. Compr. Psychiatry 84, 118–121. https://doi.org/10.1016/j.comppsych.2018.04.011.

Coccaro, E.F., Fridberg, D.J., Fanning, J.R., Grant, J.E., King, A.C., Royce Lee, R., 2016. Substance use disorders: relationship with intermittent explosive disorder and with aggression, anger, and impulsivity. J. Psychiatr. Res. 81, 127–132.

Copeland, W.E., Shanahan, L., Erkanli, A., Costello, E.J., Angold, A., 2013. Indirect co-morbidity in childhood and adolescence. Front. Psychiatry 4, 144. http://doi.org/10.3389/fpsyt.2013.00144.

Cosgrove, V.E., Rhee, S.H., Gelhorn, H.L., Boeldt, D., Corley, R.C., Ehringer, M.A., et al., 2011. . Structure and etiology of co-occurring internalizing and externalizing disorders in adolescents. J. Abnorm. Child Psychol. 39, 109–123.

El-Gabalawy, R., Tsai, J., Harpaz-Rotem, I., Hoff, R., Sareen, J., Pietrzak, R.H., 2013. Predominant typologies of psychopathology in the United States: a latent class analysis. J. Psychiatr. Res. 47, 1649–1657. https://doi.org/10.1016/j.jpsychires.2013.07.028.

Eisenhower, D., Mathiowetz, N.A., Morganstein, D., 2004. Recall error: sources and bias reduction. In: Biemer, P.P., Groves, R.M., Lyberg, L.E., Mathiowetz, N.A., Sudman, S. (Eds.), Measurement Error in Surveys, second ed. John Wiley & Sons, Chichester, pp. 127–144.

Essau, C.A., Petermann, F. (Eds.), 2001. Anxiety Disorders in Children and Adolescents: Epidemiology, Risk Factors, and Treatment. Brunner Routledge, London.

Essau, C.A., Conradt, J., Petermann, F., 2000. Frequency, comorbidity, and psychosocial

impairment of anxiety disorders in adolescents. J. Anxiety Disord. 14, 263–279.

Frick, P.J., Lahey, B.B., Loeber, R., Stouthamer-Loeber, M., Christ, M.A.G., Hanson, K., 1992. Familial risk factors to oppositional defi ant disorder and conduct disorder: parental psychopathology and maternal parenting. J. Consult. Clin. Psychol. 60, 49–55.

Gould, M.S., Bird, H., Jaramillo, B.S., 1993. Correspondence between statistically derived behavior problem syndromes and child psychiatric diagnoses in a community sample. J. Abnorm. Child Psychol. 21, 287–313.

Kessler, R.C., Avenevoli, S., Costello, E.J., Green, J.G., Gruber, M.J., Heeringa, S., et al., 2009. National comorbidity survey replication adolescent supplement (NCS-A): II. Overview and design. J. Am. Acad. Child Adolesc. Psychiatry 48, 380–385.

Kessler, R.C., Avenevoli, S., Costello, E.J., Green, J.G., Gruber, M.J., McLaughlin, K.A., et al., 2012. Severity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication Adolescent Supplement. Arch. Gen. Psychiatry 69, 381–389. https://doi.org/10.1001/archgenpsychiatry.2011.1603.

Kessler, R.C., Chiu, W.T., Demler, O., Walters, E.E., 2005. Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. Arch. Gen. Psychiatry 62, 617–627.

Knauper, B., Cannell, C.F., Schwarz, N., Bruce, M.L., Kessler, R.C., 1999. Improving accuracy of major depression age-of-onset reports in the US National Comorbidity Survey. Int. J. Methods Psychiatr. Res. 8, 39–48.

Krueger, R.F., Markon, K.E., 2006. Reinterpreting comorbidity: a model-based approach to understanding and classifying psychopathology. Annu. Rev. Clin. Psychol. 2, 111–133. https://doi.org/10.1146/annurev. .clinpsy.2.022305.095213. 06.

Krueger, R.F., 1999. The structure of common mental disorders. Arch. Gen. Psychiatry 56, 921–926 http:// doi.org/10.1001/archpsyc.56.10.921.

Laceulle, O.M., Vollebergh, W.A.M., Ormel, J., 2015. The structure of psychopathology in adolescence: replication of a general psychopathology factor in the TRAILS Study. Clin. Psychol. Sci. https://doi.org/10.1177/2167702614560750.

Lanza, S.T., Cooper, B.R., 2016. Latent class analysis for developmental research. Child Dev. Perspect. 10. https://doi.org/10.1111/cdep.12163.

Lau, S., Kwok, L.-K., 2000. Relationship of family environment to adolescents' depression and self-concept. Soc. Behav. Personal. 28, 41–50 SOCIAL.

Letcher, P., Sanson, A., Smart, D., Toumbourou, J.W., 2012. Precursors and correlates of anxiety trajectories from late childhood to late adolescence. J. Clin. Child Adolesc. Psychol. 41, 417–432.

Lewinsohn, P.M., Zinbarg, R., Seeley, J.R., Lewinsohn, M., Sack, W.H., 1997. Lifetime comorbidity among anxiety disorders and between anxiety disorders and other mental disorders in adolescents. J. Anxiety Disord. 11, 377–394.

Lewinsohn, P.M., Hops, H., Roberts, R.E., Seeley, J.R., Andrews, J.A., 1993. Adolescent psychopathology: I. Prevalence and incidence of depression and other DSM-III—R disorders in high school students. J. Abnorm. Psychol. 102, 133.

Lubke, G.H., Luningham, J., 2017. Fitting latent variable mixture models. Behav. Res. Ther. 98, 91–102. https://doi.org/10.1016/j.brat.2017.04.003.

McClelland, M.M., Geldhof, G.J., Cameron, C.E., Wanless, S.B., 2015. Development and self-regulation. In: Lerner, R.M. (Ed.), Handbook of Child Psychology and Developmental Science, seventh ed. John Wiley & Sons, Hoboken, pp. 523–565.

McCloskey, M.S., Kleabir, K., Berman, M.E., Chen, E.Y., Coccaro, E.F., 2010. Unhealthy aggression: intermittent explosive disorder and adverse physical health outcomes. Health Psychol. 29, 324–332.

Merikangas, K., Avenevoli, S., Costello, J., Koretz, D., Kessler, R.C., 2009. National co-morbidity survey replication adolescent supplement (NCS-A): I. Background and measures. J. Am. Acad. Child Adolesc. Psychiatry 48, 367–369 [PubMed: 19242382].

Merikangas, K.R., He, J.P., Burstein, M., Swanson, S.A., Avenevoli, S., Cui, L., Benjet, C., Georgiades, K., Swendsen, J., 2010. Lifetime prevalence of mental disorders in U.S. adolescents: results from the National Comorbidity Study-Adolescent Supplement (NCS-A). J. Am. Acad. Child Adolesc. Psychiatry 49, 980–989.

Nolan, S.A., Flynn, C., Garber, J., 2003. Prospective relations between rejection and depression in young adolescents. J. Pers. Soc. Psychol. 85, 745–755 JOURNAL.

Nottelmann, E.D., Jensen, P.S., 1999. Comorbidity of depressive disorders in children and adolescents: rates, temporal sequencing, course and outcome. In: Essau, C.A., Petermann, F. (Eds.), Depressive Disorders in Children and adolescents: Epidemiology, Risk Factors, and Treatment. Jason Aronson, Northvale, NJ.

Nylund, K.L., Asparouhov, T., Muthén, B.O., 2007. Deciding on the number of classes in latent class analysis and growth mixture modeling: a Monte Carlo simulation study. Struct. Equ. Model. 14, 535–569.

Olino, T.M., Klein, D.N., Farmer, R.F., Seeley, J.R., Lewinsohn, P.M., 2012. Examination of the structure of psychopathology using latent class analysis. Compr. Psychiatry 53, 323–332. https://doi.org/10.1016/j.comppsych.2011.05.008.

Petersen, A.C., Sarigiani, P.A., Kennedy, R.E., 1991. Adolescent depression: why more girls? J. Youth Adolesc. 20, 247–271.

Prinz, R.J., Jones, T.L., 2003. Family-based interventions. In: Essau, C.A. (Ed.), Conduct and Oppositional defi Ant disorders: Epidemiology, Risk factors, and Treatment. Lawrence Erlbaum Associates, New Jersey.

Reinherz, H.Z., Giaconia, R.M., Lefkowitz, E.S., Pakiz, B., Frost, A.K., 1993. Prevalence of psychiatric disorders in a community population of older adolescents. J. Am. Acad. Child Adolesc. Psychiatry 32, 369–377.

Rohde, P., Lewinsohn, P.M., Seeley, J.R., 1991. Comorbidity of unipolar depression: II. Comorbidity with other mental disorders in adolescents and adults. J. Abnorm. Psychol. 100, 214–222.

Su, L., Wang, K., Fan, F., Su, Y., Gao, X., 2008. Reliability and validity of the screen for child anxiety related emotional disorders (SCARED) in Chinese children. J. Anxiety Disord. 22, 612–621.

Tofighi, D., Enders, C.K., 2008. Indentifying the correct number of classes in growth mixture models. In: Hancock, G.R., Samuelsen, K.M. (Eds.), Advances in Latent Variable Mixture Models, editors. Information Age, Greenwich, CT, pp. 317–341.

Vaidyanathan, U., Patrick, P.J., William, G., Iacono, W.G., 2011. Patterns of comorbidity among mental disorders: a person-centered approach. Compr. Psychiatry 52, 527–535.

Van Lang, N.D.J., Ferdinand, R.F., Ormel, J., Verhulst, F.C., 2006. Latent class analysis of anxiety and depressive symptoms of the Youth Self-Report in a general population sample of young adolescents. Behav. Res. Ther. 44, 849–860. https://doi.org/10.1016/j.brat.2005.06.004.

Vermunt, J.K., 2010. Latent class modeling with covariates: two improved three-step approaches. Polit. Anal. 18, 450–469. https://doi.org/10.1093/pan/mpq025.

Weems, C.F., 2008. Developmental trajectories of childhood anxiety: identifying continuity and change in anxious emotion. Dev. Rev. 28, 488–502. https://doi.org/10.1016/j.dr.2008.01.001.

Widiger, T.A., Clark, L.A., 2000. Toward DSM-V and the classification of psychopathology. Psychol. Bull. 126, 946–963.