Obsessive-Compulsive Symptomatology in Community Youth: Typical Development or a Red Flag for Psychopathology?

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Objective: Obsessive-compulsive symptoms (OCS) are common throughout development and often considered developmentally appropriate. We evaluated the prevalence and phenotypic heterogeneity of self-reported OCS in a large community youth sample not ascertained for seeking mental-health help. We aimed to identify patterns in OCS that are associated with serious psychopathology and may thus represent a "red flag" that merits psychiatric evaluation.

Method: Data were analyzed from youth from the Philadelphia Neurodevelopmental Cohort (N = 7,054, aged 11−21 years, 54% female). Participants underwent structured psychiatric interviews, including screening for OCS (8 obsessions, 8 compulsions, and hoarding) and other major psychopathology domains. Factor analysis was conducted to identify clustering of OCS presentation. Regression models were used to investigate association of OCS with threshold lifetime diagnoses of obsessive-compulsive disorder (OCD), depressive episode, psychosis, and suicide ideation.

Results: OCS were common in non−mental health−seeking individuals (38.2%), although only 3% met threshold OCD criteria. OCS were more common in female participants and postpuberty. Factor analyses resulted in 4 factors: F1 – Bad Thoughts; F2 − Repeating/Checking; F3 – Symmetry; F4 – Cleaning/Contamination; and Hoarding as a separate item. All OCS were associated with higher rates of OCD, depression, psychosis, and suicide ideation. However, endorsement of F1 symptoms, prevalent in more than 20% of the sample, showed the most substantial associations with major psychiatric conditions.

Conclusion: OCS are common in community youth. Although for most youths OCS symptoms may be benign, some patterns of OCS are associated with major psychiatric conditions. These findings may help to identify youth at risk for serious psychopathology.

Key words: obsessive-compulsive, developmental psychopathology, factor analysis

bsessive-compulsive symptoms (OCS) are characterized by repetitive thoughts, urges, or mental images (obsessions) and/or repetitive behaviors (compulsions). Self-reported OCS rates are not reliably characterized, ranging from 8% to 72% in children, adolescents, and young adults.[1-3] When these obsessions and compulsions are accompanied by distress and impairment levels that become intrusive and debilitating, a formal diagnosis of obsessive-compulsive disorder (OCD) is more appropriate.[4] OCD affects 2% to 4% of children and adolescents[5-7]; however, OCD goes undetected and untreated in as many as 90% of cases.[8]

Engaging in repetitive and ritualistic behaviors is a part of typical child development.[9,10] Young children use these behaviors as a tool to help enforce consistency, connect with peers, and improve socialization.[9] However, as children grow older, these behaviors may no longer be necessary to help reach age-appropriate goals.[9] A study of community sample children, aged 8 to 14 years, showed that overall OCS endorsement declines as children reach adolescence, although a subset of children show a surge in OCS in eighth grade.[11] For patients in whom OCS reach threshold OCD, there are 2 patterns of OCD onset: childhood vs. adult onset.[12] Puberty is the decisive feature in these 2 patterns, whereas childhood onset is characterized by symptoms antedating puberty and commonly affecting more male youth.[8] Adult onset is characterized by symptoms starting during or after puberty and commonly affecting more women.[13]

OCD is heterogeneous across individuals with differing patterns of obsessions or compulsions.[14] Likewise,

comorbidity patterns are also heterogeneous.[15] Studies examining adults diagnosed with OCD have shown that the most common comorbid disorder with OCD is depression (lifetime: 54%, concurrent: 36%),[16] but adults with OCD often present with other comorbid serious psychiatric conditions, such as psychosis (25%)[17] and suicidal thoughts (36%).[18] Children with OCD are similarly affected by a range of comorbidities.[19] Earlier-onset OCD is associated with comorbid externalizing and anxiety disorders at younger ages,[20,21] whereas later-onset OCD comorbidity patterns resemble those of adults, regardless of age of onset.[20]

A method used to reduce phenotypic heterogeneity across individuals is factor analysis.[22,23] Previous dimensional studies using factor analyses in children and adolescents with OCD have revealed similar (although not identical in all studies) factors.[24-28] The factors can be generally divided into the following: an aggressive, sexual, religious thoughts factor; a symmetry, ordering, counting, repeating factor; a contamination and cleaning factor; and a hoarding factor.

Although previous studies have almost exclusively focused on identifying dimensions that emerge among children and adolescents who meet criteria for threshold OCD,[25-27,29] 2 studies have examined these factors in community samples of children and adolescents who report subthreshold OCS, and 1 study has examined OCS dimensionally without the use of factors. Fullana et al.[1] examined the presence of 4 obsessions and compulsions in a sample of 792 children 11 years of age and reported 8% OCS endorsements. Alvarenga et al.[30] found that parent-reported OCS endorsement gradually increased with age, and was associated with comorbid psychiatric disorders and decreased school and behavioral function. From the same cohort of children, Saad et al.[31] assessed more specific comorbidity associations of a subset of 2,512 self-reporting 6- to 12-year-old children and found that higher rates of OCS, as determined by the Child Behavior Checklist–Obsessive-Compulsive Scale, were associated most significantly with comorbid anxiety disorders, attention-deficit/hyperactivity disorder (ADHD), disruptive disorders, and mood disorders. These 2 studies suggest that subthreshold OCS may be associated with psychiatric comorbidities. However, no studies have been performed in large samples of interviewed community adolescents, spanning pre- and postpuberty with self-report of multiple OCS and clinical phenotyping for major psychiatric conditions.

Given the prevalence of children and adolescents who engage in some obsessions and/or compulsions but do not reach threshold criteria for an OCD diagnosis, it remains a clinical challenge to identify subsets at risk for major psychiatric conditions. In the current study, we aimed to fill this gap through analysis of the Philadelphia Neurodevelopmental Cohort (PNC) dataset. The PNC includes a large, non−help-seeking community sample (N = 7,054) of children and adolescents aged 11 to 21 years who were psychiatrically assessed and reported on lifetime occurrence of major domains of psychopathology, including obsessive-compulsive symptoms and disorder, depression, psychosis and suicidal ideation. The aims of this study were twofold: first, to evaluate the prevalence and heterogeneity of subthreshold OCS in a community youth sample; and second, to identify patterns of OCS presentations that are most suggestive of serious psychopathology and should trigger further psychiatric evaluation or intervention.

METHOD

Participants
The Philadelphia Neurodevelopmental Cohort is a collaboration between Children's Hospital of Philadelphia and Brain Behavior Laboratory at the University of Pennsylvania.[32] Enrollment criteria included the following: age 8 to 21 years; ambulatory in stable health; proficient in English; physically and cognitively capable of completing study procedures; and absence of a significant physical condition or developmental delay that impairs motility or cognition (eg, paresis or palsy, intellectual disability). Participants were recruited from a pool (N = 15,293) of children previously genotyped as part of a genomic study at Children's Hospital of Philadelphia health care network, which extends to more than 30 clinical community sites in the tri-state area of Pennsylvania, New Jersey, and Delaware, in the United States. Participants were not recruited from psychiatric clinics, and the sample is not enriched for those seeking mental health services. Based on electronic medical record review or follow-up telephone contact, potential participants from this pool were excluded if they were not proficient in English, had significant developmental delays or other conditions that would interfere with their ability to complete study procedures, or could not be contacted. From the remaining pool, 13,598 individuals were invited; 2,699 declined; 1,401 were excluded; and 9,498 youths (aged 8−21 years) were enrolled. The sample is large (N = 9,498) and racially diverse (56% white, 33% African American, and 11% other), with diverse socioeconomic backgrounds.[33] Clinical assessment was administered to collateral informants who were caregivers or legal guardians for participants aged 8 to 10, to both probands and collaterals for participants aged 11 to 17, and solely to probands for participants aged 18 to 21. After complete description of the study, written informed consent was obtained from participants aged ≥ 18 years, and written

assent and parental permission were obtained from children aged < 18 and their parents/legal guardians. University of Pennsylvania and Children's Hospital of Philadelphia's Institutional Review Boards approved all procedures.

For the current analyses, we included only proband interviews, and therefore only data from probands aged 11 to 21 years were analyzed (N = 7,054).

Clinical Assessment

Psychopathology symptoms were evaluated by trained and supervised assessors (Bachelor's and Master's degree level who underwent a rigorous standardized training and certification protocol) using a structured screening interview (GOASSESS), as detailed elsewhere,[32] which was based on the Kiddie Schedule for Affective Disorders and Schizophrenia (K-SADS).[34] Lifetime OCD or depressive episode diagnoses were determined if symptoms were endorsed with frequency and duration meeting *DSM-IV* disorder or episode criteria, accompanied by significant distress or impairment. Lifetime suicide ideation was determined based on a direct question regarding having thoughts of killing oneself. Psychosis was considered for participants who endorsed having hallucinations or delusions based on the K-SADS screen, with duration ≥ 1 day, occurring outside the context of substance, illness, and medicine use, and accompanied by significant impairment or distress.[35] Level of function was evaluated by the Children's Global Assessment Scale (C-GAS).[36] Pubertal status was determined based on self-report of genital development (Tanner score of 5 was considered postpubertal).

Assessment of Obsessive and Compulsive Symptoms

GOASSESS OCD screen assessed lifetime experience of 8 obsessions and 9 compulsions. Participants were asked the following about obsessions: "Have you ever been bothered by thoughts that don't make sense to you, that come over and over again and won't go away?" Obsessions included: (1) concern with harming others/self; (2) pictures of violent things; (3) thoughts about contamination/germs/illness; (4) fear that you would do something/say something bad without intending to; (5) feelings that bad things that happened were your fault; (6) forbidden/bad thoughts; (7) need for symmetry/exactness; and (8) religious thoughts. Next, participants were asked the following about compulsions: "Have you ever had to do something over and over again, that would have made you feel really nervous if you couldn't do it?" Compulsions included: (1) cleaning or washing (for example, your hands, your house); (2) counting; (3) checking (for example, doors, locks, ovens); (4) getting dressed over and over again; (5) going in and out a door over and over again; (6) ordering or arranging things;

(7) doing things over and over again at bedtime, like arranging pillows, sheets, or other things; (8) saved up so many things that people complain or they got in the way; and (9) feel the need to do things just right (like they have to be perfect). If at least 1 obsession/compulsion was endorsed, subsequent questions assessed further lifetime criteria of OCD, which was assigned if: 1 or more obsession (that were experienced as intrusive despite attempts at suppression or that the participant tried to avoid) or compulsion was endorsed that reportedly prevented the participant from doing activities s/he normally would do, were time consuming (≥ 1 hour per day), lasted for ≥ 6 months, and was accompanied by significant distress or impairment (either rated ≥ 5 on an 11-point scale).

For 406 participants (6.5% of PNC), clinical items including GOASSESS OCD screen and/or pubertal status items were missing and were therefore excluded from analyses. In the present analyses, we compared participants who endorsed at least 1 symptom on the OCD screener, namely, having obsessive-compulsive symptoms (OCS, n = 2,697), to participants who endorsed no obsessive-compulsive symptoms (non-OCS, n = 3,951) (Table 1).

Factor Analysis

Exploratory factor analysis (least-squares extraction with oblimin rotation) was performed on tetrachoric correlations among obsessive-compulsive items. The hoarding item was excluded from factor analysis, given reasons suggesting that hoarding may be a distinct construct from OCD.[37,38] This decision was supported by preliminary factor analyses (not shown, available upon request). Number of factors to extract from all OCS was determined by a combination of 5 empirical methods: parallel analysis[39] with Glorfeld correction,[40] Zoski multiple regression procedure,[41] Cattell−Nelson−Gorsuch method,[42] minimum Bayesian Information Criterion (BIC),[43] and minimum average partial.[44]

Statistical Analysis

Univariate comparisons between OCS and non-OCS participants were conducted using 2-tailed *t* tests or χ^2 tests, as appropriate. For multivariate analyses, we performed binary logistic regressions to investigate associations of sex, pubertal status, and their interaction with endorsement of at least 1 OCS as the dependent variable, controlling for age (puberty regressed) and socioeconomic status as covariates. Associations of different OCS factors with serious psychiatric conditions were evaluated using binary logistic regression models with the index dichotomous variable (OCD, depression, psychosis, or suicide ideation) as dependent variable, and the 5 obsessive/compulsive factors as

TABLE 1 Comparison of Participants Who Had Endorsed at Least 1 Obsessive-Compulsive Symptom (OCS) to Participants Who Did Not Endorse Any OCS (Controls)

	Total N = 7,054	OC Spectrum n = 2,697 (38.2%)	Controls n = 3,951 (56%)	Test	p
Age, y (SD)	15.8 (2.7)	15.8 (2.6)	15.5 (2.7)	t Test	<.001
Sex, female, n (%)	3,807 (54%)	1,581 (58.6%)	2005 (50.7%)	χ^2	<.001
Postpubertal, n (%)	3,079 (43.6%)	1,348 (50.1%)	1,731 (44.3%)	χ^2	<.001
Race, white, n (%)	3,970 (56.3%)	1,432 (53.1%)	2,303 (58.3%)	χ^2	<.001
SES, z score (SD)	0.01 (1)	−0.05 (1)	0.05 (1)	t Test	<.001
OCD, n (%)	209 (3%)	209 (7.7%)	0 (0%)	χ^2	<.001
Depression, n (%)	1,030 (14.6%)	712 (26.4%)	310 (7.8%)	χ^2	<.001
Psychosis, n (%)	348 (4.9%)	258 (9.6%)	83 (2.1%)	χ^2	<.001
Suicide ideation, n (%)	671 (9.5%)	444 (16.5%)	180 (4.6%)	χ^2	<.001
Level of function, C-GAS (SD)	78.7 (12.1)	75.4 (12.9)	81.2 (10.8)	t Test	<.001

Note: C-GAS = Children's Global Assessment Scale; OC = obsessive-compulsive; OCD = obsessive-compulsive disorder; SES = socioeconomic status.

independent variables controlling for sex, pubertal status, age, and socioeconomic status as covariates. A separate binary logistic regression model was used to investigate associations between specific symptoms in obsessive/compulsive factor of F1 – Bad Thoughts with OCD, depression, psychosis or suicide, controlling for sex, pubertal status, age, and socioeconomic status as covariates. In all analyses, depression, psychosis, and suicidal thoughts variables did not exclude individuals with other disorders; for example, a "depressed" person in these analyses might also have other disorders. A 2-tailed p value of <.05 was considered statistically significant in all analyses. Statistical analyses were performed using SPSS Statistics 24 (IBM Corp., Armonk, NY), except for factor analysis, which was performed using *nFactors* and *psych* packages in R.

RESULTS

Prevalence of Obsessive and Compulsive Symptoms Endorsement

We included participants (aged 11−21 years, N = 7,054) who reported symptoms, including 209 participants (3%) who met criteria for a lifetime OCD diagnosis. Almost 40% of the cohort (n = 2,697; 38.2%) endorsed at least 1 obsession or compulsion on the OCD screener (OCS participants). Female sex (odds ratio [OR] = 1.30, Wald = 25.97, df = 1, p < .001) and puberty (OR = 1.18, Wald = 9.95, df = 1, p = .002) were associated with OCS endorsements. There was a sex-by-puberty interaction in association with OCS manifested by higher OCS proportion in postpubertal female participants (Wald = 4.30, df = 1, p = .038) (Figure 1). Compared to non-OCS participants, the OCS group was on average slightly older, had a higher proportion of female participants, and a lower proportion of

white individuals (Table 1). For rates of OCS endorsement by age and sex, see Table S1, available online. Regarding major psychopathology phenotypes, OCS participants had higher prevalence of lifetime depression, psychosis, and suicide ideation. OCS participants were rated as having a lower level of global function (Table 1). Notably, of 2,697 OCS participants, the vast majority did not fulfill criteria for a lifetime OCD diagnosis (n = 2,488; 92.3%).

FIGURE 1 Relationship Between Sex and Pubertal Status in Association With Rate of Obsessive-Compulsive Symptoms in Study Participants
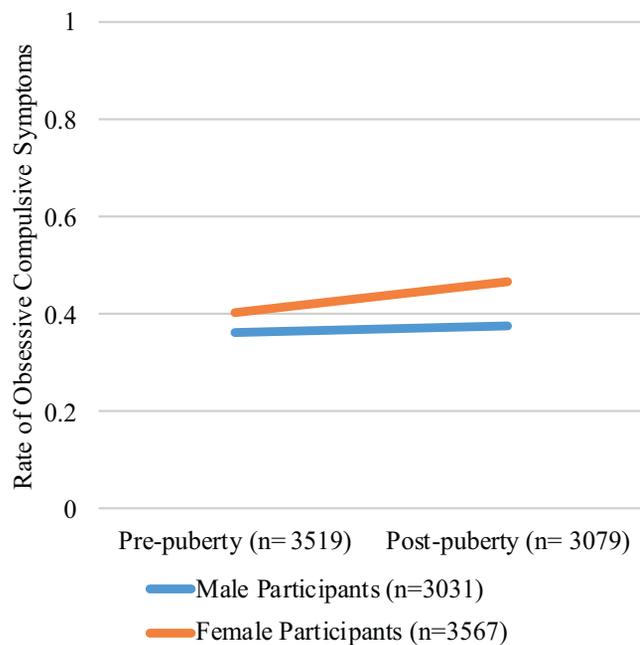
Note: Please note color figures are available online.

Factor Analysis of Obsessive and Compulsive Symptoms

Five empirical methods used here suggested 2, 3, 4, and 5 factors (see Table S2, available online). Four of the fit indices suggested that as few as 2 factors are necessary to explain adequate variance; however, χ^2 values were all significant (indicating misfit), and χ^2 difference tests revealed that 7 factors are optimal. For these reasons, we opted to choose the median number of suggested factors (4), with hoarding as a separate, stand-alone indicator (Table 2). The factors that emerged comprise the following: F1 – Bad Thoughts, including negative intrusive thoughts about harming others/self, fear of doing/saying something bad without intending to, feeling that bad things that happened were your fault, and having forbidden, bad, religious, or violent thoughts; F2 – Repeating/Checking, which also included counting; F3 – Symmetry, and F4 – Contamination (Table 2). Endorsement of symptoms across factors showed substantial overlap (Figure S1, available online). In all 4 factors and hoarding, self-reported OCS were more prevalent in female participants, with main effect for puberty in F1 and F2, and not in other OCS factors. No sex-by-puberty interaction was observed in association with any OCS factors (Table S3, available online).

Clinical Associations for Different OCS Factors

Next, we investigated the association of each OCS factor with lifetime report of major comorbid psychopathology (OCD, depression, psychosis, and suicide ideation), controlling for pubertal status, age, sex, and socioeconomic status (Figure 2, Table S4, available online). Endorsement of at least 1 OCS was significantly associated with a higher rate of lifetime history of depression, psychosis, and suicide ideation (all OR > 4.0, all $p <$ .001). Probing for associations of each factor in a model that accounts for all OCS factors revealed that F1 had the most robust associations with comorbid psychopathology phenotypes: OCD (OR = 11.7), depression (OR = 4.3), psychosis (OR = 3.3), and suicide ideation (OR = 4.4, all $p <$ .001). Other significant associations included F2 with depression (OR = 1.5, $p <$ .001), F3 with psychosis (OR = 1.8, $p <$ .001), and Hoarding with depression (OR = 1.9, $p <$ .001). F4 was not associated with any major psychiatric conditions that we evaluated except for OCD itself (OR = 1.8, $p <$ .001) (Figure 2, Table S4, available online). Analysis of comorbid associations with OCS treated as a continuous measure (sum of endorsements) showed similar findings (Table S5, available online).

Specific Clinical Correlations for Bad Thoughts (F1) Symptoms

To further probe which symptoms within F1 are associated with serious psychopathology phenotypes, we conducted a regression model including all F1 symptoms controlling for pubertal status, age, sex, and socioeconomic status (Table 3). Endorsement of thoughts that included concern with harming others/self was significantly associated with OCD, depression, psychosis, and suicide ideation (all $p <$ .023). Endorsement of having thoughts that include envisioning pictures of violence was significantly associated with depression, psychosis, and suicide ideation (all $p =$ .015). Endorsement of having thoughts that include fear of doing or saying something bad without intending to was significantly associated with OCD, depression, and psychosis (all $p =$ .001). Thinking or feeling that bad things that happened were 1's fault was associated with OCD, depression, and suicide ideation (all $p <$ .003). Endorsement of having forbidden/bad thoughts was associated with OCD, depression, and suicide ideation (all $p <$ .001). Religious thoughts were associated with OCD and psychosis (both $p <$ .03).

DISCUSSION

This study is the first and largest community youth sample (N = 7,054) that spans pre- and postpuberty (11−21 years of age) and that assessed for subthreshold obsessions and compulsions and their associated serious psychiatric comorbidities. Several key findings emerge from the data. We found that obsessive-compulsive symptoms are common in community youth, more so in female participants and after puberty. OCS can be clustered into 4 factors: F1 – Bad Thoughts; F2 – Repeating/Checking; F3 – Symmetry; and F4 – Cleaning/Contamination. Hoarding stood alone as a single item, similar to work showing that hoarding is a separate disorder from OCD.[4,38] One OCS factor, F1 – Bad Thoughts, is especially associated with serious psychopathology beyond OCD, whereas cleaning and contamination OCS are not.

Endorsement rate of at least 1 OCS in the sample was 38.2%, and although this is higher than in some studies looking at self-reported rates of OCS,[1,45,46] it fell into the 27% to 72% endorsement range reported previously.[3] Our rate of OCS endorsement may be higher because we asked about several obsessions and compulsions, and because our age range extended into postpuberty. In agreement with previous studies, we found that 3.0% of the sample met criteria for threshold OCD diagnosis.[5,19,45,46] Also in accordance with previous findings, we documented a sex-by-puberty interaction, whereby postpubertal female participants endorsed higher OCS compared to male counterparts.[8] Unlike previous studies, we did not find that prepubertal male participants endorsed higher rate of OCS compared to female peers.[6,13] Alvarenga et al.[30] reported that prepubertal boys showed an increase in OCS

TABLE 2 Factor Loadings of 17 Obsessions and Compulsions Resulting in 4 Factors

Factor	Item	F1	F2	F3	F4
(F1) Bad Thoughts	Forbidden/bad thoughts	**0.88**	0.04	−0.02	-0.05
	Concern with harming self/others	**0.87**	−0.03	−0.05	0.06
	Pictures of violent things	**0.78**	0.11	−0.06	0.00
	Fear that you would do something/say something bad without intending to	**0.77**	−0.03	0.16	0.01
	Feelings that bad things that happened were your fault	**0.74**	0.01	0.10	0.02
	Religious thoughts	**0.51**	0.08	0.03	0.18
(F2) Repeating/Checking	Getting dressed over and over again	0.08	**0.77**	−0.08	0.09
	Going in and out a door over and over again	0.13	**0.76**	0.00	−0.04
	Doing things over and over again at bedtime, like arranging pillows, sheets or other things	0.05	**0.58**	0.25	0.05
	Checking (for example doors, locks, ovens)	0.13	**0.51**	0.19	0.11
	Counting	0.09	**0.43**	0.34	0.06
(F3) Symmetry	Need for symmetry/exactness	0.09	−0.11	**0.88**	0.04
	Ordering or arranging things	−0.05	0.32	**0.69**	0.03
	Feel a need to do things just right (like they have to be perfect)?	0.12	0.06	**0.61**	0.05
(F4) Cleaning/Contamination (n = 663)	Thoughts about contamination/germs/illness	0.05	−0.03	0.00	**0.99**
	Cleaning or washing (for example, your hands, your house)?	−0.07	0.43	0.13	**0.50**

Note: Hoarding stood alone as a single factor. Numbers (n) in each factor represent total participants who endorsed at least 1 obsessive-compulsive symptom in a factor. Most salient loadings of symptoms to factors are in bold.

FIGURE 2 Visual Presentation of Odds Ratios and 95% CIs of Each Obsessive-Compulsive Symptoms (OCS) Factor in Association with Lifetime Obsessive-Compulsive Disorder (OCD), Depression, Psychosis, or Suicide Ideation
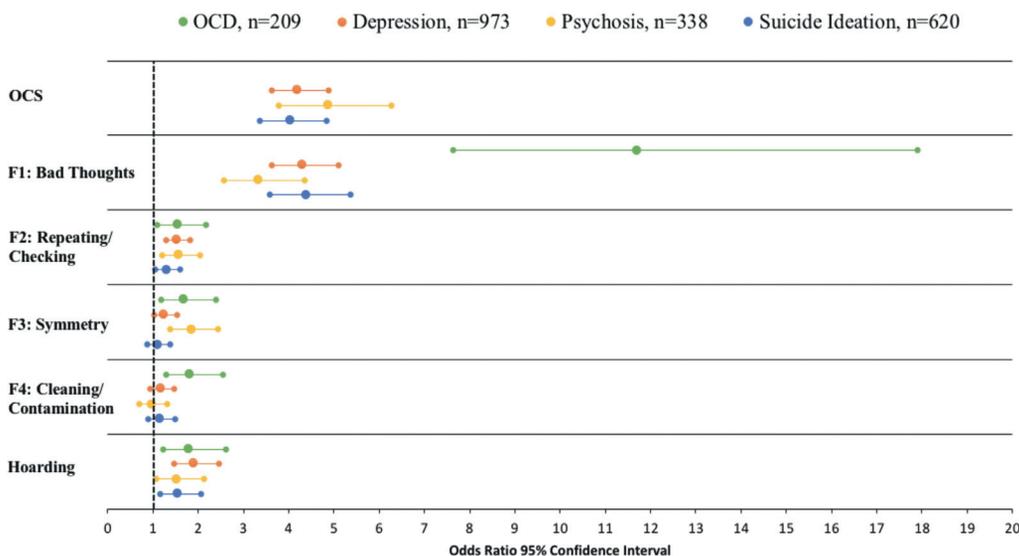
Note: Values were calculated based on binary logistic regression models including all OCS factors and controlling for pubertal status, age, sex, and socioeconomic status. F1 = Bad Thoughts; F2 = Repeating/Checking; F3 = Symmetry; F4 = Cleaning/Contamination; OCD = obsessive-compulsive disorder; OCS = endorsement of any obsessive or compulsive symptom. Please note color figures are available online.

TABLE 3 Association of Each F1 – Bad Thoughts Item With Comorbid Psychiatric Conditions (Obsessive-Compulsive Disorder [OCD], Depressive Episode, Psychosis, or Suicide Ideation)

Factor 1 Endorsed Symptom: Obsessive Thoughts Including…	OCD n = 209 n (%)	OR	95% CI Lower	Upper	p	Depression n = 973 n (%)	OR	95% CI Lower	Upper	p	Psychosis n = 338 n (%)	OR	95% CI Lower	Upper	p	Suicide Ideation n = 620 n (%)	OR	95% CI Lower	Upper	p
…concern with harming others/ self (n = 396)	80 (20.2%)	**2.5**	1.7	3.8	.000	205 (51.8%)	**2.3**	1.7	3.0	.000	75 (18.9%)	**1.5**	1.1	2.2	.022	184 (46.5%)	**5.0**	3.8	6.7	.000
…pictures of violent things (n = 371)	59 (15.9%)	1.3	0.9	2.0	.194	156 (42.0%)	**1.5**	1.1	2.0	.014	75 (20.2%)	**2.0**	1.4	2.8	.000	119 (32.1%)	**1.5**	1.1	2.1	.008
…fear of doing/ saying something bad without intending to (n = 796)	112 (14.1%)	**2.7**	1.8	4.0	.000	321 (40.3%)	**1.9**	1.5	2.3	.000	127 (16.0%)	**2.1**	1.6	2.9	.000	194 (24.4%)	1.2	0.9	1.5	.254
…feeling that bad things that happened were your fault (n = 861)	113 (13.1%)	**2.5**	1.7	3.7	.000	370 (43.0%)	**3.2**	2.6	4.0	.000	119 (13.8%)	**1.6**	1.2	2.2	.002	229 (26.6%)	**2.4**	1.9	3.1	.000
…forbidden/bad thoughts (n = 379)	72 (19.0%)	**1.9**	1.2	2.8	.003	178 (47.0%)	**1.6**	1.2	2.1	.003	71 (18.7%)	1.3	0.9	1.9	.129	131 (34.6%)	**1.7**	1.2	2.3	.001
…religious thoughts (n = 337)	58 (17.2%)	**2.1**	1.4	3.1	.000	133 (39.5%)	1.3	1.0	1.7	.093	57 (16.9%)	**1.5**	1.0	2.2	.030	76 (22.6%)	0.9	0.6	1.2	.424

Note: For each comorbidity, we ran a binary logistic regression analysis with the comorbidity as dependent variable and the 6 F1 items as independent variables, controlling for age (puberty regressed), sex, and socioeconomic status. All significant odds ratios (OR) (p < .05) are in boldface type.

endorsements from ages 6 to 10 years, and that at age 11 years OCS endorsements started to decrease, whereas girls' OCS endorsements started to peak at age 11 years. It is possible that we did not find pre-pubertal boys endorsing higher OCS because age 11 was the lowest age for the self-reported data that we analyzed. However, Zohar and Bruno reported an increase in both boys' and girls' OCS endorsement in eighth grade, whereby girls endorsed more cleaning symptoms and boys endorsed more checking symptoms.[11] These results are in accordance with our data, as we saw a slight increase in OCS endorsement in both male and female participants at ages 13 to 14 years in comparison to ages 11 to 12.

It has been suggested that in order to help identify more homogenous phenotypes in psychiatric research, and in line with Research Domain Criteria (RDoC),[47] it may be useful to study OCD using factor analysis.[14,37] The emerging factors that we found are similar to a large meta-analysis including 21 studies and 5,124 participants, which found that a 4-factor model explained much of the heterogeneity in OCS endorsement.[37] That study reported 4 factors: (1) symmetry, (2) forbidden thoughts, (3) cleaning, and (4) hoarding. The 4 factors that we report map onto to what was found across these 21 studies, except that our analysis separated symmetry from repeating/checking, whereas repeating/checking was a part of symmetry factor in the meta-analysis.[37] Factors that emerged in the current study are also similar to factors generally found in factor analyses performed in children diagnosed with OCD.[24-27]

Two previous studies factor-analyzed obsessions and compulsions in community-based youth samples. Fullana *et al.*[1] examined the presence of longitudinal obsessions and compulsions at ages 11, 26, and 32 in a self-report, community sample.[1] However at age 11 years, 792 children included in that study were asked about a limited set of 4 OCS (having thoughts or pictures you don't like come into your head; having rules about things that you have to do over and over; feeling you have to do things in exactly the same way; feel you have to count something and can't stop even when you try to). Of the sample, 8% endorsed OCS, and hoarding was not assessed. Our study assessed a wider range of OCS and also captured a broader age range that spans development at critical ages around puberty. These 2 strengths may explain the discrepancy of OCS endorsement between 8% in Fullana *et al.*[1] and 38.2% in the current study. The second study to investigate dimensional factors in a community sample used parent report of Dimensional Yale−Brown Obsessive-Compulsive Scale (DY-BOCS[48]) in a large cohort of 9,937 Brazilian school-children (6−12 years old).[30] That study showed that OCS endorsement gradually increased with age, and was associated with

comorbid psychiatric disorders and with decreased school and behavior function. However, there is a major limitation in using parent report instead of youth self-report, as children can try to hide their obsessions from parents, and parent−child dyads are known to have high discordance in OCS reporting.[49] In the PNC dataset, for whom there is available proband and parent report (ages 11−18), we have observed significant discrepancies in endorsement of OCS, with lower endorsement of OCS among parents compared to youth probands (unpublished data).

We found that endorsing any obsessions or compulsions is associated with serious comorbid psychiatric conditions. Some self-reported OCS were more suggestive of serious comorbid psychiatric conditions, especially F1 – Bad Thoughts, whereas other OCS were not, such as F4 – Cleaning/Contamination. Previous work reported similar associations of bad thoughts, including aggressive, sexual, and religious thoughts, with depression in adults diagnosed with OCD.[50,51] In accordance, we found that F1 factor showed a significantly stronger association with OCD compared to other OCS factors, suggesting that having F1 symptoms is strongly associated with severity levels that constitute core features of OCD diagnosis, such as having symptoms for significant portions of the day or significant distress and impairment. Although some content of F1 items seems to be confounded with its comorbid psychopathology beyond OCD (ie, concern with harming others/ self, and suicide ideation, OR = 5.0), other nonintuitive associations are present as well. For example, feeling like bad things that happened were your fault was also associated with suicide ideation (OR = 2.4), perhaps suggesting a tendency toward the ruminating thought process that often underlies depression.[18] Regarding psychosis, although previous studies show that OCD is commonly comorbid with psychosis,[17] this study is the first to examine subthreshold OCS dimension comorbidity with psychotic symptoms in youth. Our results may suggest that endorsing any cognitions that make up F1 flags an individual to be at serious risk for 4 major psychiatric conditions: OCD, depression, psychosis, and suicidal ideation.

Some limitations should be noted. Data were cross-sectional and assessed lifetime symptoms, not current symptoms; therefore, no causal claims may be made from the current analyses. The OCS screen, although detailed, did not include a severity scale for obsessive-compulsive symptomatology like the DY-BOCS. Nonetheless, our large sample of youth self-reporting in an interview on a detailed list of OCS with robust clinical phenotyping around puberty onset facilitated analyses crucial for understanding a common (almost 40% prevalence of OCS in the current sample) phenomenon in child and adolescent

mental development. That is, our results using a large community sample are more likely to be generalizable than results using smaller or noncommunity samples.

This study may have 2 immediate clinical implications. First, we show that although OCS are common, for the vast majority of children and adolescents (92.3% of OCS endorsing youth), this does not reach the OCD clinical threshold. However, for some individuals, OCS is associated with serious psychiatric conditions besides OCD. This manifested with the following: (1) more than 1 in 4 OCS youth fulfilling criteria for a lifetime depressive episode; (2) 1 in 6 OCS reporting lifetime suicide ideation; and (3) almost 1 in 10 OCS youth endorsing threshold psychotic symptoms. The association of OCS with suicide ideation is of special importance in light of a recent population-based national cohort study in Sweden reporting that patients with OCD are at substantial risk for suicide.[52] For these youths who endorse OCS and a serious comorbid psychiatric condition, identification of OCS may be a "window" through which clinicians may probe and rapidly identify serious psychiatric conditions. Second, we show that, among OCS youth, some phenotypic subtypes are more suggestive of comorbid serious psychiatric conditions compared to others. Specifically, some factors that comprise compulsive symptoms, such as cleaning, have relatively low associations with comorbidities compared to bad thoughts. This finding has major implications for mental health policies and for general adolescent health policies. Specifically, we suggest that probing for the 6 specific OCS that make up F1 can help assign patients to levels of risk for serious psychiatric conditions. This suggestion may have practical implications for the clinical encounter, as time with the clinician is costly, and therefore there is a need to identify "high-yield" clinical questions that can help stratify risk in a short time. Future research is warranted to develop specific clinical guidelines.

To conclude, we report a high rate of obsessive-compulsive symptoms in a large, generalizable sample of US youth. Results show that, although endorsing OCS may represent an appropriate developmental milestone for most adolescents, in a significant proportion of self-reporting OCS youth, these symptoms are associated with depression, psychosis, and suicide ideation. We show that specific phenotypes of OCS presentations, especially bad obsessive thoughts, are strongly associated with serious psychiatric

conditions. We hope that these results will propel mental health professionals and non–mental health professionals (ie, pediatricians) alike to probe for these symptoms during clinical evaluations, as these may prove vital for identifying youth who are on a potentially debilitating psychiatric developmental trajectory.

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TABLE S1 Comparison of Different Age Groups' Endorsement of at Least One Obsessive-Compulsive Symptom (OCS)

	Both Sexes		Male Participants		Female Participants	
Age Bins, y	Total, n	OCS, n (%)	Total, n	OCS, n (%)	Total, n	OCS, n (%)
11—12	1,370	513 (37.4%)	684	231 (33.8%)	686	282 (41.1%)
13—14	1,441	440 (38.2%)	683	229 (33.5%)	758	321 (42.3%)
15—16	1,555	681 (43.8%)	736	288 (39.1%)	819	393 (48%)
17—18	1,507	648 (43.0%)	638	260 (40.8%)	869	388 (44.6%)
19—21	775	317 (40.9%)	320	117 (36.6%)	455	200 (44%)

TABLE S2 Suggested Number of Factors and Corresponding Fit Indices for Five Empirical Methods for Determining the Number of Factors to Extract From Obsessive-Compulsive Symptoms

Method	Suggested No.	χ^2	CFI	TLI	SRMR	RMSEA
Parallel analysis with Glorfeld correction (quantile = 0.95)	5	108.1 (df = 50; $p < .00005$)	1.00	1.00	0.021	0.013 ± 0.003
Zoski multiple regression procedure	4	176.5 (df = 62; $p < .00005$)	1.00	0.99	0.025	0.016 ± 0.003
Minimum Bayesian Information Criterion (BIC)	4	176.5 (df = 62; $p < .00005$)	1.00	0.99	0.025	0.016 ± 0.003
Cattell—Nelson—Gorsuch method	3	322.1 (df = 75; $p < .00005$)	0.99	0.99	0.035	0.022 ± 0.003
Minimum Average Partial (MAP) method	2	678.0 (df = 89; $p < .00005$)	0.98	0.98	0.052	0.031 ± 0.002

Note: CFI = Comparative Fit Index; df = degrees of freedom; No. = number; RMSEA = root mean-square error of approximation; SRMR = standardized root mean residual; TLI = Tucker-Lewis Index.

TABLE S3 Main Effects and Interaction of Sex and Puberty in Association With Obsessive-Compulsive Symptoms (OCS) Factors

Factors	Dependent Variables	OR	Lower Bound, 95% CI	Upper Bound, 95% CI	Wald (df)	*p*
F1 — Bad Thoughts	Sex	1.16	1.03	1.31	5.576 (1)	.018
	Puberty	1.14	1.01	1.28	4.475 (1)	.034
	Sex × Puberty				0.087	.768
F2 — Repeating/ Checking	Sex	1.27	1.13	1.43	16.14	.000
	Puberty	1.2	1.07	1.34	9.147	.002
	Sex × Puberty				0.734	.392
F3 — Symmetry	Sex	1.42	1.24	1.63	25.457	.000
	Puberty	1.02	0.9	1.17	0.122	.727
	Sex × Puberty				1.493	.222
F4 — Cleaning/ Contamination	Sex	1.41	1.19	1.67	15.305	.000
	Puberty	1.13	0.96	1.33	2.001	.157
	Sex × Puberty				0.397	.529
Hoarding	Sex	1.31	1.06	1.62	6.17	.013
	Puberty	1.18	0.95	1.45	2.316	.128
	Sex × Puberty				3.21	.073

Note: Values represent results of binary logistic regression with sex, puberty, and their interaction as independent variables and the index OCS factor as the dependent variable. Models control for age (puberty regressed) and socioeconomic status.

TABLE S4 Association of Each Obsessive-Compulsive Symptoms (OCS) Factor With Comorbid Psychiatric Conditions

Factor Endorsed	OCD n = 209		95% CI			Depression n = 973		95% CI			Psychosis n = 338		95% CI			Suicide Ideation n = 620		95% CI		
	n (%)	OR	Lower	Upper	p	n (%)	OR	Lower	Upper	p	n (%)	OR	Lower	Upper	p	n (%)	OR	Lower	Upper	p
Any OCS Spectrum[a] (n = 2,697)	209 (7.7%)				<.001	712 (26.4%)	**4.2**	3.6	4.8	.000	258 (9.6%)	**4.9**	3.8	6.3	.000	444 (16.5%)	**4.0**	3.3	4.8	.000
F1 — Bad Thoughts[b] (n = 1,462)	173 (11.8%)	**11.7**	7.6	17.8	.000	529 (36.2%)	**4.3**	3.6	5.1	.000	197 (13.5%)	**3.4**	2.6	4.4	.000	336 (23.0%)	4.3	3.5	5.3	.000
F2 — Repeating/ Checking[b] (n = 1,646)	131 (8.0%)	**1.7**	1.2	2.5	.002	459 (27.9%)	**1.3**	1.1	1.6	.014	171 (10.4%)	**1.9**	1.4	2.5	.000	265 (16.1%)	1.1	0.9	1.4	.350
F3 — Symmetry[b] (n = 1,106)	118 (10.7%)	**1.5**	1.1	2.1	.016	341 (30.8%)	**1.5**	1.3	1.8	.000	147 (13.3%)	**1.5**	1.2	2.0	.002	199 (18.0%)	**1.3**	1.1	1.6	.013
F4 — Cleaning/ Contamination[b] (n = 663)	93 (14%)	**1.8**	1.3	2.5	.001	227 (34.2%)	1.2	0.9	1.5	.217	83 (12.5%)	0.9	0.7	1.3	.737	139 (21.0%)	1.1	0.9	1.5	.367
Hoarding[b] (n = 403)	52 (12.9%)	**1.8**	1.2	2.6	.003	146 (36.2%)	**1.9**	1.5	2.5	.0000	59 (14.6%)	**1.5**	1.1	2.1	.023	97 (24.1%)	**1.6**	1.2	2.1	.003

Note: Each OCS Factor was treated as a dichotomous measure (endorsement of at least one/none of the OCS items). For each comorbidity (obsessive-compulsive disorder [OCD], depressive episode, psychosis, or suicide ideation), we ran a binary logistic regression analysis with the comorbidity as the dependent variable and the OCS Factor as the independent variable, controlling for age (puberty regressed), sex, and socioeconomic status (SES).
[a]Model controls for pubertal status, age, sex, and SES.
[b]Models control for all other OC factors, pubertal status, age, sex, and SES. All significant odds ratios (OR) (p < .05) are in boldface type.

TABLE S5 Association of Each Obsessive-Compulsive Symptoms (OCS) Factor, Treated as a Continuous Measure (a Count of Endorsed OCS Items), With Comorbid Psychiatric Conditions

Factor Endorsed	OCD n = 209 n (%)	OR	95% CI Lower	Upper	p	Depression n=973 n (%)	OR	95% CI Lower	Upper	p	Psychosis n=338 n (%)	OR	95% CI Lower	Upper	p	Suicide Ideation n=620 n (%)	OR	95% CI Lower	Upper	p
Any OCS Spectrum[a] (n = 2,697)	209 (7.7%)	**1.5**	1.4	1.5	.000	712 (26.4%)	**1.4**	1.3	1.4	.000	258 (9.6%)	**1.3**	1.3	1.3	.000	444 (16.5%)	**1.3**	1.3	1.3	.000
F1 — Bad Thoughts[b] (n = 1,462)	173 (11.8%)	**1.8**	1.6	2.0	.000	529 (36.2%)	**1.8**	1.7	1.9	.000	197 (13.5%)	**1.5**	1.4	1.6	.000	336 (23.0%)	**1.7**	1.7	1.9	.000
F2 — Repeating/ Checking[b] (n = 1,646)	131 (8.0%)	**1.4**	1.1	1.6	.000	459 (27.9%)	**1.4**	1.3	1.5	.000	171 (10.4%)	**1.3**	1.1	1.5	.000	265 (16.1%)	**1.1**	1.1	1.3	.000
F3 — Symmetry[b] (n = 1,106)	118 (10.7%)	1.1	0.9	1.3	.381	341 (30.8%)	1.0	0.9	1.1	.647	147 (13.3%)	**1.2**	1.1	1.4	.000	199 (18.0%)	0.8	0.8	1.0	.204
F4 — Cleaning/ Contamination[b] (n = 663)	93 (14%)	**1.7**	1.3	2.1	.000	227 (34.2%)	1.1	0.9	1.3	.411	83 (12.5%)	0.9	0.7	1.2	.533	139 (21.0%)	0.8	0.8	1.2	.887
Hoarding[b] (n = 403)	52 (12.9%)	1.5	1.0	2.2	.078	146 (36.2%)	**1.7**	1.3	2.2	.000	59 (14.6%)	1.3	0.9	1.9	.149	97 (24.1%)	0.9	0.9	1.8	.109

Note: For each comorbidity (obsessive-compulsive disorder (OCD), depressive episode, psychosis or suicide ideation), we ran a binary logistic regression analysis with the comorbidity as the dependent variable and the OCS Factor as the independent variables, controlling for age (puberty regressed), sex, and socioeconomic status (SES).
[a]Model controls for pubertal status, age, sex and SES.
[b]Models control for all other OC factors, pubertal status, age, sex and SES. All significant OR (p value < .05) are in bold.

FIGURE S1 Venn Diagram of the Overlap Between Obsessive-Compulsive Symptom (OCS) Factors
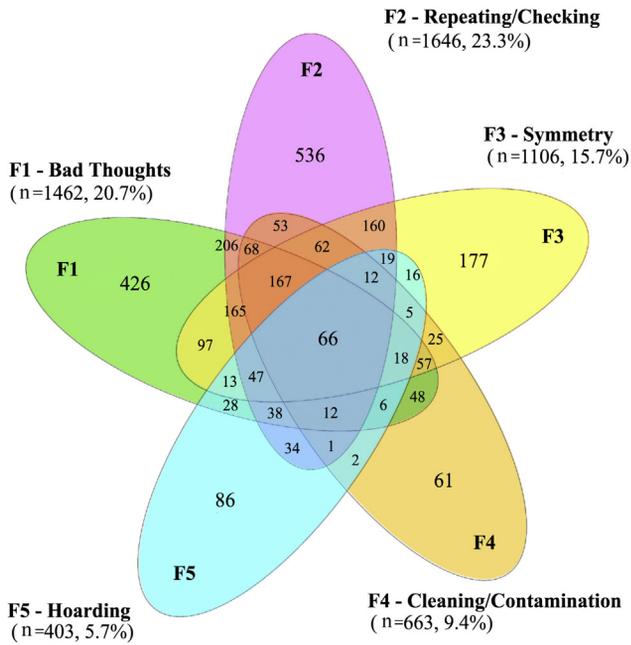
Note: Values represent number of participants that endorsed at least 1 obsessive-compulsive symptom in each factor.