Effects of COVID-19 pandemic on the score of Yale-Brown obsessive-compulsive scale among university students: a prospective survey

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Submitted to: Journal of Medical Internet Research
on: June 29, 2020

Table of Contents

Original Manuscript..... 5

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Corresponding Author:
Xian-Zhang HuMD, PhD,
Phone: +8613938744850
Email: huxianzhang@xxmu.edu.cn

Abstract

Background: The COVID-19 pandemic is associated with common mental health problems (e.g. fear). Evidence of how the fear of COVID-19 affected obsessive-compulsive disorder (OCD) is limited.

Objective: This study aimed to examine if fear of negative events affects the score of Yale-Brown obsessive compulsive scale (Y-BOCS) in a fear-invoke environment.

Methods: All participants were medical university students and voluntarily completed three surveys via smart-phone or computer. Survey 1 was conducted on Feb. 8, 2020 after two-week quarantine without online courses, Survey 2 was conducted on March 25 when participants had been taking online courses for two weeks, and Survey 3 on April 28 when no new case had been reported for two weeks. We used a battery of questionnaire in Surveys, including basic information (age, gender, having sibling, enrollment year, major), knowledge on COVID-19 (0 for ‘do not know’ and 3 for ‘very knowledgeable’, The fear (0 for ‘no fear’ and 9 for ‘extreme fear’), Yale-Brown obsessive compulsive scale (Y-BOCS), and Zung Self-Rating Anxiety Scale (SAS).

Results: Survey 1 showed that 1519 (11.3%) of 13478 participants scored ?16 on Yale-Brown obsessive compulsive scale (Y-BOCS), defined as possible OCD (pOCD). Survey 2 and Survey 3 demonstrated 3.6% (305 of 8162) and 3.5% (305 of 8511), respectively. The Y-BOCS score, anxiety level, quarantine level, and intensity of fear were significantly lower at Surveys 2 and 3 than that at Survey 1 (P<.001 for all). Compared to those with a lower Y-BOCS score (<16), participants with pOCD had higher intensity of fear and SAS standard score (P<.001). The regression linear analysis indicated that the intensity of fear was positively correlated to the rate of pOCD and the average total scores for Y-BOCS in each survey (P<.001 for all). Multiple regressions indicated that those with higher intensity of fear, higher anxiety level, are male, have sibling(s), and majored in non-medicine predicted higher Y-BOCS score in all surveys. These results were re-demonstrated in 5827 Survey 1 and Survey 2 matched participants and in 4006 matched participants from three surveys. Furthermore, in matched participants, the Y-BOCS score was negatively correlated to the changes of the intensity of fear (r=0.63 for Survey 2 and 0.74 for Survey 3, P<.01).

Conclusions: Our findings indicated that the fear of COVID-19 was associated with the increase of Y-BOCS score, suggesting that environment x psychology interaction might be involved in OCD and that a fear of negative events might play a role in the etiology of OCD.

(JMIR Preprints 29/06/2020:21915)
DOI: https://doi.org/10.2196/preprints.21915

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Guangjun Ji[b†], MD; Kai-Chen Yue[a†], MD; Heng Li[c], MB; Li-Jing Shi[a], BSN; Jian-Dong Ma[a], MD; Chen-Yang He[d], MD; Sheng-Sheng Zhou[a], MD; Zongya Zhao[b], PhD; Tao Lou[a], MD; Jie Cheng[a], MD; Shi-Chang Yang[a], MD, PhD; Wenjun Wei[b]*, MD; Xian-Zhang Hu[a,c]*, MD, PhD

[a] The Second Affiliated Hospital of Xinxiang Medical University, Xinxiang 453002, Henan Province, P. R. China
[b] Xinxiang Medical university, Xinxiang 453002, Henan Province, P. R. China
[c] The First Affiliated Hospital of Xinxiang Medical University, Xinxiang 453002, Henan Province, P. R. China
[d] Institute of Psychiatry and Neuroscience, Xinxiang Medical university, Xinxiang 453002, Henan Province, P. R. China

[†] GJ Ji and KC Yue contributed equally to this work.
*Corresponding Authors:
Xian-Zhang Hu
The Second Affiliated Hospital of Xinxiang Medical University, Xinxiang 453002, Henan Province, P. R. China
Email: huxianzhang@xxmu.edu.cn
Wen-Jun Wei
Xinxiang Medical university, Xinxiang 453002, Henan Province, P. R. China
Email: weiwenjun@xxmu.edu.cn

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Furthermore, in matched participants, the Y-BOCS score was negatively correlated to the changes of the intensity of fear (r=0.63 for Survey 2 and 0.74 for Survey 3, P<.01).

Conclusions: Our findings indicated that the fear of COVID-19 was associated with the increase of Y-BOCS score, suggesting that environment x psychology interaction might be involved in OCD and that a fear of negative events might play a role in the etiology of OCD.

Keywords: COVID-19, fear, anxiety, obsessive-compulsive disorder, Yale-Brown obsessive-compulsive scale

Introduction

At the end of 2019, an outbreak of coronavirus disease, caused by novel coronavirus (SARS-CoV-2 or COVID-19), was reported in the Chinese city of Wuhan [1]. With the number of cases and the death toll climbing, fear and uncertainty had spread around the globe as coronavirus continued to captivate the world's attention. Since the end of January 2020, many provinces including Henan province declared quarantine, which might further instill fear of the virus within communities. At the same time, public education on disease prevention and environmental hygiene was emphasized in public facilities across the country. Information outlets such as the internet, television, radio, newspapers, cellphones, and social media (e.g. WeChat) were full of the advice on how to prevent individuals from being infected by the virus (e.g. stay at home, wear face masks, wash hands frequently, and/or sanitize hands). At the same time, the rapid transmission of COVID-19, around 2% fatality rate, lack of effective treatments and vaccines, and mass quarantine measures are associated with common mental health problems (e.g. fear, anxiety, depression, and sleep problems) in subpopulations including COVID-19 patients, those with close contact, the public, and health care professionals [2, 3]. A study including 1210 respondents from 194 cities in China found that 54% of respondents rated the psychological impact of the Covid-19 outbreak as moderate or severe; 29% reported moderate to severe anxiety symptoms; and 17% reported moderate to severe depressive symptoms[4]. However, there is a lack of researches on effects of the COVID-19 pandemic on specific mental disorders, such as obsessive-compulsive disorder (OCD).

OCD is a chronic and debilitating mental disorder and tends to be treatment refractory and is characterized by unwanted intrusive thoughts (obsessions)and repetitive compulsive behaviors or mental rituals (compulsions). Individuals perform compulsions in response to the distress associated with the content of the obsessions. Often of early onset, OCD affects 2% to 3% percent of the United States population [5] and affects patients throughout their lives, leading to a diminished quality of

life for patients and their families, reduced productivity, and high health care costs. OCD accounts for 2.2% of total years lived with disability (YLD), around the same percentage as schizophrenia [6].

OCD has been reported to have several specific clinical characteristics. First, individual manifests OCD symptom only under certain situations that usually invoke a fear of negative events. Second, more than 90% of the general population have ever experienced intrusive thoughts [7]. Third, the more effort put into controlling the obsessions, the more frequent and intense the obsessions intruded into the patients' mind [8]. Forth, the compulsions can make intrusive thoughts become more frequent, repetitive, and disturbing [9]. Fifth, the performance of repetitive behaviors (e.g. handwashing or checking) are generally related to a fear of negative events, such as fear of contamination or fear of a house catching on fire. Finally, in an OCD symptom-induced situation, the fear of negative events, obsessions, and compulsions can be considered as stressors and their effects on individuals can be neutralized when appropriate coping strategies are used [10-12]. These evidences suggest that a fear of negative events involves in the symptom development and maintenance. For example, individuals with OCD repetitively check due to a fear of loss of property and spend long time in handwashing due to a fear of contamination [13, 14]. In addition, worry, disgust, and not-just-right can be involved in the onset of OCD [15, 16]. Recently, a study in pediatric OCD found that individuals with OCD exhibit greater fear acquisition and impaired inhibitory learning, compared to healthy control [17]. However, there is lack of prospective studies on the relationship between the onset of OCD and a fear of negative events.

In this prospective study, we conducted surveys with students of the Xinxiang Medical University (XXMU) at three timepoints during the COVID-19 pandemic. We primarily sought to investigate whether the fear of COVID-19 affected the prevalence of possible OCD (pOCD) based on the score ≥16 of Yale-Brown obsessive-compulsive scale (Y-BOCS). We also aimed to investigate the predictors for the pOCD. We hypothesized that the fear of COVID-19 contamination would be

correlated to the Y-BOCS score.

Methods

Participants

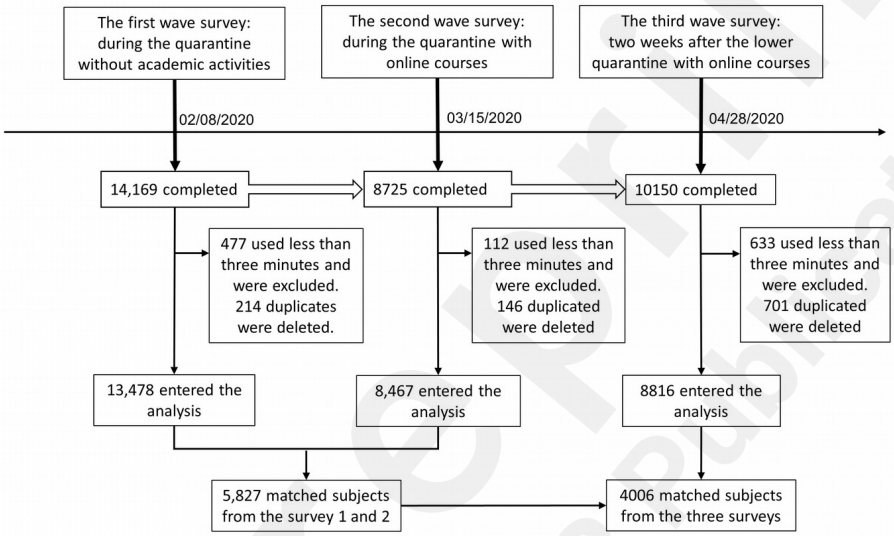
In this prospective cohort study, we surveyed college students in XXMU, including medical students and non-medical students. A battery of questionnaires, containing demographic information, basic knowledge of COVID-19 (0: do not know, 1: a little; 3: some; and 4: very much), intensity of fear of the virus (scored 0-9, none=0, and 9=extreme fear), Yale-Brown Obsessive compulsive scale (Y-BOCS), and Zung Self-Rating Anxiety Scale (SAS), was posted through WeChat. All participants voluntarily completed the survey through their own smartphone or computer at three timepoints.

Procedure

The surveys were taken at three time-points. Initail Survey 1 was taken on Feb. 8, 2020 when the participants were on winter-break under highest level of quarantine with increased COVID-19 cases reported. The Survey 2 was taken on March 15 when the participants had been taking online courses for two weeks under middle level of quarantine. The Survey 3 was taken on April 30 when the participants were still taking academic activities at home under low quarantine level with no new case reported. Among them, 477 students who completed the survey in less than 3 minutes were excluded, and 214 duplications were deleted. In Survey 2, we received 8725 completed reports. Among them, 112 students who completed the survey in less than 3 minutes were excluded and 146 duplications were deleted. In Survey 3, we received 10150 completed reports. Among them, 633 students who completed the survey in less than 3 minutes were excluded and 701duplications were deleted. In order to track the identity of individuals who completed all three surveys, we used nickname, age, gender, address (city), grade, and major as ID variables and got 5,827 ID matched participants from the two surveys, after excluding one of the ID duplicate in each survey and those who completed the surveys in 3 minutes (Figure 1). In the surveys, quarantine level in different areas

where participants were staying were announced by the government and were designed into low (scored 1), medium (scored 2), and high (scored 3), which reflected the severity of COVID-19 pandemic. The survey protocol was approved by the Committee on Human Research at the Xinxiang Medical University. This study involving internet technologies ensured compliance with the principles of voluntary participation. All participants were given informed consent of electronic version.

Figure 1. The flow diagram of surveys in the undergraduate students and residencies



Assessment

We used a battery of questionnaire in Surveys, including basic information (age, gender, having sibling, enrollment year, major), knowledge on COVID-19 (0 for ‘do not know’ and 3 for ‘very knowledgeable’, The fear (0 for ‘no fear’ and 9 for ‘extreme fear’), Yale-Brown obsessive compulsive scale (Y-BOCS), and Zung Self-Rating Anxiety Scale (SAS). The Y-BOCS is an undisputed gold standard to evaluate the severity of OCD symptoms [18, 19]. It is the most widely used semi-structural scale in both clinical and research settings. It is comprised of a comprehensive symptom checklist to identify the specific type and content of obsessive and compulsive symptoms in addition to a 10-item rating scale. After inquiring about what types of obsessions and compulsions the patient experiences using a standard checklist, individuals are asked to identify their main

symptoms (obsessions and compulsions) and respond to a series of questions that comprise the Y-BOC Scale. The scale is divided into two subscales that separately measure obsessions and compulsions. For each subscale, five aspects of obsessive and compulsive pathology are each rated on a scale ranging from 0 (no symptoms) to 4 (extreme symptoms): time spent, degree of interference, distress, resistance (greater resistance is assigned lower scores), and perceived control over the symptom. Subscale scores are summed to yield a Y-BOCS Total score. The consistence and discrepancy between self-report and clinician-rated Y-BOCSs are reported that they are moderately correlated with the highest correlation observed for the compulsion subscale and that patients rate symptoms lower than clinicians [20, 21]. Since many studies use Y-BOCS score ≥16 as an inclusion criteria for OCD, we defined that score as pOCD in this study because of a lack of face-to-face interview to make a diagnosis. The SAS was designed by William W. K. Zung M.D, (1929-1992) a professor of Psychiatry from Duke University, to quantify a patient's level of anxiety [22]. The SAS is a 20-item self-report assessment device built to measure anxiety levels, based on scoring in 4 groups of manifestations: cognitive, autonomic, motor, and central nervous system symptoms. Responding to each item, a person should indicate how much each statement applies to him or her in the recent one or two weeks. Each question is scored on a scale of 1-4 (based on these replies: "a little of the time," "some of the time," "good part of the time," "most of the time"). Five items are negatively worded to avoid the problem of set response. The total raw scores range from 20-80. The raw score is used as an anxiety severity score. The total score of 20-44 indicates normal range, 45-59 indicates mild to moderate anxiety, 60-74 indicates marked to severe anxiety, and 75 and above indicates extreme anxiety.

Statistical analyses

The microdata from the three surveys of the same population were analyzed using the SPSS version 24. Demographic characteristics of the study were tabulated by using means and standard deviations for continuous variables and frequency distributions for categorical variables. The

repeated measure analyses (Wilson's Lambda) were performed in 5827 participants who were matched using ID variables from the first two surveys and in 4006 matched participants from all three surveys, to examine the changes in Y-BOCS score, anxiety levels (SAS score), and intensity of fear over the COVID-19 disease. For all eligible participants from all surveys, ANOVA, Chi-square test, and regression analyses were performed to examine the demographic characteristics and the Y-BOCS score predictors.

Results

There were 13478 participants in Survey 1, 8467 participants in Survey 2, and 8816 participants who entered the analysis. The participants aged from 17 to 50 years old (mean ± SD: 21.3±2.5 in Survey 1, 21.2 ± 2.3 in Survey 2, 20.9±2.0 in Survey 3 that was lower than those in Survey 1 and Survey 2, P<.001). Six hundred and sixty-four (4.9%) participants in Survey 1, 274 (3.2%) participants in Survey 2, and 199 (2.6%) participants in Survey 3 aged ≥26 years old. The proportion of the participants who majored in clinical medicine was higher in Survey 1, compared to those in Survey 2 and Survey 3 (P<.001). There were 5827 participants who had at least five out of six ID variables matched in Survey 1 and Survey 2 and 4006 participants were matched from all three surveys. The gender composition ratio and the rate of having sibling(s) were not significantly different between the three surveys. The distribution of participants in the year of enrollment (2015 to 2019) was different between the three surveys (χ^2 =151.6, df=4, P<.001) (Table 1).

Table 1. Demographic characteristics and questionnaire score

	Survey 1	Survey 2	Survey 3	F or χ^2	P
Age (year, mean±SD)	21.3±2.5	21.2±2.3	20.9±2.0	85.6	<.001
Intensity of fear (mean±SD)	7.8±2.0	6.7±2.2	6.5±2.2	1147.9	<.001
Y-BOCS score (mean±SD)	7.9±5.7	4.8±5.1	4.5±5.1	1366.6	<.001
SAS standard score (mean±SD)	36.9±7.9	36.1±8.2	36.2±8.1	34.2	<.001
Quarantine level	2.44±0.65	1.26±0.45	1.00±0.03	27129.4	<.001
Age, N (%)					
<26	12814 (95.1)	8193 (96.7)	8617 (97.4)		
≥26	664 (4.9)	274 (3.3)	199 (2.6)	113.6	<.001
Gender, N (%)	4662 (34.6)	2991 (35.3)	3113 (35.3)	1.8	.414

Male					
Female	8816 (65.4)	5476 (64.7)	5703 (54.7)		
Major					
Clinical	8549 (63.4)	4576 (54.0)	5259 (59.7)		
Basic medical	3428 (26.4)	2902 (34.3)	2467 (28.0)		
Non-medical	1501 (11.1)	989 (11.7)	1090 (12.3)	227.3	<.001
Having sibling(s), N (%)					
No					
Yes	2452 (18.2)	1495 (17.7)	1557 (17.7)		
	11026 (81.8)	6972 (82.3)	7259 (82.3)	1.5	.480
Enrolled year, N (%)					
2015	1319 (10.0)	941 (11.1)	665 (7.5)		
2016	2343 (17.7)	1863 (22.0)	1403 (15.9)		
2017	2997 (22.6)	1511 (17.8)	2013 (22.8)		
2018	3274 (24.7)	2169 (25.6)	2474 (28.1)		
2019	3017 (22.8)	1883 (22.2)	2206 (25.0)		
others	291 (2.2)	92 (1.3)	55 (0.6)	360.9	<.001
Y-BOCS score, N (%)					
≥ 16	1519 (11.3)	305 (3.6)	305 (3.5)		
< 16	11959 (88.7)	8162 (96.4)	8511 (96.5)	704.5	<.001

The OR for Y-BOCS was 2.4 (95% CI: 2.2 to 2.7).

In Survey 1 11.3% of participants with Y-BOCS score ≥16 (possible obsessive-compulsive disorder) was significantly higher than 3.6% in Survey 2 (χ^2 =401.2, df=1, OR: 2.4, 95% CI of OR: 2.2 to 2.7, *P*<.001) and 3.5% in Survey 3 (χ^2 =431.9, df=1, OR: 3.5, 95% CI of OR: 3.1 to 4.0, *P*<.001). Compared to the baseline, the self-reported intensity of fear of COVID-19, Y-BOCS score, SAS standard score, and quarantine level (low=1, medium=2, and high=3) were significantly reduced in Survey 2 and Survey 3 (*P*<.001 for all) (Table 1).

Table 2. Repeated measure analysis (Wilson's Lambda) in matched samples between the first two surveys (n=5827) and among all three surveys (n=4006)

	Survey 1	**Survey 2**	**Survey 3**	**F (df)**	**P value**
Y-BOCS score	8.0 ± 5.60	4.7±4.9		1858.6 (1)	<.001
SAS score	36.6±7.6	35.7±7.9		81.2 (1)	<.001
Intensity of fear	7.8±2.0	6.6±2.3		1357.9 (1)	<.001
Quarantine level	2.5±0.7	1.3±0.5		21371.4 (1)	<.001
Y-BOCS score	7.9±5.5	4.7±4.9	4.3±4.9	823.8 (2)	<.001
SAS score	36.3±7.4	35.2±7.6	35.6±7.9	41.2 (2)	<.001
Intensity of fear	7.7±2.0	6.6±2.2	6.4±2.2	707.2 (2)	<.001
Quarantine level	2.5±0.7	1.3±0.4	1.0±0.03	9627.4 (2)	<.001

In the 5827 matched participants from Survey 1 and Survey 2 and the 4006 matched participants

from all three surveys, the repeated measure analysis (Wilson's Lambda) showed that the Y-BOCS score, SAS standard score, the intensity of fear of COVID-19, and the quarantine level in Survey 2 and Survey 3 decreased significantly from baseline (P<0.001 for all). The Y-BOCS score, the intensity of fear of COVID-19, and the quarantine level were lower in Survey 3 than those in Survey 2, while the SAS standard score in Survey 3 was higher than that in Survey 2 (*P*<.001 for all) (Table 2).

To further analyze the characteristic of participants, the two-way ANOVA analysis using two independent variables of the surveys and Y-BOCS score (dichotomously grouped into 'pOCD' with the score ≥16 and the participants with the score <16) was performed. Significant differences of Y-BOCS score, intensity of fear, SAS standard score, and quarantine level were found among the groups (*P*<.001), in which no statistical difference of the Y-BOCS score was found between the participants with pOCD in all three surveys. In Survey 2 and Survey 3, no difference was found in quarantine level between the participants with pOCD and those with Y-BOCS score <16 (Table 3). Also, the Chi-square test was applied to test the distribution of the pOCD in the surveys. The prevalence of pOCD in males was higher than that in female in all surveys. Taking age into account, the rates of pOCD in males aged <26 years were higher than those in females (P<0.01), while the rates of pOCD were not significantly different between male and female aged ≥26 years, in all three surveys. The distribution of pOCD was significantly different in the intensity of fear (about the COVID-19) (*P*< or = .001). The rate of pOCD in the participants who had sibling(s) was higher than that in those who had no sibling(s) ($\chi 2$=11.2, *P*=.001) in Survey 1, but no difference was found in Survey 2 and Survey 3. The distribution of pOCD in the year of enrollment was different in Survey 2 and Survey 3 (*P*<.05, Table 3).

Table 3. Comparison of the participants with higher Y-BOCS score (≥16) to those with lower Y-BOCS score (<16) from the three surveys

	Survey 1		**Survey 2**		**Survey 3**	
	Y-BOCS score <16	Y-BOCS score ≥16	Y-BOCS score <16	Y-BOCS score ≥16	Y-BOCS score <16	Y-BOCS score ≥16
Age	21.3±2.5	21.4±2.4	21.2±2.3	21.2±2.1	20.9±2.0	21.0±1.9

Y-BOCS score	6.49±4.29	18.97±3.21***	4.31±4.32	18.99±3.73***	4.0±4.2	19.3±2.9***
Intensity of fear	7.65±2.04	8.69±1.66***	6.64±2.285	7.26±2.16***	6.5±2.2	7.3±2.0***
SAS standard score	36.0±7.09	44.6±9.4***	35.6±7.5	50.1±12.6***	35.7±7.5	50.5±10.6***
Quarantine level	2.43±0.66	2.48±0.63**	1.26±0.46	1.26±0.44	1.0±0.03	1.0±0.00
Gender						
Male	4081 (87.5)	581 (12.5)**	2860 (95.6)	131 (4.4)**	2974 (95.5)	139 (4.5)***
Female	7878 (89.4)	938 (10.6)	5302 (97.3)	174 (2.7)	5537 (97.1)	166 (2.9)
Age						
<26						
Male	3865 (87.4)	556 (12.6)**	2772 (95.6)	129 (4.4)**	2911 (95.5)	137 (4.5)***
Female	7499 (89.3)	894 (10.7)	5127 (96.9)	165 (3.1)	5407 (97.1)	162 (2.9)
≥26						
Male	216 (89.6)	25 (10.4)	91 (97.8)	2 (2.2)	63 (96.9)	2 (3.1)
Female	379 (89.6)	44 (10.4)	172 (95.0)	9 (5.0)	130 (97.0)	4 (3.0)
Major						
Clinical	7652 (89.5)	897 (10.5)**	4425 (96.7)	151 (3.3) **	5098 (96.9)	161 (3.1)*
Basic medical	3002 (87.6)	426 (12.4)	2801 (96.5)	101 (3.5)	2367 (95.9)	100 (4.1)
Non-medical	1305 (86.9)	196 (13.1)	936 (94.6)	53 (5.4)	1046 (96.0)	44 (4.0)
Have sibling(s)						
No	2223 (95.6)	229 (4.4)**	1449 (96.9)	46 (3.1)	1501 (96.4)	56 (3.6)
Yes	9736 (97.3)	1290 (2.7)	6713 (96.3)	259 (3.7)	7010 (96.6)	249 (3.4)
Year of enrollment						
2015	1170 (88.7)	149 (11.3)	914 (97.1)	27 (2.9)*	645 (97.0)	20(3.0)*
2016	2076 (88.6)	267 (11.4)	1788 (96.0)	75 (4.0)	1348 (96.1)	55 (3.9)
2017	2633 (87.9)	364 (12.1)	1452 (96.1)	59 (3.9)	1923 (95.5)	90 (4.5)
2018	2914 (89.0)	360 (11.0)	2103 (97.0)	66 (3.0)	2407 (97.3)	67 (2.7)
2019	2708 (89.8)	309 (10.2)	1815 (96.4)	68 (3.6)	2135 (96.8)	71 (3.2)
Intensity of fear						
0	96 (97.0)	3 (3.0)***	180 (98.4)	3 (1.6)**	185 (99.5)	1 (0.5)***
1	100 (98.0)	2 (2.0)	223 (98.2)	4 (1.7)	218 (99.5)	1 (0.5)
2	216 (97.3)	6 (2.7)	382 (97.7)	9 (2.3)	471 (98.5)	7 (1.5)
3	293 (97.7)	7 (2.3)	446 (97.4)	12 (2.6)	544 (97.5)	14 (2.5)
4	980 (95.1)	51 (4.9)	1189 (97.1)	35 (2.9)	1278 (97.6)	31 (2.4)
5	1921 (93.5)	134 (6.5)	1607 (96.6)	55 (3.3)	1758 (96.8)	59 (3.2)
6	1781 (92.0)	154 (8.0)	1179 (97.0)	37 (3.0)	1295 (96.2)	51 (3.8)
7	2088 (90.0)	231 (10.0)	1116 (95.0)	59 (5.0)	1138 (96.3)	44 (3.7)
8	1086 (87.7)	153 (12.3)	513 (96.7)	18 (3.4)	462 (93.7)	31 (6.3)
9	3398 (81.4)	778 (18.6)	1327 (94.8)	73 (5.2)	1162 (94.6)	66 (5.4)
Quarantine level						
Low	1102 (90.6)	114 (9.4)**	6073 (96.4)	228 (3.6)	8501 (96.5)	305 (3.5)
Medium	4885 (89.6)	564 (10.4)	2032 (96.4)	76 (3.6)	10 (100.0)	0
High	6272 (88.2)	841 (11.8)	57 (98.3)	1 (1.7)	0	0

* $P<.05$; ** $P<.01$; *** $P<.001$

The regression linear analysis indicated that the intensity of fear was significantly correlated to the proportions of pOCD and the average total scores for Y-BOCS. The correlation coefficient between the intensity of fear and the rate of participants with pOCD was 0.92 for Survey 1, 0.89 for Survey 2, and 0.96 for Survey 3 ($P<.001$ for all). The correlation coefficient between the intensity of fear and the average of Y-BOCS score was 0.99 for Survey 1, 0.96 for Survey 2, and 0.96 for Survey 3 ($P<.001$ for all) (Figure 2).

Figure 2. Correlations of intensity of fear with rate of possible OCD and the Y-BOCS score

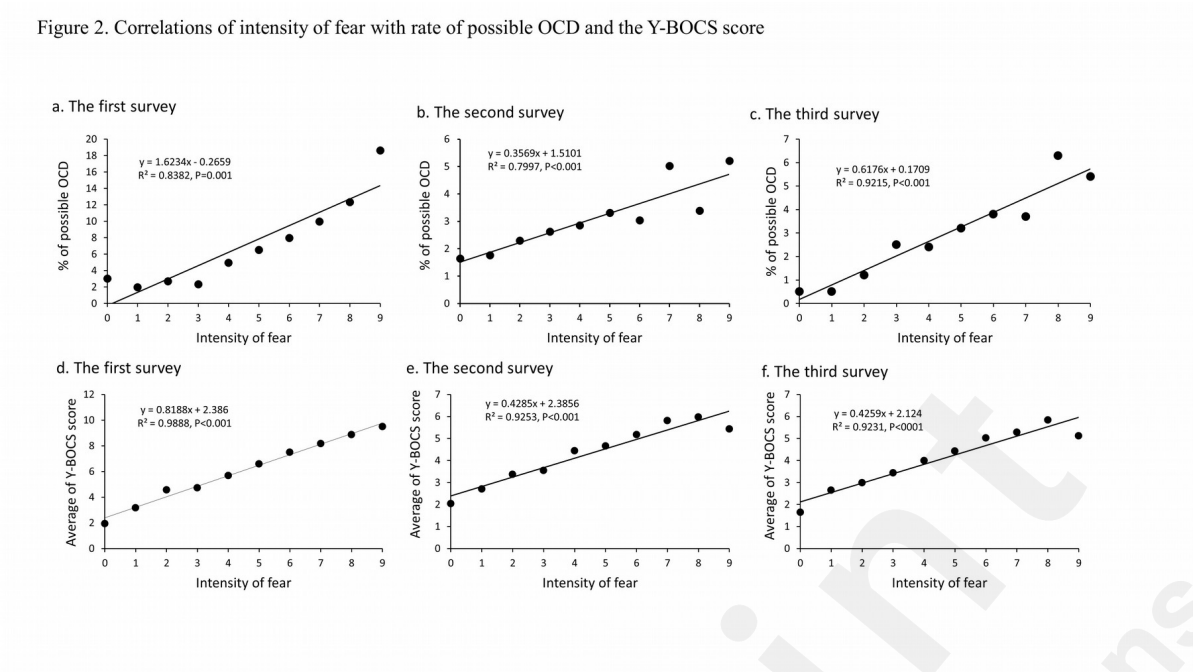


Figure 2. Correlations between intensity of fear and the rate of possible OCD and the Y-BOCS score in all participants. **Panels a, b, and c** shows that the intensity of fear was positive correlated to the rate of possible OCD (r=0.92 for Survey 1, r=0.89 for Survey 2, and r=0.96 for survey 3; *P*<.001 for all) in all participants, respectively. **Panels d, e, and f** shows that the intensity of fear was positive correlated to Y-BOCS score (r=0.99 for Survey 1, r=0.96 for Survey 2, and r=0.96 for Survey 3; *P*<.001 for all) in all participants, respectively.

In 5827 matched participants from Survey one and Survey two and 4006 matched participants from all three surveys, regression analysis indicated that the change of the intensity of fear ((Δfear = fear score from Survey 1 – fear score from Survey 2 or Survey 3) was negatively correlated to the average score of Y-BOCS (*P*<.001) (Figure 3).

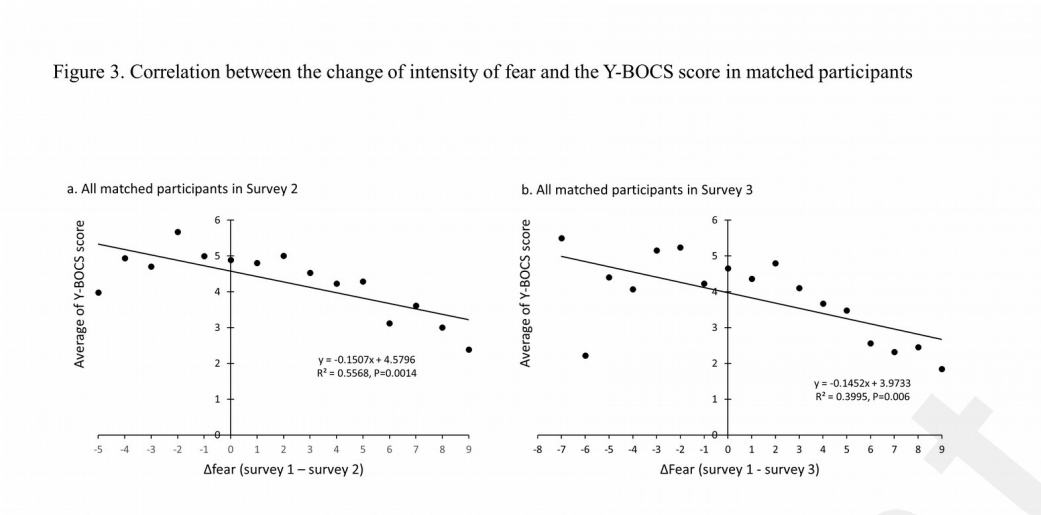


Figure 3. Correlation between the change of intensity of fear and the Y-BOCS score in matched participants. **Panel a:** The changes of intensity of fear (Δfear = fear score from Survey 1 – fear score from Survey 2) was significantly negatively correlated to the Y-BOCS score in Survey 2 (r=0.75, P<0.01) in 5827 matched participants. **Panel b:** The changes of intensity of fear (Δfear = fear score from Survey 1 – fear score from Survey 3) was significantly negatively correlated to the Y-BOCS score in Survey 2 (r=0.63, *P*<.01) in 4006 matched participants.

In order to test the factors that potentially served as predictors for the Y-BOCS score, the multiple linear stepwise regression was conducted and five variables (the intensity of fear, SAS standard score, gender, having sibling(s), and major (1: clinical medicine, 2: basic medical science, and 3: non-medical major)) entered the equation for all three surveys. The knowledge on COVID-19 entered the equations for Survey 1 and Survey 2 and was negatively correlated to the Y-BOCS score. The quarantine level entered the equation for Survey 1 only. The educational level and the year of enrollment were excluded from all equations (Table 4). The R^2 of the regression equation was 0.23 for Survey 1, 0.23 for Survey 2, and 0.26 for Survey 3.

Table 4. Multiple linear regression analysis using Y-BOCS score as dependent variable

Survey		B	Std. Error	Beta	t	*p*	95% CI for B
1	(Constant)	-9.15	0.48		-19.22	<.001	-10.09 to -8.22
	SAS standard score	0.29	0.01	0.40	52.08	<.001	0.28 to 0.30
	Intensity of fear	0.54	0.02	0.19	24.67	<.001	0.50 to 0.58

	Gender	0.50	0.09	0.04	5.44	<.001	0.32 to 0.68
	Having sibling(s)	0.49	0.11	0.03	4.32	<.001	0.27 to 0.71
	Major	0.27	0.06	0.03	4.29	<.001	0.15 to 0.40
	Quarantine level	0.18	0.07	0.02	2.71	<.01	0.05 to 0.31
	Knowledge on COVID-19	-0.17	0.09	-0.01	-1.96	<.05	-0.33 to 0.00
2	(Constant)	-8.37	0.48		-17.30	<.001	-9.32 to -7.42
	SAS standard score	0.28	0.01	0.45	46.35	<.001	0.27 to 0.29
	Intensity of fear	0.18	0.02	0.08	8.10	<.001	0.13 to 0.22
	Gender	0.67	0.10	0.06	6.51	<.001	0.47 to 0.87
	Having sibling(s)	0.64	0.13	0.05	4.97	<.001	0.39 to 0.89
	Major	0.21	0.07	0.03	2.97	<.01	0.07 to 0.35
	Knowledge on COVID-19	-0.22	0.09	-0.02	-2.52	<.05	-0.40 to -0.05
3	(Constant)	-9.82	0.36		-27.02	<.001	-10.54 to -9.11
	SAS standard score	0.30	0.01	0.48	51.44	<.001	0.29 to 0.32
	Intensity of fear	0.15	0.02	0.07	7.15	<.001	0.11 to 0.19
	Gender	0.38	0.10	0.04	3.82	<.001	0.19 to 0.58
	Having sibling(s)	0.73	0.12	0.05	5.90	<.001	0.49 to 0.98
	Major	0.21	0.07	0.03	3.19	<.01	0.08 to 0.34

Discussion

This online prospective survey study found that the prevalence of pOCD (11.3%) in Survey 1 at the early stage of COVID-19 pandemic was significantly higher than that in survey 2 (meddle stage) and Survey 3 (late stage). The Y-BOCS score, anxiety level, quarantine level, and intensity of fear of COVID-19 were significantly lower at Surveys 2 and 3 than that at Survey 1. Compared to those with a lower Y-BOCS score (<16), participants with pOCD had higher intensity of fear and SAS standard score (P<.001). The intensity of fear was positively correlated to the rate of pOCD and the average total scores for Y-BOCS in each survey (P<.001 for all). Multiple regressions indicated that those with higher intensity of fear, higher anxiety level, are male, have sibling(s), and majored in non-medicine predicted higher Y-BOCS score in all surveys. In matched participants among the surveys, the Y-BOCS score was negatively correlated to the changes of the intensity of fear of COVID-19.

The prevalence of pOCD in Survey 1 was three folds higher than that in Survey 2 and Survey 3,

suggesting that pOCD was induced in early stage of the COVID-19 pandemic. Also, the intensity of fear of COVID-19, anxiety level and the quarantine level significantly higher in Survey 1 compared to Survey 2 and Survey 3. The changes on the fear scale was negatively correlated with Y-BOCS score in the follow-up surveys. In each survey, the fear score was strongly correlated to the Y-BOCS score and the rate of pOCD. In multiple regression analysis showed that both SAS standard score and intensity of fear significantly contributed to the variation of Y-BOCS score. These findings suggested that the intensity of fear of COVID-19 played a role in OCD and that the interaction between fear, anxiety and pandemic-induced quarantine might be one of risk factors for the increase of Y-BOCS score. Also, to be expected, the high prevalence of pOCD (11.3%) in Survey 1 was observed. The COVID-19 pandemic might invoke the emotion of fear and individuals would manifest OCD-like symptoms when they overacted to the fear, especially with a feeling of anxiety. This was an example of the effects of environment x psychology interaction on OCD.

In the present study, the prevalence of pOCD at baseline decreased to 3.6% in five weeks and maintained at 3.5% after another six weeks. In all three surveys the participants were at their own home – living environment did not vary significantly. At the timepoint of Survey 2, the participants had been taking online courses at home for two weeks and the pandemic was partially under control. At the timepoint of Survey 3, the COVID-19 pandemic was under control; quarantine level was lowered further, and the participants continued taking online courses at home. The intervals between the three surveys were 5-6 weeks. Therefore, compared to Survey 1, the changed environmental factors at Survey 2 and Survey 3 mainly included the status of pandemic, level of quarantine, and online courses, while the changed psychological factors at Survey 2 and Survey 3 included the intensity of fear of COVID-19, the anxiety level decreased, and getting more knowledge about COVID-19. Statistical analysis indicated that the quarantine level and knowledge on COVID-19 were not correlated to Y-BOCS in Survey 3, while knowledge on COVID-19 was negative correlated to Y-BOCS score and explained less than 1% variation of Y-BOCS score. The decreases of the

intensity of fear and the anxiety level might be related to the reduction of quarantine level due to the decrease in new case report and getting more knowledge of COVID-19 and to their interaction with time. In addition, taking online courses could be considered as an intervention to reduce the fear of COVID-19 and anxiety. The more time spent on their online courses and the less time on tangling with the fear of COVID-19 and COVID-19-related anxiety. The reduction of the extensity of fear and anxiety was correlated to Y-BOCS score, leading to lower rate of pOCD. Taking online courses was a similar strategy we use in OCD treatment with cognitive-coping therapy for OCD [10, 11]. That, subsequently, might be related to the lower rate of pOCD in a relatively short period of time.

Not all participants with fear of COVID-19 were qualified to be pOCD on Y-BOCS score, although our findings indicated that the higher intensity of fear was related to higher prevalence of pOCD. Previously, we investigated the relationship between the fear of negative events and OCD on patients, and found that most of OCD patients attributed a fear of negative events to their symptoms [10-12]. The findings in this study introduced a new perspective to understanding this issue in the general population. First, it is not unusual that the most participants in this study reported a certain intensity of fear in the situation of COVID-19 pandemic. Second, the attitude, evaluation, and cognition of the fear might affect their response to it. Third, when fear is excessive and disproportionate to the situation, it could lead to the development of an anxiety disorder [23, 24]. Those who took the fear seriously and overreacted to the fear were more likely to be pOCD. Forth, environment x psychology interaction could be a risk factor for some people and a resilience factor for others due to the value-system differences.

We noted that 3 out of 1519 pOCDs in Survey 1, 3 out of 305 pOCDs in Survey 2, and 3 out of 305 pOCDs in Survey 3 reported that their intensity of fear was zero. However, they reported to have fear of bodily waste of secretions, dirt or germs, infectious illnesses, and environmental contamination. In the matched samples nobody reported zero on the intensity of fear had Y-BOCS score ≥16.

In addition, the participants who reported to have sibling(s) were more likely to qualify for pOCD

than those who had no sibling(s). In China, an only child easily becomes the family's center to attention. An only child usually gets the care from not only parents, but also grandparents, even throughout early adulthood. Only children have closer parent-child relationship, which is probably related to being dependent upon others and have relatively less familial responsibilities [25]. On the other hand, those with siblings generally takes on more responsibility, such as taking care of siblings or taking part in family affairs as a helper. The participants who had sibling(s) might be more responsible and thus overreacted to their fear of COVID-19 during the pandemic and was involved in the transient OCD.

Our findings demonstrated that the prevalence of pOCD in Survey 2 and Survey 3 was 3.6% and 3.5%, respectively. Also, the prevalence of pOCD in male participants at all timepoints was higher than that in female. The findings suggested that the students in medical university might have higher prevalence of OCD. Previously, Torres et al. found that 3.8% of Brazil medical student presented pOCD on the obsessive-compulsive inventory-revised [26]. Using the OCD subsection of the clinical interview schedule-revised as a self-administered questionnaire, Jaisoorya et al. report the point prevalence of OCD in Indian college students is 3.3% (males: 3.5%; females: 3.2%) [27]. Yoldascan et al. reported that, in Turkish university students, the prevalence of OCD is 4.2% and OCD was significantly associated with male [28]. Those data, and ours, suggested that the prevalence of OCD among the university students was similar and higher than general population in different cultures.

Our surveys indicated that the prevalence of pOCD was positively correlated to the major that the participant is studying. Basic medical scientific students had higher prevalence of pOCD than medical students and lower prevalence of pOCD than non-medical students. Also, students in their third and fourth year had higher prevalence of pOCD than others (the first, second, and fifth year). The findings suggested that knowledge involved in the 'onset' of pOCD, probably via affecting one's cognition and evaluation of fear of COVID-19.

Limitations

The strengths of this study include the pragmatic design and large sample size. There are several limitations in this study. First, the individuals with pOCD were defined only according to the Y-BOCS score and were not verified via face-to face interview. It might be related to the higher prevalence of pOCD in medical university students in this study than that in general population. Second, we did not collect any biological species and therefore could not analyze the relationship between OCD and the biological factors such as genetics and/or expression of certain proteins. Third, all participants are students at university and the findings should not be referred to general population. Further studies in general population are needed.

Conclusions

The environment (COVID-19 pandemic) x psychology (fear and/or anxiety) interaction might involve in the onset of OCD and that the fear of negative events should be considered as a target of intervention for mental health and well-being in both stressful situations and clinical practice.

Acknowledgements

We would like to thank the participants for taking part in the surveys. We would also like to thank statistician and professor Li-Hui Gui for sharing his knowledge and helping in the analysis of data.

Financial support

The National Natural Foundation of China (81371504).

Role of the funding source

The funder played no role in the design, conduct of the study; the collection, management, analysis and interpretation of data; the preparation, review and approval of the manuscript; and decision to

submit the manuscript for publication.

Contribution

XZ Hu contributed to the design of the study. XZ Hu, W Wei, G Ji, and KC Yue contributed to the questionnaire design and dissemination. G Ji, KC Yue, H Li, LJ Shi, JD Ma, CY He, SS Zhou, Z Zhao, T Lou, J Cheng, SC Yang, and W Wei were responsible for dissemination of the questionnaire, data collection, and data management. X.Z. Hu, G Ji, and KC Yue performed the statistical analyses. G Ji, KC Yue, and XZ Hu drafted the manuscript. All authors contributed to the interpretation of the data and offered critical revisions of the draft. All authors read and approved the final manuscript.

Conflicts of Interest

The authors have no conflicts of interest to declare.

Abbreviations

OCD: obsessive-compulsive disorder
pOCD: possible obsessive-compulsive disorder

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