Journal of Psychiatric Research 134 (2021) 69–77

Contents lists available at ScienceDirect

Journal of Psychiatric Research

journal homepage: www.elsevier.com/locate/jpsychires

Students' mental health problems before, during, and after COVID-19 lockdown in Italy

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ARTICLE INFO

Keywords:
COVID-19
Social isolation
Lockdown
Mental health
Students

ABSTRACT

The lockdown due to the coronavirus pandemic may have exacerbated mental health problems. To what degree mental health may be affected by social isolation is still poorly known. We collected prospective data on students' mental health in two instances: (i) in October and December 2019, and (ii) 6 months later, in April 2020 amidst the COVID-19 lockdown in Italy and in mid-May/June 2020, after the lifting of lockdown. A total of 358 Italian students aged 18–30 completed socio-demographic questionnaires and the Beck Depression Inventory – 2 (BDI-2), the Beck Anxiety Inventory (BAI), the Obsessive-Compulsive Inventory – Revised (OCI-R), the Eating Habits Questionnaire (EHQ), and the Eating Disorder Inventory-3 (EDI-3). We applied multiple regression models to evince any changes in the aforementioned questionnaire scores during and after lockdown with respect to the scores before lockdown. Students reported on average worse depressive symptoms during lockdown than 6 months before isolation (median increase in the BDI-2 score +2; IQR = −3, 6; $\beta = 0.09 \pm 0.03$, $p = 0.005$), with students without any established diagnosis of psychopathology being affected the most. The regression models predict that 86.2% (IQR = 67.9, 91.4%) of students would not experience a clinically significant worsening of symptoms, while approximately 6% of our target population could develop more severe depressive symptoms. This study supports the view that depressive symptomatology may be aggravated during lockdown, but also highlights that after the lifting of lockdown any changes quickly vanished, as the BDI-2 scores were not different from the ones reported before lockdown.

1. Introduction

The current coronavirus pandemic has been affecting countries all over the world since March 2020, forcing governments to put citizens into lockdown. Among growing concerns of the effects of isolation on mental health (Castro-de-Araujo and Machado, 2020; Holmes et al., 2020; Ng, 2020; Reger et al., 2020; Webb, 2020), and recommendations for mental health support during the pandemic (Sani et al., 2020), mostly cross-sectional data (Di Nicola et al., 2020; Gualano et al., 2020; Kaparounaki et al., 2020; Kochhar et al., 2020; Moccia et al., 2020; Odriozola-González et al., 2020; Pieh et al., 2020; Qiu et al., 2020; Rehman et al., 2020; Verma and Mishra, 2020) or data from previous pandemics (Brooks et al., 2020) are available to assess if and to what degree mental health problems might worsen. The cited studies evidenced an increase in symptoms of psychological distress (Di Nicola et al., 2020; Moccia et al., 2020; Odriozola-González et al., 2020), depressive and anxiety symptoms (Gualano et al., 2020; Kaparounaki et al., 2020; Odriozola-González et al., 2020; Pieh et al., 2020; Qiu et al., 2020; Rehman et al., 2020; Verma and Mishra, 2020), or sleep disturbances (Gualano et al., 2020; Kaparounaki et al., 2020) in the general population, university students or people in remission from a major depressive disorder, but proper control for exposure to outbreaks or pre-lockdown mental health assessment is largely missing. To the best of our knowledge, few prospective studies that take into consideration

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https://doi.org/10.1016/j.jpsychires.2020.12.045
Received 12 August 2020; Received in revised form 8 December 2020; Accepted 17 December 2020
Available online 21 December 2020

Table 1
Sample characteristics.

	Females without disorder history	Females with disorder history	Females	Males without disorder history	Males with disorder history	Males	Total
No. of participants (total/No. during lockdown/No. after lockdown	227/95/132	59/31/28	286	58/31/27	14/4/10	72	358
Age (mean ± sd)	21.1 ± 2.0	22.2 ± 2.2	21.3 ± 2.1	21.6 ± 2.16	22.4 ± 2.3	21.7 ± 2.2	21.3 ± 2.1
BDI-2 score before lockdown (median; IQR)	9; 5, 17	15; 8, 28	11; 5, 18	9; 4, 13.8	13.5; 7.25, 23.5	9; 4, 14.5	10; 5, 18
BDI-2 score change during lockdown	2; −3, 6	2; −5, 6	2; −4, 6	1; −3, 6.5	1; −3.7, 5.7	1; −3, 6.5	2; −3, 6
BDI-2 score change after lockdown	0; −4, 4	1; −4, 8.2	0; −4, 5	0; −5.5, 3.5	2.5; −2, 5.5	0; −5, 4	0; −4, 4
BAI score before lockdown	13; 6, 21	19; 10, 34	13; 7, 23	9.5; 4, 16.5	14.5; 12, 25.8	10.5; 4, 17.2	13; 6, 22
BAI score change during lockdown	−1; −6, 5	1; −5.5, 7.5	−1; −6, 5	0; −1.5, 3	−1.5; −9.7, 7.5	0; −2, 4	0; −5, 5
BAI score change after lockdown	0; −4.2, 4	0; −6.5, 4	0; −5, 4	−1; −5.5, 2	−4; −6, 4	−3; −6, 2	0; −5, 4
OCI-R score before lockdown	14; 8, 21	18; 7, 26	15; 8, 22	11; 6, 19.8	21; 10, 27	11; 6, 22.2	14; 8, 22
OCI-R score change during lockdown	−1; −5, 3.5	0; −2.5, 5	−0.5; −4, 4	0; −3, 2	2; −4.7, 8.2	0; −3, 2.5	0; −4, 4
OCI-R score change after lockdown	−1; −5, 3	−2.5; −8.2, 3	−1; −5.2, 3	−2; −7, 5.5	0; −4.7, 1	0; −6, 3	−1; −6, 3
EHQ score before lockdown	39; 34, 46	43; 36, 52	39; 34, 46	38.5; 35, 44.8	33; 30.2, 37	38; 33.8, 43.2	39; 34, 46
EHQ score change during lockdown	0; −3, 3	0; −3, 3	0; −3, 3	−2; −3.5, 2	−3.5; −5.2, 2	−2; −4, 2	0; −4, 3
EHQ score change after lockdown	0; −3.2, 2	−1; 5.2, 3.2	0; −4, 2	−2; −4.5, −0.5	−0.5; −5.5, 2.7	−2; −5, 1	−1; −4, 2
ED Risk score before lockdown	49; 38, 64	56; 41, 77	51; 38.2, 66.8	36; 32, 44.8	42; 38.2, 64	37.5; 32.8, 46.2	47.5; 37, 63
ED Risk score change during lockdown	0; −5, 5	1; −6, 5.5	0; −5, 5	1; −1, 3	10; 4.7, 12.2	1; −1, 4.5	1; −5, 5
ED Risk score change after lockdown	−1.5; −8, 4	3.5; −6, 9.5	−1; −8, 5	−4; −6, 1	−2; −2, 2.5	−2; −6, 1	−2; −7, 4
GPM score before lockdown	129; 110, 157	156; 112, 182	132; 111, 164	126; 100, 150	144; 116, 191	126; 101, 152	130; 109, 162
GPM score change during lockdown	3; −11, 12.5	1; −6.5, 22	2.5; −10.8, 14	4; −7, 12.5	6; −7, 20.2	4; −7, 13.5	3; −9, 14
GPM score change after lockdown	−1.5; −14, 10	2; −12.2, 20	−1; −14, 12.2	−1; −10.5, 12	−5.5, −14.8, 9	−1; −11, 12	−1; −13, 12

Table 1 Legend: BDI-2 = Beck Depression Inventory – 2. BAI = Beck Anxiety Inventory. OCI-R = Obsessive Compulsive Inventory – Revised. EHQ = Eating Habits Questionnaire. ED Risk = Eating Disorder Risk, subscale of the Eating Disorder Inventory – 3. GPM = General Psychological Maladjustment, subscale of the Eating Disorder Inventory – 3. IQR = interquartile range; sd = standard deviation. Each score change is referred to as a change in a specific questionnaire score, either during or after lockdown with respect to the score before lockdown.

Table 2
Regression models.

BDI-2 score models refer to Fig. 1	df	ΔAIC to null model or Lockdown- only model, (p)	Significance of predictors
BDI-2 Score ~ Lockdown	5	4.9, p = 0.01	During Lockdown, p < 0.005 (β = 0.09 ± 0.03) After Lockdown, n.s. (β = 0.01 ± 0.03)
BDI-2 Score ~ Lockdown: Sex + Sex	8	1.5, p = 0.056	Males:DuringLockdown, p = 0.006 (β = 0.20 ± 0.07) Females:DuringLockdown, p = 0.04 (β = 0.07 ± 0.03) Males, p = 0.03 (β = −0.24 ± 0.11)
BDI-2 Score ~ Lockdown: DisorderHistory + DisorderHistory	9	4.4, p = 0.01	No_DisorderHistory:DuringLockdown, p = 0.001 (β = 0.12 ± 0.03) DisorderHistory:DuringLockdown, n.s. (p = 0.18) No_DisorderHistory, p < 0.005 (β = −0.21 ± 0.07)
BAI score models refer to Fig. 2	df	ΔAIC to null model or Lockdown- only model, (p)	Significance of predictors
BAI Score ~ Lockdown	5	6.4, p = 0.005	After Lockdown, p = 0.001 (β = −0.088 ± 0.02)
BAI Score ~ Lockdown: Sex + Sex	8	11, p < 0.0001	After Lockdown: Females, p = 0.02 (β = −0.06 ± 0.02) After Lockdown: Males, p < 0.001 (β = −0.22 ± 0.06) Males, p = 0.001 (β = −0.34 ± 0.11)
BAI Score ~ Lockdown: DisorderHistory + DisorderHistory	9	16.8, p < 0.0001	After Lockdown: No_DisorderHistory, p < 0.01 (β = −0.08 ± 0.03) No_DisorderHistory, p < 0.0001 (β = −0.26 ± 0.06)
OCI-R score models refer to Fig. 3A	df	ΔAIC to null model or Lockdown- only model, (p)	Significance of predictors
OCI-R Score ~ Lockdown	5	6, p < 0.01	After Lockdown, p = 0.001 (β = −0.07 ± 0.02)
OCI-R Score ~ Lockdown: Sex + Sex	8	−3.3, p = 0.44	//
OCI-R Score ~ Lockdown: DisorderHistory + DisorderHistory	9	0, p = 0.1	After Lockdown: DisorderHistory, p < 0.005 (β = −0.17 ± 0.05) After Lockdown: No_ DisorderHisotry, p = 0.04 (β = −0.056 ± 0.02))
EHQ score models refer to Fig. 3B	df	ΔAIC to null model or Lockdown- only model, (p)	Significance of predictors
EHQ Score ~ Lockdown	5	−2.2, p = 0.4	//
EHQ Score ~ Lockdown: Sex + Sex	8	2.3, p = 0.04	//
EHQ Score ~ Lockdown: DisorderHistory + DisorderHistory	8	- 2.7, p = 0.34	//
ED Risk score models refer to Fig. 3C	df	ΔAIC to null model or Lockdown- only model, (p)	Significance of predictors
ED Risk Score ~ Lockdown	5	−2, p = 0.37	//
ED Risk Score ~ Lockdown:Sex + Sex	8	28.2, p < 0.0001	Males, p < 0.0001 (β = −0.27 ± 0.04)
ED Risk Score ~ Lockdown: AnyEatingDisorderHistory + AnyEatingDisorderHistory	9	47.1, p < 0.0001	AnyEatingDisorderHistory, p < 0.0001 (β = 0.21 ± 0.05) AnyEatingDisorderHistory: After Lockdown, p = 0.036 (β = 0.1 ± 0.04)
GPM score models refer to Fig. 3D	df	ΔAIC to null model or Lockdown- only model, (p)	Significance of predictors
GPM Score ~ Lockdown	5	−1, p = 0.22	//
GPM Score ~ Lockdown: Sex + Sex	8	−1.9, p = 0.25	//
GPM Score ~ Lockdown: AnyEatingDisorderHistory + AnyEatingDisorderHistory	8	1.8, p = 0.05	//

Table 2 Legend: BDI-2 = Beck Depression Inventory – 2. BAI = Beck Anxiety Inventory. OCI-R = Obsessive Compulsive Inventory – Revised. EHQ = Eating Habits Questionnaire. ED Risk = Eating Disorder Risk, a subscale of the Eating Disorder Inventory – 3. GPM = General Psychological Maladjustment, a subscale of the Eating Disorder Inventory – 3. IQR = interquartile range; null model = regression model with no predictors or regression model with only Lockdown as a predictor; AIC = Akaike Information Criterion; ΔAIC = difference between null model and better model AIC, when assessing Lockdown-only model; difference between Lockdown-only model and a more complex model when assessing the significance of Sex/History of a mental disorder as predictors; df = degrees of freedom of a model; ":" means interaction between predictors; β = estimated regression coefficient ± standatd error; n.s. = not significant.

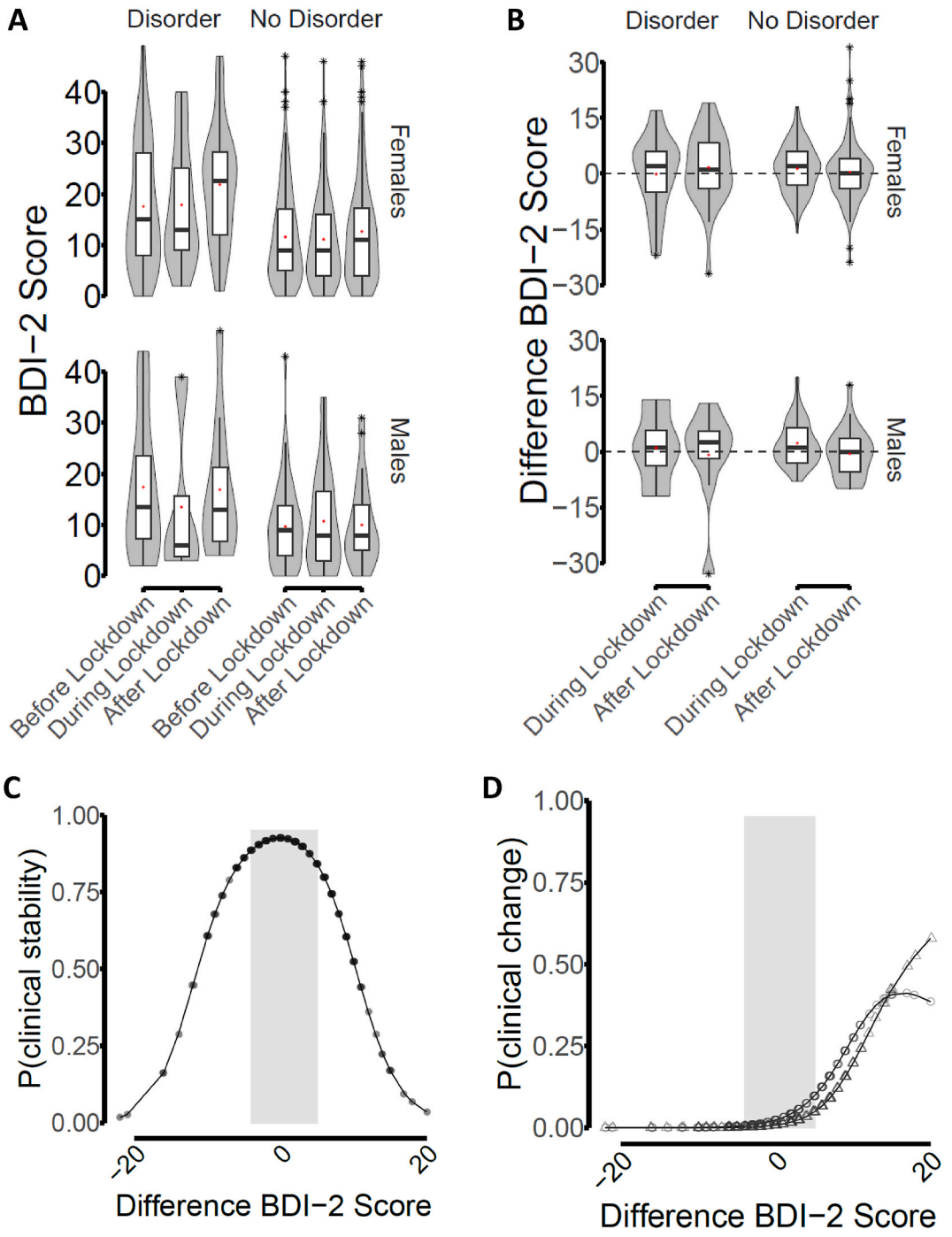

Fig. 1. Lockdown impact on depressive symptomatology. BDI-2 = Beck Depression Inventory – 2. P(clinical stability) = Probability of remaining in the same clinical category as before lockdown also during lockdown. P(clinical change) = Probability of a worsening in clinical depression category during lockdown. Red dot = mean. Black star = outlier. Boxplot represents median ± interquartile range (IQR). Gray shade in Panel A and B underneath boxplots = violin plots. Gray rectangles in Panel C and D represent observed IQR of difference in the BDI-2 score during lockdown with respect to before lockdown. A) The BDI-2 total score before, during and after lockdown, stratified according to sex and history of a mental disorder. B) The BDI-2 score change during lockdown with respect to before lockdown, or score change after lockdown with respect to before lockdown, stratified according to sex and history of a mental disorder. C) Estimated probabilities (black dots) of depressive symptoms stability (no clinical change) during lockdown as a function of increase in the BDI-2 score. D) Estimated probabilities of a worsening of depressive symptoms (clinical category change). Triangles = estimated probability of a steep worsening (from category below the 90th percentile, characterised by mild or no symptoms, to the most severe clinical category - higher than the 95th percentile); empty dots = estimated probability of worsening either from below the 90th percentile to the 90th-95th (moderate depressive symptoms) or from the latter range to above the 95th percentile; gray-shaded area = the reported estimated probabilities are referred to a change in the BDI-2 score of −4 to +5 points.

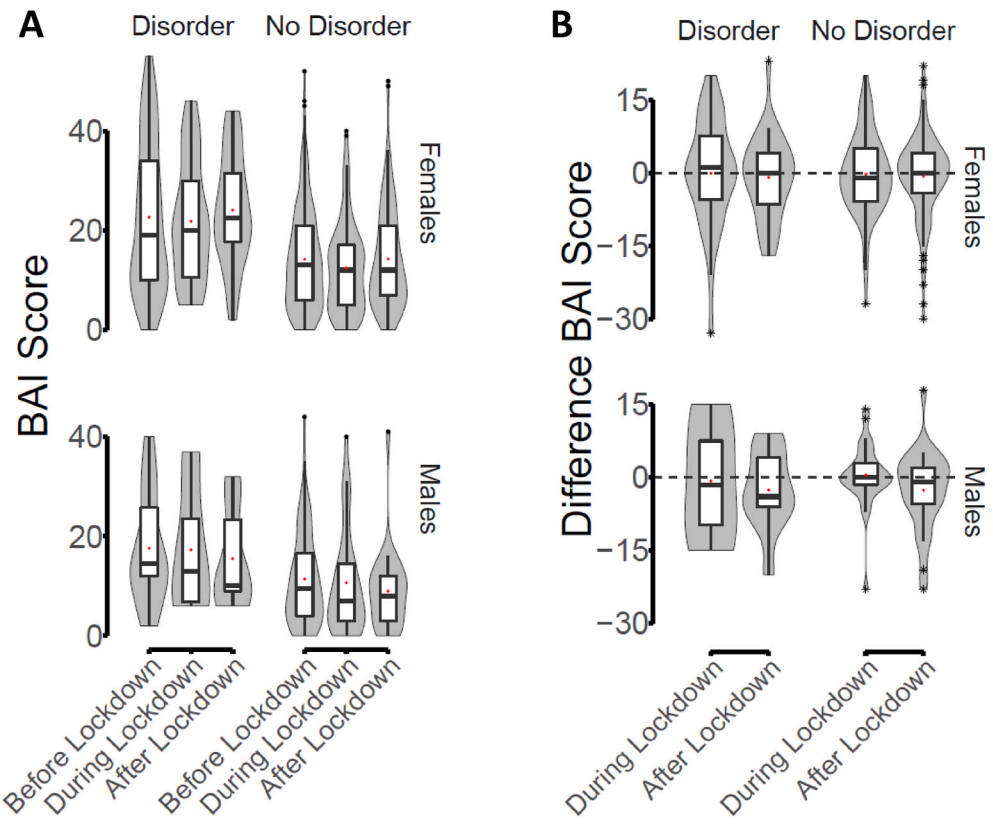

Fig. 2. Lockdown impact on anxiety symptomatology. BAI = Beck Anxiety Inventory; Red dot = mean. Black star = outlier. Boxplot represents median ± interquartile range (IQR). Gray shade in Panel A and B underneath boxplots = violin plots. A) The BAI total score before, during and after lockdown according to sex and history of a mental disorder. B) The BAI score change during lockdown with respect to before lockdown; or score change after lockdown with respect to before lockdown, stratified according to sex and history of a mental disorder.

mental health problems before lockdown have been published so far (Cellini et al., 2020; Elmer et al., 2020; Pierce et al., 2020). These longitudinal studies highlighted a possible increase in depressive and anxiety symptoms, as well as sleep disturbances, during lockdown with respect to a baseline condition assessed before restrictive measures were put in place. Nonetheless, it is still debated whether these changes in mental health might persist also after lockdown. We used inventories for the assessment of depressive, anxiety, obsessive-compulsive and eating disorders symptoms, with the aim of providing prospective evidence of changes in the mental health of Italian university students during COVID-19 lockdown (which consisted in a restriction of the freedom of movement from March 9th to May 4th) and after its lifting, with respect to a baseline condition assessed before the imposition of lockdown.

2. Methods

2.1. Study cohort

All procedures were approved by the University of Padova Psychology Ethical Committee in accordance with the latest version of the Declaration of Helsinki, and participants provided written informed consent. Recruitment took place in Padova, a city of the Veneto region (North-Eastern Italy) with a population of 200,000 that hosts one of the largest universities in the country, having a student population of more than 50.000. Between October 3rd and October 23rd, 2019, at the start of different teaching classes, the first author introduced in person the ECOS (Eating, Compulsive and Obsessive Symptoms in young adults) prospective study to approximately 1000 University of Padova students. The study aimed to assess, with a six month cadence, the most common mental health problems shown by students (Auerbach et al., 2018; Duffy et al., 2019; Rehman et al., 2020; Volpe et al., 2019). The students were handed out a card containing an URL. By accessing the URL the students could provide their informed consent and participate in the study. Every six months the participants would be automatically notified via e-mail that they could take part in another data collection. Among these students, 337 students accepted to participate in the study, and 161 participants matched target population characteristics (Italian native speaker students, aged 18–30) and also completed a demographic questionnaire, the Italian version of the Beck Depression Inventory-2 (Beck et al., 2011; Sica and Ghisi, 2007) (BDI-2), the Beck Anxiety Inventory (BAI) (Creamer et al., 1995; Sica and Ghisi, 2007; Steer and Beck, 1997), the Obsessive-Compulsive Inventory-Revised (OCI-R) (Abramowitz and Deacon, 2006; Sica et al., 2009), the Eating Habits Questionnaire (EHQ) (Gleaves et al., 2013; Novara et al., 2017) and the Eating Disorder Inventory – 3 (EDI-3) (Garner, 2004; Giannini et al., 2008; Waldherr et al., 2008) online (Harris et al., 2009) twice, both in October 2019 and 6 months later, in April (between 3rd-23rd) 2020, amid the imposition of lockdown in Italy. A second introduction of the study was delivered with the same procedure as described above between November 11th and December 19th to approximately a further 1200 students. Among these students, 379 accepted to participate in the study, 197 of which met the aforementioned inclusion criteria and completed the questionnaires both in November–December and a second time between May 11th and June 21st, that is after the lifting of social restrictions (which took place on May 4th). With this method, we fortuitously obtained two samples from the same population: one sample completed the questionnaires before and during lockdown, the other before and after the lockdown. Students that participated in the study are currently enrolled in Medicine and Surgery, Psychology, Biology, Pharmacy, Economics, Engineering, and Social and Political Sciences.

2.2. Statistical analysis

Unless otherwise specified, we applied a paired comparison

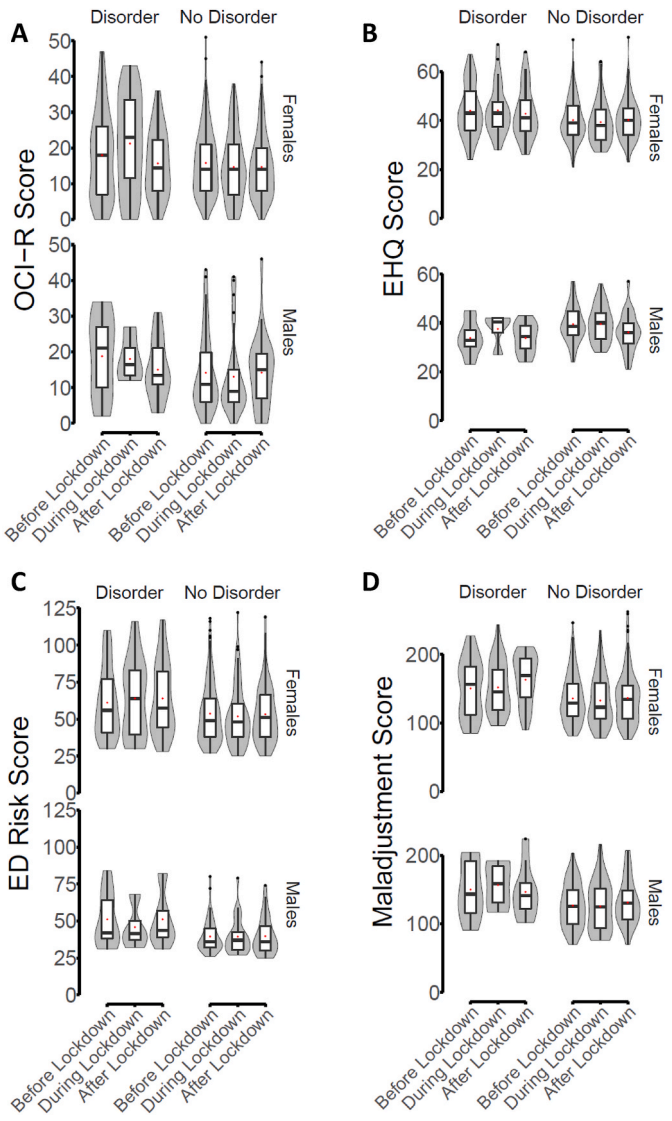

Fig. 3. Lockdown impact on obsessive-compulsive and eating disorder symptomatology. OCI-R = Obsessive Compulsive Inventory – Revised. EHQ = Eating Habits Questionnaire. ED Risk = Eating Disorder Risk, subscale of the Eating Disorder Inventory – 3. Maladjustment = General Psychological Maladjustment, subscale of the Eating Disorder Inventory – 3. Red dot = mean. Black star = outlier. Boxplot represents median ± interquartile range (IQR). Gray shade in Panel A and B underneath boxplots = violin plots.

approach to analyse this prospective data set. Anonymised data were downloaded from the REDCap (Harris et al., 2009) platform and curated using RStudio 3.5.3 (Alboukadel Kassambara (2018). ggpubr: "ggplot2" Based Publication Ready Plots. R package version; "Kamil Barton (2019). MuMIn: Multi-Model Inference. R package version 1.43.6.; R Core Team (2019). *R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria*). To assess the BDI-2, BAI, OCI-R, EHQ, and the EDI-3 total score dependence on lockdown phases (i.e. before, during and after), we defined different regression models (generalised linear mixed models). Since psychometric test scores are counting variables, we used the Poisson family of distributions (Kruschke, 2014; Raftery, 1995). To select the best regression model, the models were compared using the *anova* function and the model with the lowest AIC was selected. We thus evaluated the contribution of each independent variable (i.e. lockdown phases, sex, and history of a mental disorder) to the changes in scores by considering the significance of each β regression coefficient estimate. For instance, let us assume that model n+1 describes the BDI-2 score based on the values of two independent variables, sex and lockdown phases, whereas model n describes the BDI-2 score based solely on the participants' sex. Model n+1 is considered to be better than model n if it can reduce the residual variance of the data taken into consideration; in the specific case, if lockdown phases (the only extra term in model n+1) significantly change (reduce or increase) BDI-2 scores. The β regression coefficient estimates describe the effect of each value of an independent variable on the score. We undertook a step-wise approach for the modelling and analysis of the data presented herein: we evaluated the contribution of each relevant independent variable to the model and kept the variables that significantly improved the model.

To assess whether any score increase during/after lockdown could be clinically relevant, we divided participants into clinical categories according to test scores before lockdown (i.e. below the 90th percentile, above the 95th percentile, and between these two ranges for the BDI-2 scores) and used multinomial regression models to test how many participants switched from one clinical category to another or remained in the same category during different lockdown phases. We thus predicted the chance of being "clinically" affected by the imposition of lockdown. Sample characteristics and regression models employed are reported in Tables 1 and 2, respectively. Further details on the regression models are described in Supplementary Methods S1. The anonymised dataset and R script are provided upon request.

3. Results

3.1. Lockdown effects on depressive symptomatology

The Beck Depression Inventory-2 median score was significantly higher during lockdown than before the imposition of lockdown (+2; IQR = −3, 6. β = 0.09 ± 0.03, p = 0.005, Fig. 1A and B and Table 1). The median increase was higher in females (+2; IQR = −4, 6) than in males (+1; −3, 6.5), although the difference is not statistically significant (i.e. the factor "sex" does not significantly improve the regression model, ΔAIC = 1.5, p = 0.056, Table 2). However, a model considering the interaction between history of a mental disorder and lockdown phases as predictors of change in the BDI-2 score is better than a model with only lockdown phases as a predictor: this suggests that students without an established diagnosis of psychopathology experienced a significant increase in depressive symptoms during lockdown (β = 0.12 ± 0.03, p = 0.001), an effect not seen for students with a mental disorder history (Fig. 1A and B and Tables 1 and 2). The increase in depressive symptomatology is not significantly associated with familiarity for a mental disorder, worry for one's economic situation, or residence. To assess if such an increase could be clinically relevant, participants were divided into three clinically useful categories according to the BDI-2 score before lockdown: below the 90th percentile – named no/mild depressive symptoms category; above the 95th percentile – severe depressive symptoms category; and between these two ranges – moderate depressive symptoms category (Button et al., 2015; Sica and Ghisi, 2007)). We then tested how many participants switched from one category to another, or remained in the same one during lockdown. The observed data were fit to a multinomial regression model as described in the Methods section and Supplementary Methods S1. We observed that the change in the BDI-2 score during lockdown would not clinically affect 86.2% of our target population (IQR = 67.9, 91.4%; Fig. 1C); 4,2% of students (IQR = 0.1, 12.5%) would progress either from the no/mild depressive symptoms category to the moderate depressive symptoms category or from the latter to the severe symptoms category; and 1.7% (IQR = 0.02, 6.6%) would directly progress from no/mild depressive symptoms to the severe symptoms category (Fig. 1D). Approximately 5% of participants would switch to a less serious clinical category. Regarding whether this change in depressive symptoms persisted after lockdown, the regression models revealed that the BDI-2 scores after

lockdown were not different from the scores observed before lockdown, suggesting that lockdown lifting quickly improved the symptoms (Fig. 1A and B).

3.2. Lockdown effects on anxiety, obsessive, and disordered eating symptomatology

Anxiety symptoms, as measured by the Beck Anxiety Inventory (BAI), were influenced by the lockdown. Specifically, we show that the BAI scores decreased after the lifting of lockdown ($\beta = -0.088 \pm 0.02$, $p = 0.001$), even though no increase was evident during lockdown (Fig. 2A and B). This reduction in anxiety symptoms was significantly greater in males ($\beta = -0.22 \pm 0.06$, $p < 0.001$) than in females ($\beta = -0.06 \pm 0.02$, $p = 0.02$), although present in both sexes (Tables 1 and 2), but it was significant only for students without a history of mental disorder ($\beta = -0.26 \pm 0.06$, $p < 0.0001$). A trend in the reduction of the BAI scores could be detected for students who reported a diagnosed psychopathological condition, but this trend was not significant. Similarly to the BAI scores, also the OCI-R scores, which assess obsessions and compulsions, were reduced after lockdown ($\beta = -0.07 \pm 0.02$, $p = 0.001$ Fig. 3A), but, in this case, the reduction was independent of a mental disorder history or the participant's sex.

Concerning eating disorder symptoms, we assessed whether students' eating habits may have been influenced by the lockdown through the EDI-3 subscales (Eating Disorder Risk and General Psychological Maladjustment) and the EHQ questionnaires. In this regard, the Eating Disorder Risk scale scores were not altered in the majority of our sample (Fig. 3C), except for students who reported a history of eating disorders (namely Anorexia Nervosa, Bulimia Nervosa and/or Binge Eating Disorder): this specific subsample showed an increase in eating disorder symptomatology after lockdown ($\beta = 0.1 \pm 0.04$, $p = 0.036$). The General Psychological Maladjustment and the Eating Habits Questionnaire (Fig. 3B and D) did not evidence any changes in the severity of the constructs they measure during or after lockdown.

4. Discussion

Among the growing concerns of detrimental effects of lockdown on mental health, very few prospective studies are available to provide support for any actual changes (Cellini et al., 2020; Elmer et al., 2020; Pierce et al., 2020). In this prospective study, we show that students were affected by social isolation to varying degrees independently of sex: the lockdown seemed to be responsible for a 2-point median increase in the BDI-2 score, that is, students were more likely to experience a worsening in the depressive symptomatology during lockdown. However, this increase was not clinically relevant for 86.2% of our target population. On the other hand, our models predict that approximately 6% of students would experience a clinically significant worsening of depressive symptoms during lockdown. Nevertheless, after lockdown, depressive symptomatology was again comparable to that before lockdown. This indicates that a period of approximately 7 weeks of lockdown exerted a burden on students' depressive symptoms, but as the lockdown was lifted this effect quickly vanished. We also investigated whether other mental health problems could be exacerbated or aggravated by the imposition of lockdown: anxiety symptoms, as measured by the Beck Anxiety Inventory, and obsessive-compulsive symptoms, as measured by the Obsessive Compulsive Inventory – Revised, were not affected by lockdown. In contrast, we report a significant reduction of the scores after the lifting of lockdown. Moreover, lockdown did not affect eating disorder symptoms, measured by the Eating Habits Questionnaire and the Eating Disorder Inventory-3; the only students who reported experiencing an increase in the symptomatology are those with a history of eating disorder.

This study highlights that different symptoms related to mental health problems may be differently affected by lockdown, with obsessive-compulsive and anxiety symptoms being reduced after the lifting of lockdown and eating disorder symptoms not being much affected. Only the Beck Depression Inventory – 2 score is significantly increased during lockdown, and this probably mirrors a real increase in depressive symptoms, as previously reported (Cellini et al., 2020; Elmer et al., 2020; Pierce et al., 2020; Wang et al., 2020). Furthermore, not all students reported an increase in depressive symptoms: we evidence that the most affected students are those with no mental disorder history. The main strength of this study is the report of participants' psychological conditions before lockdown and the assessment of various mental health dimensions through the compilation of validated questionnaires. However, it should be taken into consideration that self-reporting questionnaires are not diagnostic instruments, and thus they might not detect relevant changes in the mental health of participating subjects. Moreover, our findings might not reflect the general population's well-being, as our investigation specifically deals with the mental health of the student population. Due to the heterogeneity of the measures adopted by different research groups, and the different populations studied to assess the consequences of restrictive measures on mental health, it would be possible to identify lockdown as a cause of the worsening of depressive symptoms only after extensive prospective evidence (Ren et al., 2020) or international collaborations. However, we wish to emphasise that it is extremely difficult to control for possible confounders such as: economic uncertainty or socio-economic status (Perry, 1996; Warren, 2009; Weich and Lewis, 1998), which have been thoroughly described as factors involved in common mental health problems; other consequences of lockdown, such as the reduction in physical activity (Paluska and Schwenk, 2000), the fear of being infected (Brooks et al., 2020), or other relevant biological or physical health-related factors independent from infection (Adam et al., 2017; Di Nicola et al., 2020; Jamilian et al., 2019). Furthermore, whether multiple lockdowns might cause a worsening of symptoms, or whether a sort of "habituation" might take place, is still an open question. Until sufficient and properly-controlled data is available, the media and researchers should refrain from linking lockdown to disastrous psychological consequences (Reger et al., 2020; Thakur and Jain, 2020), the depiction of which could be more damaging than lockdown *per se* (Ahmad and Murad, 2020; Gao et al., 2020; Guo et al., 2020; Sonneck et al., 1994; Townsend et al., 2020).

In conclusion, mental health workers should cautiously consider a possible aggravation of depressive symptoms in students during lockdown phases, independently from a history of mental disorder.

CRediT authorship contribution statement

Nicola Meda Conceptualization, Methodology, Data acquisition, Formal analysis, Visualization, Data curation, Writing - original draft, Writing - review & editing. **Susanna Pardini:** Conceptualization, Methodology, Supervision, Writing - review & editing. **Irene Slongo:** Conceptualization, Methodology, Data acquisition, Writing - review & editing. **Luca Bodini:** Conceptualization, Methodology, Data acquisition, Writing - review & editing. **Mauro Agostino Zordan:** Data curation, Software, Writing - review & editing. **Paolo Rigobello:** Data acquisition, Software, Writing - review & editing. **Francesco Visioli:** Conceptualization, Methodology, Supervision, Writing - review & editing. **Caterina Novara:** Conceptualization, Methodology, Supervision, Writing - review & editing.

Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychires.2020.12.045.

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