

1 **COVID-19 and depressive symptoms in students before and during lockdown**

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15 **ABSTRACT**

16 The lockdown due to coronavirus pandemic may exacerbate depressive symptoms, experts argue.

17 Here we report that students, a high-risk category for mental disorders, report on average worse

18 depressive symptoms than six months before isolation. The prospective data reported herein should

19 alert clinician of a possible aggravation as well as new-onsets of depressive symptoms in students.

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21 The current coronavirus pandemic has been affecting Europe since late February 2020, forcing

22 governments to put citizens in lockdown. Among growing concerns of the effects of isolation on

23 mental health^{1,2}, only retrospective data are available to assess if actual changes occur³. Here we

24 provide prospective evidence of a change in depressive symptomatology of Italian students during

25 COVID-19-related lockdown.

26 The study was approved by the University of Padova Ethical Committee of Psychology and

27 participants provided informed consent. Between October 3rd and October 23rd 2019, we introduced

28 the study to approximately 1000 University of Padova students, 153 of which matched target

29 population characteristics (Italian native speaker students, age 18-30) and completed a demographic

30 questionnaire and the Italian version of Beck Depression Inventory-2⁴ (BDI-2, a validated self-

31 report questionnaire for depressive symptoms evaluation, the score of which correlates with severity

32 of depressive symptomatology) online⁵, both in October and in April (between 3rd-23rd) 2020. We

33 implemented generalised linear mixed models to evince if BDI-2 score changed during isolation

34 with respect to the scores reported 6 months before. To assess a percentage change in BDI-2 score,

35 we defined $\% \Delta \text{BDI-2}$ as the difference between BDI-2 score during lockdown and before

36 lockdown, the whole divided by BDI-2 score before lockdown + 1 and analysed $\% \Delta \text{BDI-2}$ with

37 linear mixed-effects models. To assess clinically relevant changes in depressive symptoms, we

38 employed multinomial regression models. Sample characteristics and models employed are reported

39 in Tables A and B, respectively. Anonymised dataset, further details on data analysis, and script are

40 provided as Supplementary Material.

41 BDI-2 total score is slightly higher during lockdown than before (Figure, A and Table). We
42 recorded that the median percentage increase is higher in males (+36%; IQR = -12 – 91%) than in
43 females (+16%; -26 – 89%) and is independent from a history of mental disorder (Figure, B),
44 although students with such history report higher before and during lockdown BDI-2 scores than
45 students without any established diagnosis of psychopathology (Figure, C and Table). This increase
46 is not significantly linked to sex, familiarity for a mental disorder, worry for one's economic
47 situation, or residence. Statistically, it is significantly linked to BDI-2 score before lockdown
48 (Figure, D) and age, evidencing that younger participants with lower BDI-2 score before lockdown
49 report higher percentage increases in BDI-2 score during lockdown. To assess if such increase
50 could be clinically relevant, we divided participants into three clinically useful categories according
51 to BDI-2 scores before lockdown (below 90th percentile, above 95th percentile, and between these
52 two ranges⁴) and tested how many participants switched from one category to another, or remained
53 in the same one during lockdown. We fit the observed data to a multinomial regression model and
54 found that a median increase of 22% in BDI-2 score (IQR= -21 – 90%) would not clinically affect
55 79,2% of our target population (IQR = 74,7 – 81,4%); 8,2% (6,9 – 9,8%) would progress to a more
56 serious clinical category (either from < 90th to 90th-95th range or from this latter to > 95th); and 6,2%
57 (5,3 – 7,2%) would directly progress from < 90th percentile category to the most severe clinical
58 category (Figure, E and F). Less than 5% of participants would improve.

59 As Italy was entirely put in lockdown, it is impossible to assess isolation-independent
60 changes in BDI-2 score. Students could be diversely affected by lockdowns: isolation may be
61 responsible of a median increase of 22% in BDI-2 score, which would be clinically relevant for up
62 to \approx 15% of our target population. Our data should alert clinicians of possible aggravation of
63 depressive symptoms in students, independently from a history of mental disorder.

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67 **Author contributions:** All authors designed the study protocol, interpreted data and critically
68 revised the manuscript; N.M. acquired data and analysed it and drafted the manuscript; P.R., F.V.
69 C.N., S.P. provided technical, material or administrative support to the study; F.V., C.N., S.P.
70 provided their supervision and expertise.

71 **Competing interests:** the authors declare no competing interests

72 **Funding/Support:** this study received no financial support

73 **Additional Information:** Dataset and R Script for analysis are provided as Supplementary Material

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93 **REFERENCES**

- 94 1. Holmes, E. A. *et al.* Multidisciplinary research priorities for the COVID-19 pandemic: a call for
95 action for mental health science. *The Lancet Psychiatry* S2215036620301681 (2020)
96 doi:10.1016/S2215-0366(20)30168-1.
- 97 2. Reger, M. A., Stanley, I. H. & Joiner, T. E. Suicide Mortality and Coronavirus Disease 2019—A
98 Perfect Storm? *JAMA Psychiatry* (2020) doi:10.1001/jamapsychiatry.2020.1060.
- 99 3. Brooks, S. K. *et al.* The psychological impact of quarantine and how to reduce it: rapid review of
100 the evidence. *The Lancet* **395**, 912–920 (2020).
- 101 4. Sica, C. & Ghisi, M. The Italian versions of the Beck Anxiety Inventory and the Beck
102 Depression Inventory-II: Psychometric properties and discriminant power. in *Leading-edge*
103 *psychological tests and testing research* 27–50 (Nova Science Publishers, 2007).
- 104 5. Harris, P. A. *et al.* Research electronic data capture (REDCap)—A metadata-driven methodology
105 and workflow process for providing translational research informatics support. *Journal of*
106 *Biomedical Informatics* **42**, 377–381 (2009).

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109 **Figure Legend. Possible COVID-19-related isolation impact on depressive symptomatology**
110 Pink dots = females individual scores; blue dots = males individual scores. Point range represents
111 median \pm interquartile range. A, BDI-2 total score before and during lockdown. B, Percentage
112 increase in BDI-2 scores. C, BDI-2 score stratified according to history of mental disorder. D,
113 regression lines of percentage increase in BDI-2 score with respect to BDI-2 score before the
114 lockdown. E, estimated probabilities of depressive symptoms stability (no clinical change) before-
115 during lockdown as a function of percentage increase in BDI-2 score. F, estimated probabilities that
116 depressive symptoms get worse (clinical category change); blue triangles = estimated probability of
117 a steep worsening (from category below 90th percentile, characterised by mild or no symptoms, to
118 the most severe clinical category - higher than 95th percentile); yellow triangles = estimated
119 probability of worsening either from below 90th percentile to 90th-95th or from the latter range to
120 above 95th percentile; gray-shaded area = estimated probabilities for a 0-200% increase in BDI-2
121 score.
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123 **TABLE**

Table. Sample characteristics and regression models employed							
A Sample characteristics							
	Females without disorder history	Females with disorder history	Females	Males without disorder history	Males with disorder history	Males	TOT
N (during lockdown)	90	29	119	30	4	34	153
Age (mean ± sd)	22.0 ± 1.8	22.4 ± 1.5	22.1 ± 1.7	22.4 ± 2.3	22 ± 1.1	22.3 ± 2.2	22.2 ± 1.8
BDI-2 score before lockdown (median; IQR)	8; 4 – 15	14.5; 6.25 – 24.8	8; 5 – 17	7; 2 – 13	9; 9 – 9	7.5; 2.5 – 12.8	8; 4 – 16
BDI-2 score during lockdown (median; IQR)	9; 4 – 16	13; 8 – 26	10; 4 – 18	10.5; 3 – 18.5	6; 3.75 – 15.8	9; 3 – 18.5	10; 4 – 18
% ΔBDI-2 (median; IQR)	24%; -27 – 100	0%; -25 – 33	16%; -26 – 89	36%; -12 – 91	21%; -25 – 115	36%; -12 – 91	22%; -21 – 90
B Regression models							
BDI-2 score model refers to Figure, A			df	ΔAIC to null model	Significance of predictors		
BDI-2 Score ~ Lockdown : Sex + Sex			6	14.6	Males:DuringLockdown, p < 0.001 (β = 0.27 ± 0.07) Females:DuringLockdown, p = 0.019 (β = 0.08 ± 0.03) Males, n.s. (p = 0.052)		
BDI-2 score model refers to Figure, C			df	ΔAIC to null model	Significance of predictors		
BDI-2 Score ~ DisorderHistory : Lockdown + DisorderHistory			6	26.5	No_DisorderHistory, p < 0.001 (β = -0.44 ± 0.12) No_DisorderHistory:DuringLockdown, p < 0.001 (β = 0.19 ± 0.04) DisorderHistory:DuringLockdown, n.s. (p = 0.18)		
%ΔBDI-2 model refers to Figure, B and D			df	ΔAIC to null model	Significance of predictors		
%ΔBDI-2 ~ BDI-2 score before Lockdown			5	15.3	BDI-2 score before Lockdown, p < 0.001 (β = -0.05 ± 0.01)		
%ΔBDI-2 ~ Age			4	2.26	Age, p = 0.039 (β = -0.16 ± 0.07)		

124 Abbreviations and symbols: IQR = interquartile range; sd = standard deviation; null model =

125 regression model with no predictors; AIC = Akaike Information Criterion; ΔAIC = difference

126 between null model and better model AIC; df = degrees of freedom of a model; “:” means

127 interaction between predictors; β = estimated regression coefficient ± sd ;n.s. = not significant.

128 Further details on models can be found in supplementary material.

