



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

Following a healthy/balanced diet predicts lower anxiety and depression during the COVID-19 pandemic



Seguir una dieta sana/equilibrada predice una menor ansiedad y depresión durante la pandemia de COVID-19

Dear Editor:

The COVID-19 pandemic has increased anxiety and depressive symptoms in the general population.¹ Health bodies have recommended several behaviors to cope with them. Still, prospective longitudinal evidence on the efficacy of these behaviors to reduce such symptoms is scarce. We

have followed a population-representative cohort of 1049 Spanish adults for one year to shed light on the subject. We asked participants to rate the frequency of ten coping behaviors and the intensity of anxiety (GAD7)² and depressive (PHQ9)³ symptoms every two weeks (we detail the procedures elsewhere).⁴ On December 3, 2021, 946 participants (90.2%) had finished (or were about to finish) the study and 103 (9.8%) had opted out or failed to complete $\geq 70\%$ questionnaires with $< 10\%$ missing answers. We used multiple imputation for missing GAD7/PHQ9 items and fitted weighted mixed-effects autoregressive moving average (ARMA_{2,1}) models to assess whether coping behaviors predicted subsequent anxiety and depressive symptoms. These models considered the effect of previous symptoms on posterior symptoms and weighted the observations to ensure the representativity of the sample in population terms.

We will publish the complete analysis results after all participants finish the study. Still, we find it relevant to

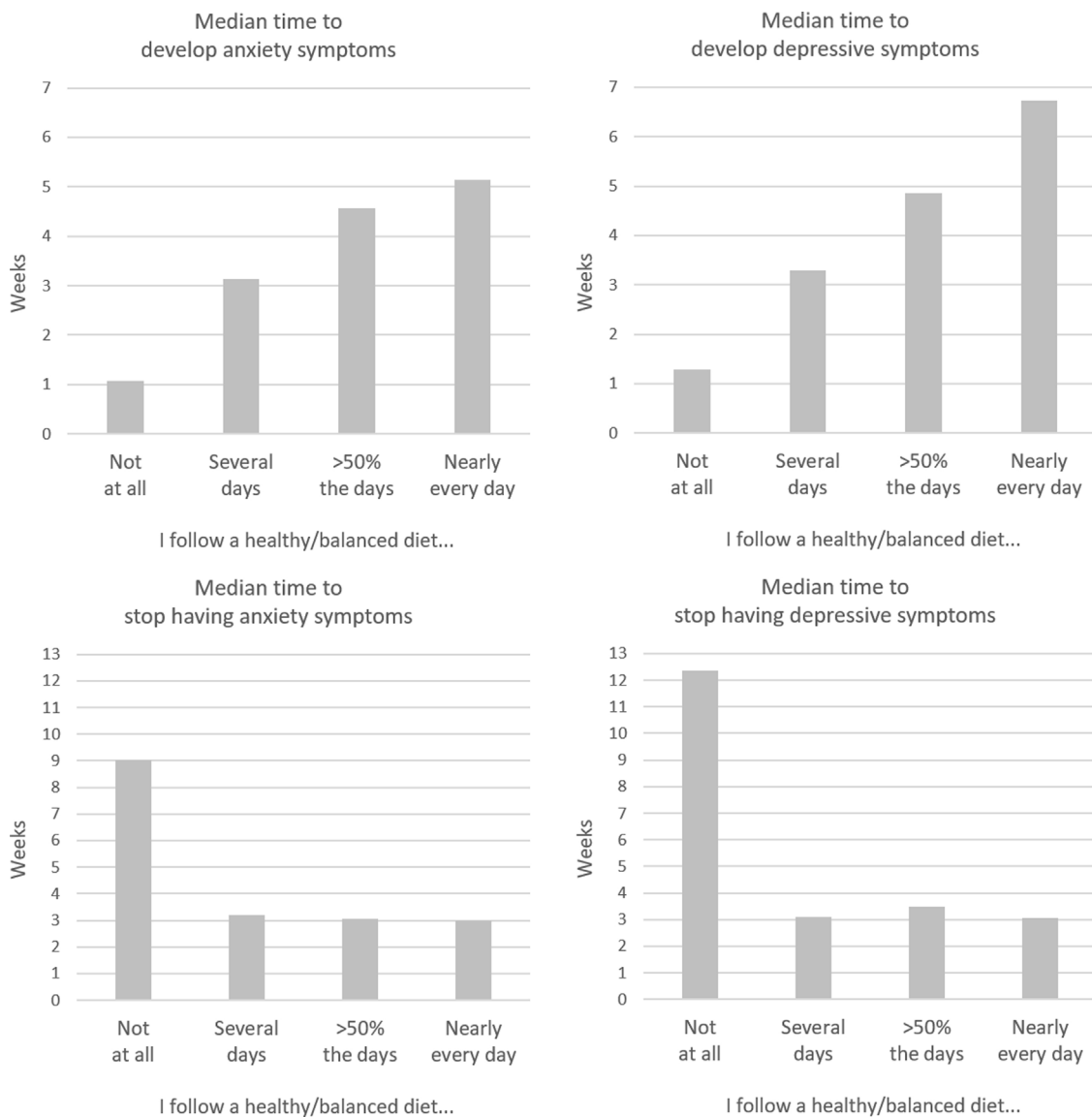


Figure 1 Median time to develop or stop having anxiety and depressive symptoms depending on the reported frequency of following a healthy/balanced diet.

disseminate without delay the potential utility of one of the coping behaviors assessed -following a healthy/balanced diet- in preventing anxiety and depressive symptoms.

Specifically, we found that following a healthy/balanced diet predicted less future anxiety ($b = -0.85$, $p < 10^{-13}$) and depressive ($b = -1.27$, $p < 10^{-28}$) symptoms substantially more strongly than other behaviors such as talking with relatives/friends or taking the opportunity to pursue hobbies ($b = -0.25$ to -0.02 , $p = 0.045$ to 0.86) (b is the difference in GAD-7/PHQ-9 scores when following vs. not following a healthy/balanced diet, considering past GAD-7/PHQ-9 scores). To investigate the potential preventive or therapeutic effects of a healthy/balanced diet, we then fitted ad-hoc weighted mixed-effects Cox regressions to the same data. Following a healthy/balanced diet delayed the emergence of anxiety or depressive symptoms ($GAD7/PHQ9 \geq 5$)^{2,3} (anxiety: hazard ratio (HR)=0.41, $p < 10^{-12}$; depressive: HR=0.46, $p < 10^{-7}$). These preventive effects showed a robust dose-response relationship: the more days per week a participant followed a healthy/balanced diet, the less likely he/she was to develop anxiety or depressive symptoms (Fig. 1). Moreover, both types of symptoms remitted earlier when following a healthy/balanced diet (anxiety: HR = 1.74, $p < 10^{-4}$; depressive: HR = 1.65, $p < 10^{-4}$) (Fig. 1).

As other coping behaviors assessed (physical exercise, following a routine, and drinking water to hydrate) highly correlated with following a healthy/balanced diet (weighted $r = 0.43-0.50$), we repeated the ARMA covarying for these behaviors. Overall, the results remained unchanged (anxiety: $b = -0.76$, $p < 10^{-9}$; depressive: $b = -1.03$, $p < 10^{-15}$). We also obtained similar results when we excluded participants with hazardous alcohol consumption ($AUDIT \geq 8$)⁵ (anxiety: $b = -1.03$, $p < 10^{-11}$; depressive: $b = -1.53$, $p < 10^{-23}$).

The mechanisms through which a healthy/balanced diet might protect against anxiety and depressive symptoms may vary, ranging from improving the brain's nutritional intake to stabilizing the gut microbiome. Regardless, our study is longitudinal but not interventional. Thus, we cannot rule out that not following a healthy diet is only an early sign of some mechanism that later leads to increased anxiety and depressive symptoms. We also acknowledge that following a healthy/balanced diet was assessed only by self-report. However, previous studies have shown that most individuals in the general population have good practical knowledge about what a healthy/balanced diet means.⁶

We have known for decades that a healthy diet effectively prevents several illnesses. We provide promising evidence that it might also prevent anxiety and depressive symptoms.

Funding

AXA Research Fund supports this research via a grant from the call "Mitigating risk in the wake of the Covid-19 Pandemic" to J.R. Additionally, the Instituto de Salud Carlos III - Subdirección General de Evaluación y Fomento de la Investigación and the European Regional Development Fund (FEDER, "Investing in your future") supports J.R. (Miguel Servet Research Contract CPII19/00009) and L.F. (PFIS Pre-doctoral Contract FI20/00047). The funders have no role in the study's design and conduct, collection, management,

analysis, interpretation of the data, preparation, review, or approval of the manuscript, and decision to submit the manuscript for publication.

Conflict of interest

None reported.

Acknowledgements

We sincerely thank the individuals who participated in this study.

Bibliografía

1. Schafer KM, Lieberman A, Sever AC, Joiner T. Prevalence rates of anxiety, depressive, and eating pathology symptoms between the pre- and peri-COVID-19 eras: a meta-analysis. *J Affect Disord.* 2021;298 Pt A:364-72.
2. Spitzer RL, Kroenke K, Williams JB, Lowe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med.* 2006;166:1092-7.
3. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med.* 2001;16:606-13.
4. Fortea L, Solanes A, Pomarol-Clotet E, Garcia-Leon MA, Fortea A, Torrent C, et al. Study protocol - coping with the pandemics: what works best to reduce anxiety and depressive symptoms. *Front Psychiatry.* 2021;12:642763.
5. Saunders JB, Aasland OG, Babor TF, de la Fuente JR, Grant M. Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption - II. *Addiction.* 1993;88:791-804.
6. Motteli S, Barbey J, Keller C, Bucher T, Siegrist M. Measuring practical knowledge about balanced meals: development and validation of the brief PKB-7 scale. *Eur J Clin Nutr.* 2016;70:505-10.

Joaquim Radua^{a,b,c,d,*}, Lydia Fortea^{a,b,e},
Edith Pomarol-Clotet^{b,f}, Eduard Vieta^{b,e,g,h},
Miquel Àngel Fullana^{a,b,g}, Aleix Solanes^{a,i}

^a *Imaging of Mood- and Anxiety-Related Disorders (IMARD) Group, Institut d'Investigacions Biomèdiques August Pi i Sunyer (IDIBAPS), Barcelona, Spain*

^b *Centro de Investigación Biomédica en Red de Salud Mental (CIBERSAM), Instituto de Salud Carlos III, Madrid, Spain*

^c *Early Psychosis: Interventions and Clinical-Detection (EPIC) Lab, Department of Psychosis Studies, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom*

^d *Centre for Psychiatric Research and Education, Department of Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden*

^e *Department of Medicine, University of Barcelona, Barcelona, Spain*

^f *FIDMAG Germanes Hospitalàries Research Foundation, Barcelona, Spain*

^g *Adult Psychiatry and Psychology Department, Institute of Neurosciences, Hospital Clínic de Barcelona, Barcelona, Spain*

^h *Bipolar and Depressive Disorders, Institut d'Investigacions Biomèdiques August Pi i Sunyer (IDIBAPS), Barcelona, Spain*
ⁱ *Department of Psychiatry and Forensic Medicine, Autonomous University of Barcelona, Barcelona, Spain*

<https://doi.org/10.1016/j.rpsm.2021.12.004>
1888-9891/ © 2021 The Author(s). Published by Elsevier España, S.L.U. on behalf of SEP y SEPB.

* Corresponding author.

E-mail address: radua@clinic.cat (J. Radua).