

ORIGINAL ARTICLE

Effective recommendations towards healthy routines to preserve mental health during the COVID-19 pandemic

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Objective: To assess the adherence to a set of evidence-based recommendations to support mental health during the coronavirus disease 2019 (COVID-19) pandemic and its association with depressive and anxiety symptoms.

Methods: A team of health workers and researchers prepared the recommendations, formatted into three volumes (1: COVID-19 prevention; 2: Healthy habits; 3: Biological clock and sleep). Participants were randomized to receive only Volume 1 (control), Volumes 1 and 2, Volumes 1 and 3, or all volumes. We used a convenience sample of Portuguese-speaking participants over age 18 years. An online survey consisting of sociodemographic and behavioral questionnaires and mental health instruments (Patient Health Questionnaire-9 [PHQ-9] and Generalized Anxiety Disorder-7 [GAD-7]) was administered. At 14 and 28 days later, participants were invited to complete follow-up surveys, which also included questions regarding adherence to the recommendations. A total of 409 participants completed the study – mostly young adult women holding university degrees.

Results: The set of recommendations contained in Volumes 2 and 3 was effective in protecting mental health, as suggested by significant associations of adherence with PHQ-9 and GAD-7 scores (reflecting anxiety and depression symptoms, respectively).

Conclusion: The recommendations developed in this study could be useful to prevent negative mental health effects in the context of the pandemic and beyond.

Keywords: COVID-19; pandemic; mental health; adherence; recommendations

Introduction

The coronavirus disease 2019 (COVID-19) pandemic and the social restrictions imposed to control it were expected from the start to take a high toll on mental health.¹ The incidence of mental health issues worldwide has substantially increased^{2,3} and many countries reported “mental, neurological, and substance use” services to have been halted or disrupted.^{4,5} In Brazil, studies have found significant increases in anxiety and depression levels.^{6,7} Younger age,^{6,8} being female,^{6,9} lower income,^{6,8} lower level of education,^{7,8} being subject to social distancing (especially for long periods),^{8,10} a previous history of psychiatric illness,⁶ frequently following the news,^{6,11} infrequent physical activity, longer periods of time engaged in sedentary behavior such as TV-viewing,^{12,13} and poorer sleep quality^{14,15} have all been associated with a higher prevalence of symptoms of anxiety and depression.

The pandemic brought renewed attention to the necessity of efficient health messaging and of advancing understanding of how such messaging can help people optimize behavioral change. Understanding which evidence-based interventions can help in primary care or in the context of having no access to face-to-face mental health services would not only be incontestably valuable now, but also in a post-pandemic setting: geographically isolated areas and places where mental health is not integrated into primary care are examples of scenarios in which people would benefit from strategies developed to deliver effective recommendations aimed at promoting mental health.¹

There is considerable evidence suggesting that behavioral and lifestyle changes may be effective.^{16,17} “Sleep hygiene” and tips based on chronobiological knowledge (i.e., strategies aimed at improving behavior and environment to favor good-quality sleep and to decrease circadian misalignment) are among such potentially useful measures.^{18,19} Other behaviors that may improve mental health include exercising,²⁰ relaxation techniques,²¹ eating balanced meals,²² leisure and recreational activities,²³ limiting news consumption,²⁴ keeping a good body posture,^{25,26} and engaging in healthy social relationships.²⁷

We designed a study to develop and test the reach and effectiveness of evidence-based recommendations for promoting mental health among the general population. The present article reports on the development of an online booklet version of our recommendations assembled in May-June 2020, and an evaluation of their effectiveness in mental health maintenance during the COVID-19 pandemic (July-November 2020). We hypothesized that recommendations to promote healthy routines and those focusing on preserving individuals’ circadian organization would be effective in improving mental health.

Methods

Development of recommendations

We developed an informative written material with recommendations aiming to positively affect people’s mental

health and wellbeing during the COVID-19 pandemic. The material was written in Brazilian Portuguese. After initial meetings, the team agreed to group recommendations into the three volumes described below. Evidence-based content was debated in weekly meetings and put together with the collaboration of the whole team.

The team comprised 23 professionals from different areas (listed in Figure S1, available as online-only supplementary material), who were also at different stages of their academic careers, resulting in different perspectives when approaching topics. The development process was composed of three stages (Figure S1). Initially, a content list was prepared for each volume by three students and one postdoctoral fellow, after which three teams of students and postdoctoral fellows wrote the evidence-based recommendations, taking particular care in referencing each recommendation, and organized them in a text file using easily understandable language. Each initial draft was reviewed by a team of professors, assigned according to their research expertise. The revised version was formatted into a PDF file with figures and design elements, to ensure the material was visually appealing and easily understood by readers. Finally, the formatted volumes were reviewed by one or two members of the general public, who were not involved in creating the material, to confirm it was understandable. The material then underwent a final content review by associate professors in the field of Psychiatry and Neuroscience. The recommendations were compiled in a PDF file; layout and formatting were done in the graphic design platform Canva (<https://www.canva.com>). They were also checked by a professional designer who provided suggestions to improve the material visually.

How to avoid COVID-19

Volume 1 aimed to inform the population about practices that reduce the spread of coronavirus infection. It begins with a summary of COVID-19 symptoms and includes the recommendations listed in Table 1. After data collection for this first study, some details of Volume 1 were updated to take account of new evidence (see this link for all versions).

How to remain healthy while social distancing

Volume 2 includes information on how to manage anxiety, sadness and loneliness, deal with conflicts, explain COVID-19 to children, and help children with schoolwork, as well as the recommendations listed in Table 1.

Biological clock and sleep

Volume 3 introduces definitions in chronobiology (e.g., biological clock, chronotype), and includes the recommendations listed in Table 1.

Each volume has 10-12 pages, starting with the list of recommendations in a large font size. Every piece of advice was accompanied by explanatory texts. Main references were also included at the end of volumes for further consultation by participants. Table 1 summarizes the recommendations, as well as the questions included

Table 1 Summary of the main recommendations and related questions (14-day/28-day questionnaires), translated to English

Volume/recommendation	Adherence question: Which of the following recommendations did you follow?
<p>1 – COVID-19 prevention</p> <p>Wash your hands regularly with soap or apply hand sanitizer (70% alcohol). Avoid going out; if you have to go out, wear a mask.</p> <p>Keep a safe distance of at least 2 m from others; if you are walking, increase the distance. Avoid touching your eyes, nose, and mouth If you need to cough or sneeze, cover your mouth and nose with the inner part of your elbow or a disposable tissue. Stay at home if you feel sick. Viral transmission can occur at least 3 days before symptoms appear.</p>	<p>I washed my hands regularly or applied hand sanitizer (70% alcohol) to clean them. I avoided leaving home. When outside, I wore a mask.[†] I kept a 2-m distance from other people when outside.[†]</p> <p>I avoided touching my eyes, nose, and mouth. -</p> <p>I stayed at home if I felt any of the COVID-19 symptoms (cough, fever, difficulty breathing...)[†]</p>
<p>2 – Healthy habits</p> <p>Avoid listening to the news all the time. Practice body and mind relaxing techniques. Set aside some time for leisure activities. Exercise at home. Take care of your body posture. Maintain good oral hygiene. Take care of your nutrition.</p>	<p>I avoided listening to the news all the time. I practiced techniques to relax my mind and body. I set aside some time for leisure activities. I exercised. I took care of my body posture. I maintained good oral hygiene. I was careful with my meals.</p>
<p>3 – Biological clock and sleep</p> <p>Expose yourself to sunlight during the day. Turn off lights at night. Reduce screen time, especially at night. Use apps that turn your screen light yellow at night. Organize your routine according to your chronotype. Keep your routines regular. Avoid long naps. Avoid thinking about problems at bedtime. Make your bedroom a sleep-inducing environment. Avoid heavy meals close to bedtime. Avoid caffeine and alcohol intake close to bedtime.</p> <p>Plan your exercise schedules considering your sleep time.</p>	<p>I exposed myself to sunlight during the day. I turned off lights earlier or avoided white light exposure. I reduced the amount of screen time (computer, TV, cell phone) at night. I used an app to change the screen color temperature to yellow at night. I organized my routine according to my chronotype. I kept regular routines (sleep, meals, work-leisure). I avoided taking long naps during the day. I avoided thinking about my problems at bedtime. My bedroom was a sleep-inducing environment. I avoided heavy meals before bedtime. I avoided beverages/food containing caffeine before bedtime. I avoided alcoholic beverages before bedtime.[†] I avoided doing exercise before bedtime.</p>

Response alternatives: 0 = never; 1 = less than half of the days; 2 = more than half of the days; 3 = every day.

COVID-19 = coronavirus disease 2019.

[†] Participants could select not applicable (N/A) as a response to these questions.

in the questionnaires to assess adherence 14 and 28 days after reading the material, here translated into English.

Recruitment, data collection and study design

We used the non-probabilistic method of snowball sampling and recruited participants from the general population using social media, e-mails to university lists, personal contacts, advertising in talks at conferences or live streaming events for the community, posts on discussion boards, and mailing lists. We therefore collected a convenience sample. The inclusion criteria were age over 18 years and ability to understand the questionnaires, which were written in Portuguese. Our advertisement strategies included posts with: 1) illustrations about sleep, the biological clock, and mental health during the pandemic; 2) inviting people to “help science from home”; and 3) announcing they would receive recommendations. The text invitations we shared briefly mentioned our study goals and provided a link to the initial survey (see Figure S2 for examples).

Participants were invited to fill in validated instruments and questionnaires designed to assess sociodemographic characteristics and habits/behavior during the pandemic. Each validated questionnaire was presented on a separate page (screen): one screen for sociodemographic data; one for diseases and medications, including drugs, tobacco, stimulants, and alcohol consumption (CAGE Questionnaire); and one for social distancing + habits. The complete battery of questionnaires consisted of 10 pages, and subjects could go back and review their responses before submitting. Upon completion of the first questionnaire, subjects were provided a link giving them access to recommendations on how to keep healthy while social distancing. Participants were randomized (by the survey system, which generated a random number from 1 to 4) into four groups: group 1 (control) received only Volume 1; group 2, Volumes 1 and 2; group 3, Volumes 1 and 3; and group 4 received all volumes.

After 14 and 28 days, participants were invited by e-mail to fill in questionnaires similar to the first and to report on their adherence to each recommendation in the

form of Likert scales (0 – never; 1 – less than half of the days; 2 – more than half of the days, 3 – every day). These questions were shown on a single page (screen). Frequency of adherence was only assessed for those cases in which participants reported having read the recommendations, and only concerned the volumes that each participant received. Participants who did not read the recommendations at any time point were assigned to a separate group (“non-readers”), which was used for comparison as another control group. Participants who did not fill in the follow-up questionnaires within 24 hours received a reminder e-mail.

Between July 2 and November 27, 2020, the survey received 2,208 visits; 1,732 visitors consented to participate in the study (recruitment rate: 78.4%), of which 1,198 filled in the first questionnaire completely (completion rate: 69.2%). Among the 1,198 participants, 616 filled in the 14-day follow-up survey (14d time point) and 539 completed the 28-day follow-up survey (28d time point), while 21 participants had not yet reached one of the time points by the end of data collection for this study. We included in the current analysis those 409 participants who completed all three questionnaires. For more details regarding response rates and prevention of multiple entries, see supplementary material.

Participants

Our sample (n=409) was composed mainly of women (85%), with the majority of individuals aged between 18 and 45 years (82%). Participants were in general highly formally educated (more than 99% having completed their high school education and over 78% having a higher degree), with the most reported occupations being formally employed and student (36% each), and the vast majority of participants living in urban areas. Although people from across the country participated in the study, most of the sample lived in the states of Rio Grande do Sul (RS) and São Paulo (SP), located in the Southern and Southeastern regions of Brazil, respectively. Table 2 presents a full description of demographic aspects. Most participants considered themselves to be practicing social distancing all the time (n=160, 39%) or most of the time (n=216, 53%), for a median duration of approximately 5 months (157 days [interquartile range {IQR}128-198]), with a median of two household companions; 5% were diagnosed with COVID-19 either before or at some point during the study.

Groups 1, 2, 3, and 4 had sample sizes of 102, 104, 99 and 104 respectively.

Groups did not score differently at baseline on the PHQ-9 (H[3] = 4.006, p = 0.261) or GAD-7 (H[3] = 5.019, p = 0.170; see Figure S5). Interestingly, we found negative Spearman correlations of baseline severity of depression and anxiety with age (PHQ-9: p = -0.29, p < 0.01; GAD-7: p = -0.28, p < 0.01), which indicates that younger participants had more severe symptoms than did older

Table 2 Demographic characteristics of the study participants

Variable	n (%)
Sex	
Female	349 (85)
Male	60 (15)
Age (years)	
18-29	157 (38)
30-45	179 (44)
46-59	50 (12)
≥ 60	23 (6)
Education	
Middle school	1 (< 1)
High school	89 (22)
Bachelor's degree	158 (39)
Master's degree	79 (19)
Doctoral degree	82 (20)
Employment situation	
Formally employed	149 (36)
Self-employed	46 (11)
Student	146 (36)
Unemployed	21 (5)
Retired	13 (3)
Not available	34 (8)
Marital status	
Single	258 (63)
Married	135 (33)
Separated/divorced	14 (3)
Widowed	2 (< 1)
State of origin	
Bahia	4 (1)
Ceará	4 (1)
Minas Gerais	14 (3)
Mato Grosso do Sul	9 (2)
Pernambuco	6 (1)
Paraná	9 (2)
Rio de Janeiro	13 (3)
Rio Grande do Sul	166 (41)
Santa Catarina	12 (3)
São Paulo	157 (38)
Alagoas, Distrito Federal, Espírito Santo, Roraima	9 (2)
Outside Brazil	6 (1)
Geographical area	
Urban	396 (97)
Rural	13 (3)
Substance use	
Alcohol	261 (64)
Tobacco	20 (5)
Illicit drugs	6 (1)
Stimulants (coffee, mate)	301 (74)
Comorbidities	
None	240 (59)
Diabetes	7 (2)
Hypertension	24 (6)
Asthma	26 (6)
Depression	50 (12)
Immunodeficiency	5 (1)
Other	104 (25)

ones. Stimulants and alcohol consumption at baseline did not differ significantly across groups (alcohol: 63, 62, 69, 63%; stimulants: 70, 78, 76, 71%, stimulants at night: 7, 5, 5, 3%, for groups 1, 2, 3, and 4, respectively). Only two participants reported drinking in the morning to reduce anxiety and hangover (CAGE, question 4), and less than 6% had a CAGE sum score ≥ 2 .

No significant difference was noted between participants who completed the study and dropouts (N=768, 65% of 1177 participants; 21 participants had not yet reached 28 days by the end of data collection and were not included in this comparison), regarding group (see supplementary material), age, and GAD-7 scores (Table S2). Dropouts had a slightly higher PHQ-9 score (median [IQR]: participants, 11 [7-17]; dropouts, 12 [8-18]; U = 144452, $p < 0.05$). The proportion of men who dropped out was higher, but not significantly so ($\chi^2[1] = 3.55$, $p = 0.054$).

Questionnaires/instruments

Social distancing

Our questionnaire aimed to characterize social distancing by asking how often participants were social-distancing, how often they had contact with other people, and how were their routines regarding eating, sleeping, exercising, and light exposure. Questions were asked at all three time points.

Validated questionnaires

We used validated questionnaires to assess aspects of mental health (i.e., quality of life, anxiety and depressive symptoms, perceived stress) and sleep behavior. In this study, our first analysis of the set of recommendations, we used the Generalized Anxiety Disorder-7 (GAD-7) and Patient Health Questionnaire-9 (PHQ-9) data as outcomes.

The GAD-7 is a seven-item self-report questionnaire. It is a validated screening tool and indicator of severity for generalized anxiety disorder. Questions ask whether/how often participants had symptoms in the last 15 days, to which they can respond not at all, several days, more than half the days, and nearly every day. Participants can score from 0 to 21, with higher scores indicating greater self-reported anxiety.^{28,29} We used the validated Brazilian Portuguese version.³⁰

The PHQ-9 is a nine-item self-report questionnaire that assesses depressive symptoms in the previous 2 weeks. Questions ask whether/how often participants had depressive symptoms, to which possible responses are not at all, several days, more than half the days, and nearly every day. Scores may range from 0 to 27, with higher scores indicating higher prevalence/severity of depressive symptoms.³¹ Again, we used the validated Brazilian Portuguese version.³²

Calculation of variables

Recommendation adherence scores

Adherence scores were calculated for each volume as the sum of the Likert scale scores converted into a percen-

tage, based on the maximum possible score. Since adherence to recommendations was only collected for those participants who reportedly read the provided material, we do not have data on adherence at 14 days for participants who did not read the recommendations at that time point. We noticed some participants would report not having read the recommendations on day 28, even though they had done so at the 14d time point. We then decided to collect and include adherence data at time point 28d for such cases. This means we do not have adherence data on day 28 for the first 20 participants who met these circumstances (i.e., even if they indicated having read the recommendations at time point 14d). This represents only 4.9% of the total sample.

The mean adherence varied across the different volumes; therefore, we calculated standardized adherence scores (z scores) within volumes and averaged them across individuals (e.g., a subject from group 4 had their adherence to each of the three volumes standardized and then averaged).

Delta PHQ-9 and delta GAD-7

Delta PHQ-9 and GAD-7 were calculated as the difference between the score on day 14 (or day 28) and the baseline score.

Time points

Most participants filled in the follow-up questionnaires within 2 days of receiving the invitation, but others presented longer elapsed times between the initial questionnaire and follow-ups (Figure S3). To assess the impact of elapsed time on our results, we performed sensitivity analyses (including only the 332 participants with less than 18 days of difference between time points in the multivariate full models), which showed similar results. For the sake of clarity, even if elapsed times vary, we refer to the time points as 14d and 28d.

Statistical analyses

We tested normality using the Shapiro-Wilk test and visual inspection of histograms, taking into consideration our sample size. We present data as median and IQR, since in most of the cases the distribution was not normal. We therefore chose nonparametric tests. Statistical analyses were performed using R (v. 4.0.1, R studio 1.3.1056; R-package *ggplot* for data visualization).³³

For each of our hypotheses, we used the following tests:

H1: the proportion of reading the recommendations was different across study groups; demographic characteristics and initial scores (PHQ-9, GAD-7) were associated with reading the recommendation.

Reading was compared between groups using chi-square (χ^2) tests. We tested whether reading or not the recommendations was associated with any characteristic using χ^2 and Wilcoxon-Mann-Whitney *U* tests.

H2: adherence to recommendations was different between study groups; demographic characteristics and

initial scores (PHQ-9, GAD-7) were associated with adhering to recommendations.

For comparisons of adherence between groups (i.e., by study group), we used either Wilcoxon-Mann-Whitney *U* or Kruskal-Wallis (H) tests. We used Spearman's correlation to test whether initial scores or age were associated with adhering to the recommendations.

H3: reading and adherence to recommendations related to healthy habits and biological clock and sleep was associated with improvement in depressive (PHQ-9) and anxiety (GAD-7) symptoms.

We compared groups to see whether receiving and reading Volumes 2 and 3 would decrease depressive symptoms in comparison to subjects who did not read the recommendations or only received Volume 1. For this, we used Kruskal-Wallis test to compare deltas of PHQ-9 and GAD-7 between groups.

Additionally, using generalized estimating equations (GEE) (AR-1 covariance matrix, Gaussian distribution, with robust variance estimator; R-Package *geepack*³⁴) with PHQ-9 and GAD-7 scores as outcomes, we tested whether adherence (%) to each module was associated with a lower prevalence/severity of depressive and anxiety symptoms, controlling for age, sex, and initial score. Full GEE models were run with the standardized adherence as a factor, so that the effect of group and group * adherence could also be tested.

H4: behavioral changes were elicited by our recommendations

Our survey included questions about behaviors we aimed to positively influence with our recommendations. We ran analyses to see whether the improvement was associated with receiving and reading the recommendations using a two-proportion z-test (improved vs. did not change/got worse) for each behavior.

Ethics statement

The study was approved by the Brazilian National Research Ethics Committee (Comissão Nacional de Ética em Pesquisa – CONEP; CAAE 30396320.1.0000.5327) and conducted in accordance with the Declaration of Helsinki. All participants were informed about the study when clicking our link and provided their informed consent by clicking a statement to that effect before proceeding to the survey data collection.

Results

Reading and adherence to recommendations

Factors that influenced reading the recommendations (H1)

We first assessed the proportion of participants who reportedly read the material at each time point. No significant differences were seen between groups regarding the extent to which they read the recommendations (Figure S4; 14 days: $H[3] = 5,984$, $p = 0.112$; 28 days: $H[3] = 2,908$, $p = 0.406$). A total of 95 (23%) and 79 participants (19%) reported not having read any of the material

at 14 days or at any time point, respectively, and were assigned to the “non-readers” group.

No association was found between baseline PHQ-9 and GAD-7 scores or age with reading the recommendations. However, more women read them, both on day 14 and day 28; education may also have influenced reading the recommendations on day 14, as the proportion of less educated participants (not holding a master's or doctoral degree) who read them was higher (80 vs. 71%), but not statistically significant (Table S3).

Factors that influenced adherence to recommendations (H2)

Table 3 shows the adherence score (%) for each volume, per group. Adherence scores noticeably differ between volumes, with Volume 1 having the highest scores. However, there was no significant difference between groups in relation to how much participants adhere to each volume.

Groups did not show significant differences in adherence to any individual recommendation either. For the plots and statistics comparing adherence to each recommendation between groups and within volumes, see Table S4 and Figure S6.

It is noteworthy that initial PHQ-9 and GAD-7 scores inversely predicted mean adherence to Volumes 2 and 3 recommendations, but not to Volume 1 recommendations (Table S5, Figures S7 and S8). We also found that age positively correlated with adherence scores for all volumes, meaning that older participants complied better with all recommendations, including those related to COVID-19 prevention (Volume 1).

Effectiveness of recommendations: reported adherence (H3)

Delta PHQ-9 and GAD-7 scores were calculated for the time points of 14 and 28 days relative to baseline and are presented per group in Figure 1. Note that median delta values were negative for all groups. Negative deltas represent an overall decrease in severity of symptoms. However, no significant differences between groups were identified for either delta score (PHQ-9: 14 days – $H[4] = 1,415$, $p = 0.842$; 28 days – $H[4] = 2,109$, $p = 0.716$; GAD-7: 14 days – $H[4] = 8,342$, $p = 0.080$; 28 days – $H[4] = 2,869$, $p = 0.580$). Therefore, we cannot conclude that participants who read Volumes 2 and 3 (groups 2, 3, and 4) had a greater improvement in comparison to non-readers or participants from group 1 (control).

GEE analyses (Table 4) for each volume with PHQ-9 scores at time points 14d and 28d as outcomes showed: Model Volume 1: no significant effect of adherence to Volume 1; Model Volume 2: significant main effect of adherence to Volume 2 and significant interaction adherence to Volume 2 * time point, with those with higher adherence having lower PHQ-9 scores and a slightly steeper slope of adherence vs. scores at time point 28d (Figure S9); Model Volume 3: significant main effect of adherence to Volume 3, with those with higher adherence having lower PHQ-9 scores. In all three

Table 3 Recommendation adherence scores for the three volumes according to group

Group	Volume 1 14 days	Volume 1 28 days	Volume 2 14 days	Volume 2 28 days	Volume 3 14 days	Volume 3 28 days
1	86.7 (80.0-93.3)	86.7 (80.0-93.3)	-	-	-	-
2	86.7 (80.0-93.3)	86.7 (80.0-93.3)	54.8 (42.8-66.7)	57.1 (42.9-66.7)	-	-
3	91.1 (86.7-100.0)	93.3 (86.7-100.0)	-	-	65.4 (55.8-74.3)	65.4 (51.3-73.8)
4	88.9 (86.7-94.4)	86.7 (80.0-93.3)	52.4 (42.8-66.7)	52.4 (38.1-66.7)	61.5 (53.8-69.2)	61.5 (52.8-71.8)
p-value	0.236	0.211	0.506	0.542	0.135	0.570

Data presented as median (interquartile range) and p-values for comparison between groups. Kruskal-Wallis test was used for Volume 1 comparisons and Wilcoxon-Mann-Whitney *U* test for Volumes 2 and 3 comparisons. Group 1 (control) received Volume 1; group 2 received Volumes 1 and 2; group 3 received Volumes 1 and 3; group 4 received Volumes 1, 2, and 3.

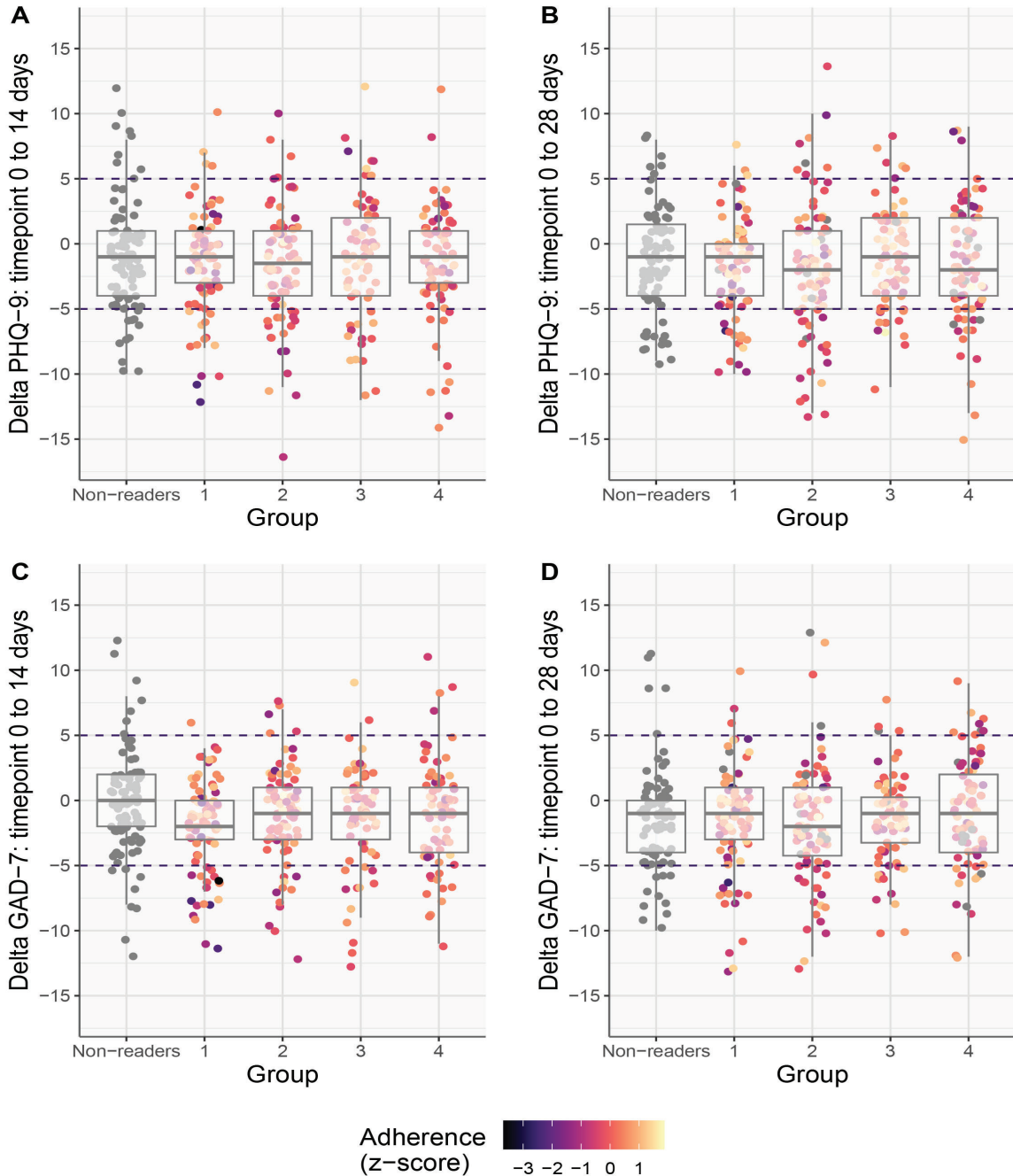


Figure 1 Delta Patient Health Questionnaire-9 (PHQ-9) (A and B) and Generalized Anxiety Disorder-7 (GAD-7) (C and D) scores at the 14-day and 28-day time points, per group. Color scale represents adherence (z score) for each group. Group 1 received Volume 1; group 2 received Volumes 1 and 2; group 3 received Volumes 1 and 3; group 4 received Volumes 1, 2, and 3. Non-readers: 14 days – did not read the recommendations at 14 days; 28 days – did not read the recommendations at either 14 or 28 days.

Table 4 Generalized estimating equations: adherence associated with PHQ-9/GAD-7 scores

	Model Volume 1	Model Volume 2	Model Volume 3	Full
Outcome: PHQ-9 scores (time point 14d/28d)				
Age (years)	-0.06 (0.01)**	-0.05 (0.02)*	-0.06 (0.02)*	-0.05 (0.01)**
Sex (male)	-0.01 (0.52)	0.39 (0.68)	0.03 (0.78)	-0.07 (0.50)
Initial PHQ-9	0.70 (0.03)**	0.63 (0.05)**	0.65 (0.05)**	0.68 (0.03)**
Time point (28d)	-2.97 (1.95)	2.67 (1.70)	-0.03 (1.81)	-0.26 (0.22)
Adherence (%) [†]	0.01 (0.02)	-0.05 (0.02)*	-0.06 (0.03)*	-
Adherence × time point	0.03 (0.02)	-0.05 (0.03)*	-0.00 (0.03)	-
Group 2 × adherence	-	-	-	-1.31 (0.54)*
Group 3 × adherence	-	-	-	-1.31 (0.58)*
Group 4 × adherence	-	-	-	-2.85 (0.64)**
Outcome: GAD-7 scores (time point 14d/28d)				
Age (years)	-0.02 (0.01)	-0.02 (0.02)	-0.03 (0.02)	-0.02 (0.01)
Sex (male)	0.06 (0.51)	-0.32 (0.74)	-0.14 (0.84)	-0.02 (0.50)
Initial GAD-7	0.66 (0.03)**	0.61 (0.05)**	0.60 (0.06)**	0.66 (0.03)**
Time point (28d)	0.41 (1.82)	0.56 (1.04)	2.21 (1.38)	-0.16 (0.20)
Adherence (%) [†]	0.03 (0.02)	-0.03 (0.02)*	-0.02 (0.02)	-
Adherence × time point	0.00 (0.02)	-0.02 (0.02)	-0.04 (0.02)	-
Group 2 × adherence	-	-	-	-1.02 (0.53)
Group 3 × adherence	-	-	-	-0.74 (0.43)
Group 4 × adherence	-	-	-	-1.84 (0.57)*
n entries n subjects	624 330	312 169	294 157	624 330

Coefficients (standard errors). Group 1 received Volume 1; group 2 received Volumes 1 and 2; group 3 received Volumes 1 and 3; group 4 received Volumes 1, 2, and 3.

GAD-7 = Generalized Anxiety Disorder-7; PHQ-9 = Patient Health Questionnaire-9.

* $p < 0.05$; ** $p < 0.001$.

[†] Adherence to Volumes 1, 2, and 3 in the three first columns, respectively.

models, age and initial PHQ-9 values were significantly associated with PHQ-9 scores on day 14 and 28.

The same models with GAD-7 scores at time points 14d and 28d as outcomes show: Model Volume 1: no significant effect of adherence to Volume 1; Model Volume 2: significant main effect of adherence to Volume 2, with those with higher adherence having lower GAD-7 scores; Model Volume 3: no significant main effect of adherence to Volume 3. However, when removing the interaction term, Volume 3 was significantly associated with GAD-7 as well, with those with higher adherence having lower scores. In all three models, initial GAD-7 was significantly associated with the scores (at 14d and 28d).

Full GEE, with all three volumes, showed a significant interaction effect of group × standardized adherence on scores of PHQ-9 and GAD-7. Interaction plots in Figures 2A and B (PHQ-9 and GAD-7, respectively) show lines (adherence[x] vs. predicted score[y]) partialling out the variance shared with other factors in the model. No main effect of time point was identified in the full model; all GEE models included subjects independently of them having one or two measures of adherence. However, participants who reportedly read the recommendations at neither time point (14d and 28d) were not included, as we did not collect any adherence data for them.

Behavioral changes related to the recommendations ("actual adherence," H4)

In addition to recommendations, we investigated potential recommendations-related behavioral changes by comparing responses to direct questions included in the follow-up questionnaires to those provided at time point 0.

Overall, we found that the average proportion of participants who had behavioral improvements related to Volume 2 recommendations at 14d and 28d was 20.7 and 22.1%, respectively. The average proportion of participants with Volume 3-related behavioral improvements at 14d and 28d was 22 and 23.2%, respectively. Such changes occurred within the study timeframe, suggesting that participating in the study had a positive impact. However, similarly to the results reported above, we found no significant association between reading the recommendations and improving behaviors (Table S8).

Discussion

In a large ongoing study, we are testing the reach and effects of evidence-based recommendations on promoting mental health. We intend to iteratively analyze results and improve the format, content, and methods of delivery of the recommendations. The main product and result of this first report is a set of effective recommendations put together by a team of health professionals and students, the effectiveness of which was assessed between July and November 2020. The information gathered and distributed in the study were shown to be relevant to mental health, since those individuals who followed our advice more closely had lower scores on scales of depressive and anxiety symptoms. However, simply reading the recommendations was not associated with an improvement in mental health, nor was receiving them associated with changes in behavior.

The majority of our participants (> 80%) reported having read at least part of our material. We did not see

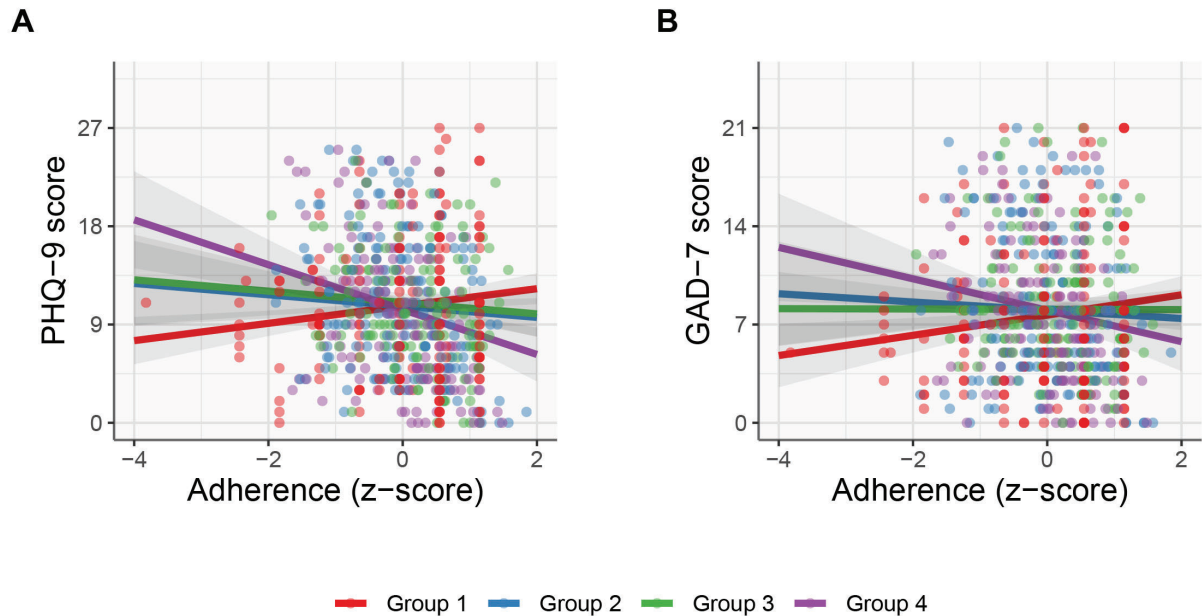


Figure 2 Association between group \times adherence (z score) and Patient Health Questionnaire-9 (PHQ-9) (A) or Generalized Anxiety Disorder-7 (GAD-7) (B) scores. Lines are derived from the GEE models, which included age, sex, time point, and initial PHQ-9 (A) or GAD-7 (B) scores as factors. While lines represent adherence vs. predicted score; dots show adherence vs. score. Shaded areas: 95% confidence intervals. Group 1 received Volume 1; group 2 received Volumes 1 and 2; group 3 received Volumes 1 and 3; group 4 received Volumes 1, 2, and 3.

an improvement in mental health among those who read Volumes 2 and 3 of our recommendations in comparison to non-readers or those who only received Volume 1. However, having higher adherence to Volumes 2 and 3 was associated with a better outcome; hence, the content of these volumes proved to be useful in preserving mental health during the social distancing period imposed by the pandemic. As useful as the recommendations may be, we identified a gap between reading them and implementing a positive behavioral change, as expected for this type of intervention.³⁵ For both volumes, the median adherence score was around 60%, which was rather low when compared to Volume 1. When looking at behavioral changes directly assessed during the study, around 20-30% of participants implemented positive changes during the study, and this was independent of reading or not the respective recommendations. It is possible that, while answering our questions, participants were led to rethink their routines. Considering their higher level of education, it is likely that they were already aware of the importance of those behaviors, such that being questioned about their habits triggered a positive response.

It is already well recognized that online interventions have the potential to aid prevention in primary care.³⁶ Research suggests that a number of factors influence how individuals engage with such intervention programs, including: 1) environmental factors (e.g., available time, internet access); 2) individual characteristics (e.g., demographical, psychosocial); and 3) features of the intervention (e.g., content, format, delivery mode).³⁷ Adherence to the recommendations of Volumes 2 and 3 may have been influenced by either of these three factors.

When considering factor 2 (individual characteristics), it was noted that older people were more adherent to the recommendations contained in these two volumes, while also having lower PHQ-9 and GAD-7 scores. On the other hand, individuals with higher severity of anxiety and depression symptoms at the beginning of the study had lower adherence to both Volumes 2 and 3, despite having read them to the same extent as others; this is probably due to the stronger resistance to behavioral changes seen in patients with mental health issues.³⁵ Regarding our booklet features, we do not believe that understanding the content was an issue, since our sample was composed mainly of highly formally educated participants. We also made it clear that all recommendations were based on scientific evidence and included references for further consultation, along with short explanations as to why each recommendation might affect mental health. However, providing smaller amounts of information and more guided instructions (i.e., “how-tos”) may prove useful to increase adherence in some groups.

Some limitations of this study must be noted. Adherence to health recommendations varies across people and, importantly, it is suggested that they tend to cluster – e.g., the same people who seek to eat healthily do not smoke.³⁸ This makes it difficult for observational studies to disentangle the effects of behavioral interventions. With our sample size, we have not yet been able to adequately gauge the effectiveness of following individual recommendations. However, by asking for adherence to each of them individually, we intend to tackle that question in the future and with larger sample sizes.

Furthermore, we used a convenience sample, which limits the generalizability of conclusions related to our hypotheses. The characteristics of the public we reached in our first round of data collection are probably a consequence of our advertising strategies. The wide use of various university social networks and websites to recruit participants were probably responsible for the sample being heavily biased towards not only higher education (78% of respondents had a university education) and women (85% of the sample), but also some geographical locations (urban areas of SP and RS). This means our recommendations so far have only reached limited areas and socioeconomic strata of the population, and our results should be interpreted accordingly. A significant number of participants also reported using alcohol and stimulants, which may be relevant in our study, considering the association of their consumption with chronotype and social jetlag.^{39,40}

The dropout rate in this study was substantial when we consider the three time points (65%). Longitudinal web surveys are prone to low survival rates,^{41,42} a major limitation, which may bias their results towards positive outcomes.⁴² Dropouts from this study had a slightly higher score for depressive symptoms compared to participants, but the difference is hardly relevant and no other differences between the two groups were statistically significant.

We cannot clearly associate receiving and reading the material with the mental health outcomes of interest, as we have little information on the extent to which participants were already practicing the effective recommendations before entering the study or if they were encouraged to do so during the study by secondary factors (unrelated to receiving our advice). It is also possible that a good mental health status favors motivation to engage in healthy activities (as suggested by the association between baseline scores and adherence), which in turn protects mental health, generating a positive cycle; our study design does not allow the establishment of causal relationships between the studied variables. It is clear, however, that this study allowed us to identify a valuable set of recommendations that are effective in protecting mental health during a pandemic.

We are experiencing a time in which there is a great need for reliable and uniform information, as well as initiatives that contribute to decreasing social inequalities. Therefore, we would like to make these recommendations more accessible to lower-income areas, where such directions are harder to obtain. In this context, it is important to discuss the financial cost that implementing the recommendations may represent to the participants. Most of our recommendations are almost cost-free to implement. It is well established that having the necessary resources (financial and environmental) is a limiting factor for behavioral changes.^{35,37} Tailoring recommendations to an individual's personal needs and to their environmental factors is likely to improve outcomes – first by increasing the perceived value of the recommendations, which in turn increases compliance³⁵; second, by adjusting them to the individual's socioeconomic reality.

Another important challenge will be the assertiveness of the recommendations for individuals with severe anxiety and depression symptoms, who showed lower adherence to Volumes 2 and 3. Future versions of the recommendations will make use of digital technology resources to tailor recommendations to individual characteristics, and will take advantage of more appealing and interactive methods of delivery.

This study is a first report on a set of recommendations put together by researchers, health professionals, and students aiming to positively affect the mental health and wellbeing of individuals during the COVID-19 pandemic. Our material has been analyzed with the objective of continuously improving format, content, and delivery methods. Here, we provide an objective summary of our first challenges and findings, showing that: 1) alternative methods have to be thought of to make sure recommendations reach high-risk populations; 2) our recommendations, when followed, seem to be effective in promoting mental health; and 3) it is important to develop strategies to bridge the intention-behavior gap, which may include tailoring messages and planning control strategies according to individual characteristics. We hope our evidence-based recommendations and results will be helpful in outlining strategies to decrease the negative mental health effects of the pandemic and social distancing. Furthermore, such technologies and information should be useful beyond the context of the pandemic.

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Disclosure

The authors report no conflicts of interest.

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