Longitudinal changes in depression and anxiety during COVID-19 crisis in Uruguay

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Abstract

Longitudinal studies have reported decreased mental health symptoms throughout the COVID-19 crisis, while others have found improvements or no changes across time. However, most research was carried out in developed countries, with a high incidence of COVID-19 and, in several cases, mandatory lockdowns. Considering that Uruguay (a developing country) had a low COVID-19 incidence at the moment of this study and has implemented a mild lockdown, we aimed to evaluate the effect of time and mobility (using Google mobility data) on symptoms of anxiety and depression. A longitudinal panel study with six repeated measures was carried out to evaluate depressive (BDI-II) and anxiety (STAI-S) symptoms during the pandemic. A decline in symptoms of anxiety and depression was found across time. Interestingly, this effect was modulated by age; a greater difference in the symptomatology between age groups was found at the beginning of the measurements than at the end, with the youngest reporting the most severe symptoms. Finally, we found that depressive symptoms decreased as mobility increased. Overall, our findings indicate an improvement in mental health as quarantine passed and mobility increased but following a different pattern depending on age. Monitoring these trajectories is imperative moving forward, especially in vulnerable groups.

Keywords Mobility · Age · Mental health · Coronavirus · General population

Introduction

On March 11th, 2020, COVID-19 was declared a global pandemic, affecting countries worldwide. To date, over 188 million people have been infected and, over 4 million deaths had been reported (WHO, 2021). One of the most affected regions was Latin America and the Caribbean, with over 39 million confirmed cases and over 1.3 million deaths (Johns Hopkins University, 2021). As a result of the rapid increase, different measures have been implemented across the world to curtail the spread of the virus, which impacted the population's mental health (Zhang et al., 2020).

Uruguay, a South American country with around 3.5 million inhabitants, was an interesting case in the fight against the pandemic. By the end of our study (first days of October, 2020), Uruguay had only 2122 cumulative confirmed cases and 48 cumulative deaths, without implementing lockdown, curfews, or mobility limitations, as most of the world did. Instead, Uruguay's government appealed to the population's responsibility, urging people to stay at home (GACH, 2021). At the beginning of the outbreak, the closure of educational institutions, cultural events, and borders for foreign passengers was also implemented to contain the virus. With these measures, initial outbreaks were controlled in the country.

As the pandemic seemed under control and Uruguay had a low incidence of the disease, several activities were opened using protocols and the Test, Trace and Isolate strategy (GACH, 2021) (see Fig. 1 for a timeline and cumulative cases and deaths per million people). Importantly, these events were accompanied by an optimistic discourse that highlighted the success of the Uruguayan strategy (Uruguay XXI, 2020) and the transition towards the "new normality". Regarding Uruguayan discipline and adherence to the measures, in a survey conducted during February

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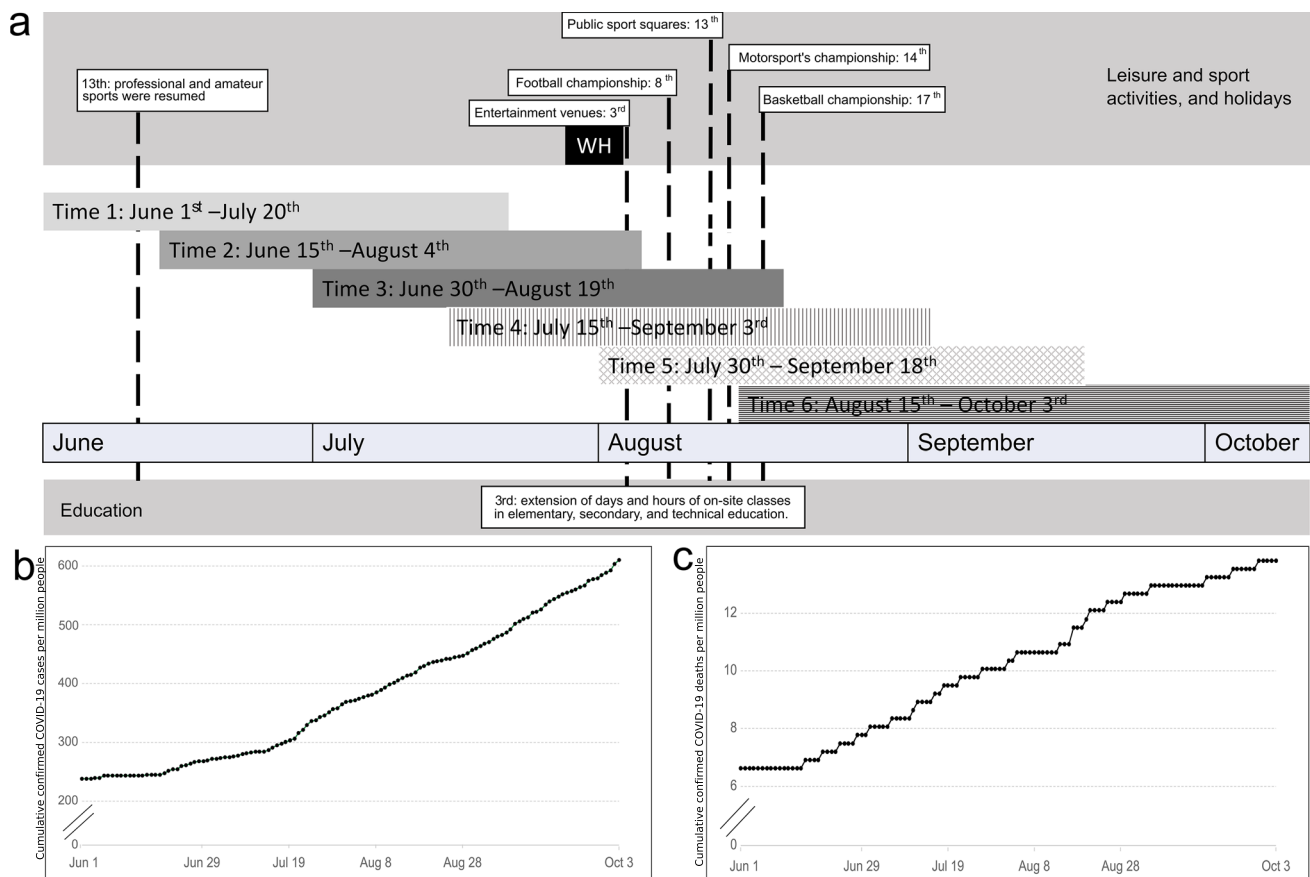
Fig. 1 **a** the study timeline shows the data collection times (Time 1 to Time 6) and the dates when data was collected. Opening events are marked with a broken line. Events related to leisure and sport activities and holidays are presented in the upper part of the figure, while education opening events are presented in the lower part of the figure. WH means Winter holidays. **b** Cumulative confirmed COVID-19 cases per million people from June 1st to October 3rd, 2020 (Our World in Data; Source: Johns Hopkins University CSSE COVID-19 Data 2021). **c** Cumulative confirmed COVID-19 death per million people from June 1st to October 3rd, 2020 (Our World in Data; Source: Johns Hopkins University CSSE COVID-19 Data 2021)

2021, most participants reported a high adherence to the use of mask in indoor public spaces and an agreement with the prohibition of mass gatherings; while, less than half of the participants agreed with the stay-at-home measure (OSEC, 2021). Even though restrictive measures were not applied in Uruguay, it is likely that the unpredictable nature and duration of the crisis impact the population's psychological health.

Several cross-sectional studies around the world have shown a high prevalence of depression and anxiety symptoms during the COVID-19 crisis (Cam et al., 2021; Salari et al., 2020). Also, in countries where strict isolation measures were not applied and the pandemic was under control, as in the Uruguayan case, poor mental health outcomes were observed (Lee et al., 2021). Moreover, longitudinal studies that examined changes before and after lockdown have found small but significant effects on mental health symptoms. Importantly, most of these studies were carried out in Europe, Asia, or North America.

Few longitudinal studies evaluated the effect of lockdown or stay-at-home orders duration. Most of these studies were carried out in countries with a high incidence of COVID-19 and, in several cases, mandatory lockdowns. In countries where strict measures were applied, a deterioration of some dimensions of mental health (depression, anxiety, suicidal risk and loneliness) was found across time (Argentina (Canet-Juric et al., 2020; López Steinmetz et al., 2020), United Kingdom (UK) (Daly et al., 2020; Groarke et al., 2021), and China (Li et al., 2021; Zhang et al., 2020)). Moreover, an increase in depressive symptoms was found in a 5-month follow-up in a multinational sample (Veldhuis et al., 2021). Following a different pattern, some studies from Spain and UK have seen an increase in depressive symptoms throughout the lockdown (Ozamiz-Etxebarria et al., 2020) and then a decrease when the lockdown was lifted (González-Sanguino et al., 2021; Pierce et al., 2021).

On the contrary, a decline in anxiety symptoms was observed during the quarantine in Argentina (Canet-Juric

et al., 2020; López Steinmetz et al., 2021b). A similar result was found in the UK; anxiety symptoms decreased over time, while depressive symptoms did not change (O'Connor et al., 2020). Another study in England found similar results; anxiety and depressive symptoms decreased across the 20 first weeks of lockdown (Fancourt et al., 2021). In the same vein, a Chinese study found that symptoms decreased as time passed (Qiu et al., 2020), while another found no changes in a four-week period (Wang et al., 2020).

In the United States (US), where measures were less severe, it was found that distress levels rose at the beginning of the outbreak and then declined some months later, even though COVID-19 cases continued to rise in that country (Daly & Robinson, 2021; Riehm et al., 2021). Daly and Robinson (2021) argue that this decline could be related to lifting the restrictions in some states, which may have indicated to some people that the pandemic was under control. Finally, some studies in Ireland, US, and UK have found no difference in symptomatology between the beginning of the outbreak and the follow-up (Hyland et al., 2021; McGinty et al., 2020; Shevlin et al., 2021).

Besides time, mobility data can be used to evaluate the effect of the measures on mental health. Using Google mobility data, a study from the US assessed the impact of reduced mobility on mental health (Devaraj & Patel, 2021). These authors found that increased residential mobility (people staying at home) increases psychological distress, while higher mobility related to retail and enjoyment leads to an improvement in mental health indexes (Devaraj & Patel, 2021). Similar results were found in a study in Ecuador, where mandatory confinement was applied (Carpio-Arias et al., 2021).

As governments relax containment measures, different impacts are expected in mental health. Evidence from Spain, the United Kingdom, and Italy showed that people reported negative expectations about the future and were fearful about what was to come in the following months (Codagnone et al., 2021).

Uruguay implemented a mild lockdown, understood as a non-coercive lockdown (Yamamoto et al., 2020), and several activities were opened a few months after the pandemic started. Therefore, based on previous literature and the fact that the lockdown was not mandatory, and activities returned to normal quickly, we expect to find that mental health problems improve over time with different patterns depending on age. Being young is a risk factor for mental health problems (Gustavson et al., 2018). In fact, young people's mental health was severely impacted during the pandemic (Guo et al., 2020; López Steinmetz et al., 2020). This might be explained due to several factors. First, it is expected that young people suffer financial uncertainty, loss of their jobs, and dramatic changes in educational environments (online classes) due to COVID-19 (Guo et al., 2020; Hawes et al., 2021; Ozamiz-Etxebarria et al., 2020). Moreover, social

distancing measures could impact social relationships (Santabárbara et al., 2021). Therefore, opening leisure and sport activities might positively impact young people in two ways: first, several jobs, particularly in the younger population, depend on these activities (Hawes et al., 2021); second, these activities are practiced by young people who usually benefit from open-air physical activities and socialization (Marques de Miranda et al., 2020). Additionally, school opening positively affect parents, particularly young-to-middle adults, because the pandemic has placed additional stress on families regarding homeschooling (Pelaez & Novak, 2020). On the other hand, elderly individuals could have an increase of fear, depression, and anxiety (Zhou et al., 2021) because an increase in mobility increase viral circulation (Bhowmik et al., 2021), and the elderly have a higher probability of dying from COVID-19 (CDC, 2021).

Although it was warned that the COVID-19 pandemic would have serious mental health consequences (López Steinmetz et al., 2021a; Salari et al., 2020), the longitudinal evidence produced in mild-lockdown countries with low viral circulation across the world is scarce. Moreover, most of the evidence was produced in developed countries. To fill this gap, we aimed to evaluate the effect of time and mobility on symptoms of anxiety and depression in Uruguayan adults.

Methods

Participants and procedure

All procedures were in accordance with the Declaration of Helsinki and were approved by the local Research Ethics Committee.

To evaluate mental health during the COVID-19 crisis, a longitudinal panel study with six repeated measures (Time 1 to Time 6) was carried out from June 1st, 2020 to October 3rd, 2020 in a non-probabilistic sample (T1: $n = 1051$; T2: $n = 470$; T3: $n = 340$; T4: $n = 330$; T5: $n = 278$; T6: $n = 232$) of adults aged ≥18 years from Uruguay. The study was advertised through social networks and university communication channels. The surveys were sent to participants every 15 days (see Fig. 1 for survey dates). On the first survey, participants could read the information sheet and provided electronic consent. Exclusion criteria were: have had a suicidal attempt and/or a psychiatric hospitalization in the last six months and having schizophrenia, dementia, intellectual disability, and/or Down syndrome.

Instruments

Sociodemographic and Isolation Conditions Questionnaire Participants responded to the following sociodemographic questions: sex (male or female), age, and socioeconomic status (*INSE)*

(Llambí & Piñeyro, 2012). Participants also responded about the type of isolation they were doing. This instrument was only applied in the initial assessment.

Beck Depression Inventory (BDI-II) (Beck et al., 1961) The Spanish version of the BDI-II was used to measure the presence of depressive symptomatology and its severity (Sanz et al., 2003).

State-Trait Anxiety Inventory (STAI) The Spanish version of the STAI state-anxiety subscale was used to measure state-anxiety symptomatology (Guillén-Riquelme & Buela-casal, 2011).

Mobility Data It was obtained from Google's COVID-19 community mobility reports (Google, 2021). These data provide estimates of changes (compared with a baseline value from a day between January 3rd and February 6th, 2020) in mobility patterns due to the COVID-19 pandemic at places such as residences, workplaces, retail and leisure locations, parks, shopping (groceries and/or pharmacies), and transit centers (Devaraj & Patel, 2021; Google, 2021). Congruent with the government measures stated above, we selected mobility data from retail/recreational venues, parks and, transit and stations and merged it by date to perform our mobility analysis.

Data analysis

Data analysis was performed with RStudio version 1.3.1. We implemented Mixed Linear Models (MLMs) to investigate the effect of time, isolation type, and sociodemographic variables on symptoms of anxiety and depression. All models had the participant as a random effect. The first models had time as a fixed effect. In the second models, isolation type was added, and in the third models, the interaction term between time and isolation type. The fourth models had the following fixed effects: time, isolation type, sex, age, and SES. In the fifth models, the interaction terms between time and the remaining variables were added. Using Akaike Information Criterion (AIC), the fifth models were selected for both outcome variables. Post-hoc comparisons were performed to determine the significance of pairwise contrasts using the Tukey correction. For the interaction between time and age, the *lstrends* function was used for estimating and comparing the slopes of fitted lines, with a 0.95 confidence level and a Tukey HSD adjustment method (Lenth, 2016).

Spearman correlations were used to see if mobility (retail and recreation, parks, and transit and stations) changed during the days of this study. Then, Mixed Linear Models (MLMs) were implemented to investigate the effect of mobility, isolation type, and sociodemographic variables on symptoms of anxiety and depression. All models had the participant as a random effect. The first models had mobility as a fixed effect. In the second models, isolation type was added, and in the third models, the interaction term between mobility and isolation

type. The fourth models had the following fixed effects: mobility, isolation type, sex, age, and SES. In the fifth models, the interaction terms between mobility and the remaining variables were added. Using Akaike Information Criterion (AIC), the fourth models for retail and recreation, parks, and transit and stations were selected for both outcome variables. *P*-values ≤ 0.05 were considered statistically significant.

Results

Sample characteristics

Table 1 depicts the number of participants at each time and descriptive statistics for the sample.

Effects of time on mental health

A significant main effect of Time on depressive symptoms was found ($F(5, 1564.501) = 9.952$, $p < .001$), with participants reporting more depressive symptoms in Time 1 than Time 2 ($p = .012$), Time 3 ($p < .001$), Time 4 ($p < .001$), Time 5 ($p = .011$), and Time 6 ($p < .001$) (Fig. 2A). In addition, an interaction between Time and age was found ($F(5, 1552.296) = 5.555$, $p < .001$). According to the Tukey HSD comparisons, there are three groupings of slopes: Time 1's slope (-0.105) is significantly less than Time 4 (-0.024) ($p = .002$), 5 (0.003) ($p < .001$), and 6 (-0.035) ($p = .025$); Time 2's slope is significantly less than Time 5 ($p = .020$); and Time 3's slope (-0.064) is not distinguished from any other (Fig. 3A). The complete model can be found in Table 2 from supplementary information.

A significant main effect of Time on anxiety symptoms was found ($F(5, 1610.175) = 3.971$, $p = .001$), with participants reporting more anxiety symptoms in Time 1 than Time 4 ($p = .040$) (Fig. 2b). Also, an interaction between Time and age was found ($F(5, 1596.277) = 3.577$, $p = .003$). According to the Tukey HSD comparisons there are two groupings of slopes: Time 1 and 3's slopes (-0.101 and -0.098 respectively) are significantly less than Time 5 (0.042) ($p = .005$ and $p = .019$ respectively); and Time 2, 4, and 6's slopes (-0.052, -0.017 and -0.084 respectively) are not distinguished from any other (Fig. 3b). The complete model can be found in Table 2 from supplementary information.
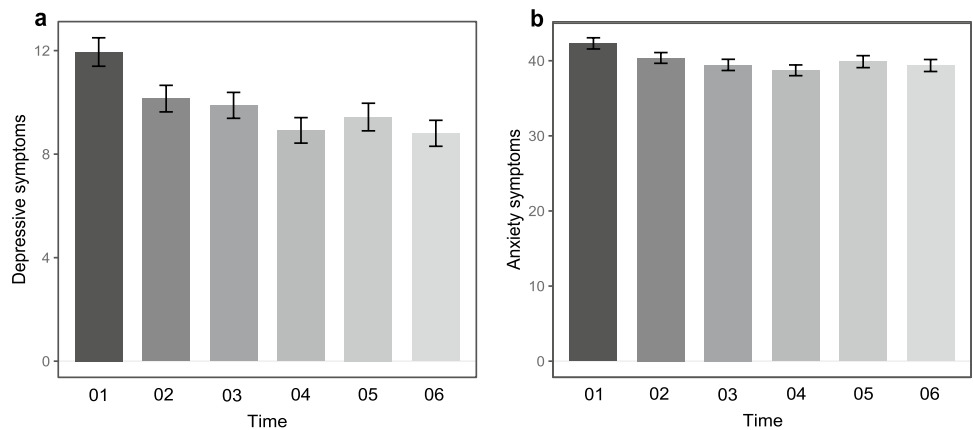
Effect of mobility on depression

As our study went on, mobility started to increase, and people stayed less at home (residentials). Correlations between Google mobility data and days of our study (122 days) were found: retail and recreation ($r_s = 0.239$, $p = .008$, $N = 122$) (Fig. 4a), parks ($r_s = 0.399$, $p = .006$, $N = 122$) (Fig. 4b), transit and stations ($r_s = 0.302$, $p < .001$, $N = 122$) (Fig. 4c). When

Table 1 Demographic characteristics and depressive and anxiety scores

Variables	T1 - n (%) Mean (SD)	T2 - n (%) Mean (SD	T3 - n (%) Mean (SD	T4 - n (%) Mean (SD	T5 - n (%) Mean (SD	T6 - n (%) Mean (SD
n	1051	470	340	330	278	232
Demographic characteristics						
Sex (n in category (%))						
Female	837 (79.64)	371 (78.94)	279 (82.06)	261 (79.09)	222 (79.86)	182 (78.4)
Male	214 (20.36)	99 (21.06)	61 (17.94)	69 (20.91)	56 (20.14)	50 (21.6)
Age (mean (SD))	37.45 (13.39)	37.45 (13.38)	38.24 (13.63)	38.99 (13.64)	41.12 (14.98)	42.39 (14.72)
SES (n in category (%))						
Low	364 (34.63)	164 (34.89)	113 (33.24)	110 (33.33)	93 (33.45)	82 (35.34)
Medium	343 (32.64)	155 (32.98)	107 (31.47)	106 (32.12)	93 (33.45)	69 (29.74)
High	342 (32.54)	150 (31.91)	119 (35)	113 (34.24)	91 (32.73)	81 (34.91)
Missing data	2 (0.19)	1 (0.21)	1 (0.29)	1 (0.30)	1 (0.36)	
Job status (n in category (%))						
Working	707 (67.27)	334 (71.06)	234 (68.82)	240 (72.73)	197 (70.86)	160 (68.97)
Unemployed	201 (19.12)	83 (17.66)	65 (19.12)	56 (16.97)	43 (15.47)	37 (15.95)
Retired	77 (7.33)	32 (6.81)	25 (7.35)	23 (6.97)	32 (11.51)	31 (13.36)
Unemployment insurance	66 (6.28)	21 (4.47)	16 (4.71)	11 (3.33)	6 (2.16)	4 (1.72)
BDI (mean (SD))	11.94 (8.90)	10.15 (8.31)	9.88 (8.11)	8.92 (7.98)	9.43 (8.64)	8.81 (8.13)
STAI-S (mean (SD))	42.31 (12.08)	40.38 (11.59)	39.45 (12.07)	38.73 (11.59)	39.88 (12.89)	39.67 (12.93)

SD standard deviation. n: number, *SES* Socioeconomical Status (participants' scores were divided into tertiles), *BDI* Beck Depression Inventory, *STAI-S* State-Trait Anxiety Inventory (State sub-scale)

Fig. 2 Mean levels of depressive (**a**) and anxiety (**b**) symptoms across time. Note: Error bars reflect ±2 standard error mean (SEM)


we explored the effects of these mobility increments in the depressive symptoms of our sample we found significant negative main effects of mobility, with scores decreasing as mobility: retail and recreation ($F(1, 1775.758) = 4.415764$, $p = .036$; $\beta = -0,02536$), parks ($F(1, 1747.151) = 10.72112$, $p = .001$; $\beta = -0,03465$) and transit and stations ($F(1, 1803.399) = 6.715$, $p = .001$; $\beta = -0.03280$). Complete model can be found in Table 3 from supplementary information.

Discussion

Previous longitudinal studies about the impact of the COVID-19 crisis on mental health across the world have reported a decrease in symptoms of anxiety and depression across time (Canet-Juric et al., 2020; Fancourt et al., 2021; López Steinmetz et al., 2021a; O'Connor et al., 2020; Qiu et al., 2020). However, most research was carried out
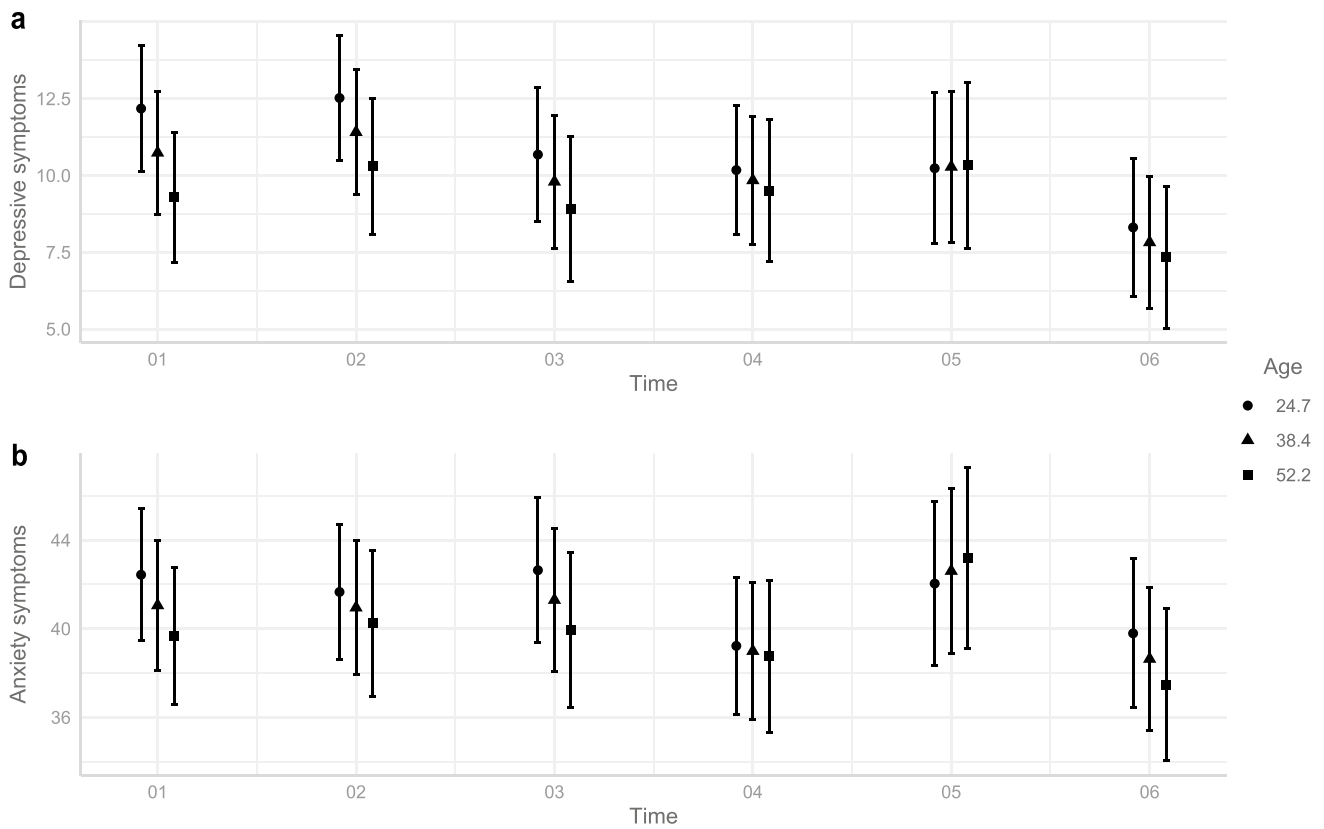
Fig. 3 Predictions from Mixed Linear Models for depressive (**a**) and anxiety (**b**) symptoms across time by age. Note: Error bars reflect 95% confidence intervals
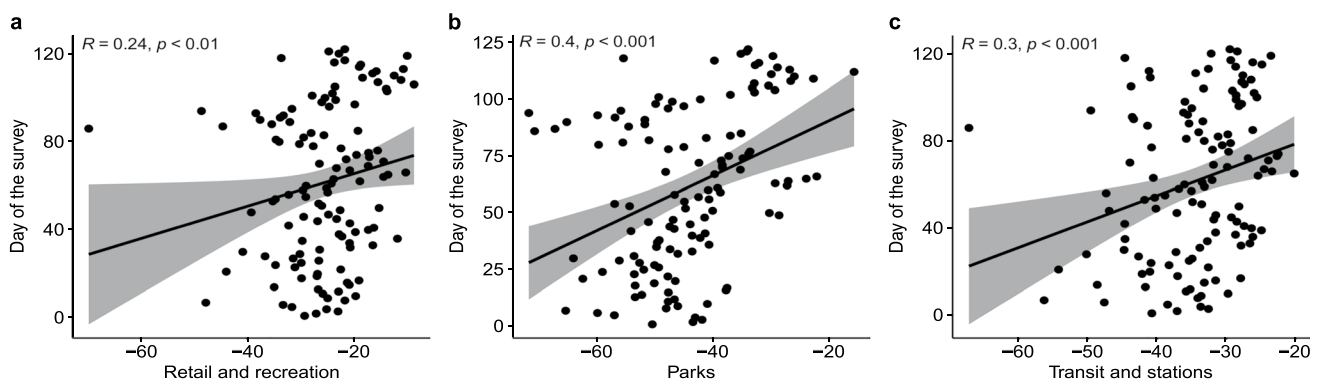
Fig. 4 Spearman correlations between days of our study and mobility in retail and recreation (**a**), parks (**b**), and transit and stations (**c**). Note: Error bars reflect 95% confidence intervals

in developed countries, where mandatory lockdowns were implemented or in those with a high incidence of COVID-19. Considering that at the moment of this study, Uruguay represented an interesting case in the fight against the pandemic (with a low COVID-19 incidence and mild lockdown), we aimed to evaluate the effect of time and mobility on symptoms of anxiety and depression. To our knowledge, this study is the first with six repeated measures of

symptoms of anxiety and depression that capture changes across time in a country with these characteristics.

Regarding depressive symptoms, an effect of time was found, with participants reporting more symptoms in the first survey (Time 1) than in the rest of the surveys (Time 2 to Time 6). Something similar happened with anxiety symptoms, with participants reporting more symptoms in Time 1 than in Time 4 (see Fig. 2). As several activities were opened since Time 2 (see

Fig. 1 for a timeline), and national authorities started to highlight the success of Uruguay in the fight against COVID-19 (Uruguay XXI, 2020), a reduction in these symptoms could be related to a decrease in people's fear of infection and less uncertainty about the future. Moreover, this optimistic atmosphere could lead to the idea that the pandemic was under control and normality was being restored (Daly & Robinson, 2021). This could have led people to started spending time doing leisure activities, leading to an increase in mobility and a decrease in symptomatology. Interestingly, we corroborate this effect; depressive scores decreased as mobility to retails and recreation, parks, and transit and stations areas increased. The decrease in symptomatology across time is also consistent with a previous study in UK reporting that mental health problems decreased after the initial stress of the pandemic (Daly et al., 2020). This decline also follows the pattern that generally appeared in response to traumatic and stressful situations (Infurna & Luthar, 2018). Monitoring these symptoms is fundamental, as a fluctuation in mental distress is expected as the pandemic continues (Riehm et al., 2021).

Interestingly, the effect of time in symptoms of anxiety and depression was modulated by age. For depressive symptoms, the differences in symptomatology between age groups were greater in Time 1 than in Time 4, 5, and 6, with the youngest reporting the most severe symptoms. In addition, this difference was greater in Time 2 than in Time 5. For anxiety symptoms, the differences in symptomatology were greater in Time 1 and 3 than in Time 5. The COVID-19 crisis severely limited social interactions in all age groups (Gruber et al., 2021). As peer interaction is vital in younger people (Benke et al., 2020), and vulnerability to mental health issues is greater in this population (Weinberger et al., 2018), it is not surprising that the youngest were the most affected by the isolation. A most pronounced rise in levels of mental distress at the beginning of the pandemic in the youngest has already been reported in the context of the COVID-19 crisis (Pierce et al., 2021). This rise declined later as several activities opened and especially the youngest started to attend events related to leisure and sports activities (see Fig. 1 for a timeline). Additionally, winter started hindering that older people stay outside. Besides, the government highlights the need to stay inside, especially to the oldest, who had the greater risk of being infected.

Limitations

The findings of this study have to be seen in light of some limitations. First, data were obtained using a non-probabilistic sample limiting the results' generalizability. Second, losses to follow-up might have affected some sample characteristics. Third, data were collected through an online survey; therefore, selection biases might have operated. Finally, given that MLM was used to analyze the data, non-linear associations may not be detected.

Conclusions

This is the first longitudinal study with six measurements that evaluate mental health in a developing country such as Uruguay, with low COVID-19 incidence and a mild lockdown. Our data showed a decline in symptoms of anxiety and depression across time that follows a different pattern depending on age and correlated with mobility (in the case of depressive symptoms). These findings highlight the need to continue monitoring the levels of mental distress in the population to respond quickly and treat the symptoms that appeared. Finally, it is necessary to be aware that specific population sub-groups (e.g., different age groups) could experience the crisis differently, leading to distinct clinical approach strategies.

Declarations

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