

Loneliness during the COVID pandemic: characteristics and associated risks

Abstract

Background: Loneliness is becoming progressively more frequent despite increasing communication facilities. The COVID lockdown and social interaction restrictions enhanced loneliness complaints in more vulnerable groups while increasing its global prevalence.

Objective: To evaluate the prevalence, characteristics, and predictors of loneliness complaints during COVID19

Methods: The sample includes 5230 participants, 67.7% female, mean age 48.6 years and SD 14.30. To assure complexity/ diversity, an extensive internet survey with 177 questions was applied during the first COVID-19 pandemic wave in Portugal, including data from the Continent and Islands (Madeira and Azores).

Results: The prevalence was higher in females, emerging adults, those living alone, living in a flat, and in a big city. The following variables were higher in LG (Loneliness Group): Stress, depression, anxiety, irritability, worries, Calamity Experience Check List (CECL), economic problems, Sleep latency and Awakenings, Screen time in TV, Mobile, Social networks, negative attitudes and negative behaviors, dependences from TV, Social networks and Games, morbidities, worsening of previous morbidities, and nightmares. The predictors were civil status, living alone, and having negative attitudes during the pandemic.

Conclusions: The study allows us to conclude that loneliness during the COVID-19 pandemic was associated with health, psychological, behavioral, lifestyle, and housing-related factors; it could be predicted by the Calamity Experience Check List (CECL); Frequency of sexual activity; Negative attitudes; Positive attitudes; Negative Behaviors; Civil status; Living alone; Sleep latency weekdays; Sleep latency weekends. There were gender similarities and differences in loneliness predictors.

Keywords: loneliness, covid-19, lockdown, health, risks, predictors

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Introduction

Humans need social connectedness, which, since human existence, assures health, progress, survival, reproduction and consequent genetic transmission; therefore loneliness has potential dramatic effects upon physical and mental human health.^{1,2}

Before the COVID pandemic social isolation and loneliness were more prevalent in chronic health conditions, mental health conditions, cardiovascular problems, autistic individuals³ and in working adults with disabilities;³ furthermore, they were associated with increased all-cause mortality, and worse cardiovascular and mental health outcomes.³

A German study conducted before the pandemic found that the prevalence of loneliness in adults was 10.5% (felt mild in 4.9%, moderate in 3.9% and severe in 1.7%); it was more frequent in women, in those who lived alone and had no children; it was associated with depression (Odds Ratio (OR) = 1.91), anxiety (OR = 1.21), suicidal ideation (OR = 1.35), higher tobacco consumption and more medical visits.⁴

Loneliness in frontline medical workers figures among the risks of suicidal ideation during COVID, together with low social support; high physical and mental exhaustion and poorer self-reported physical health; sleep disturbances; quarantine; exhaustion; and mental health difficulties.⁵

In a French study loneliness and worries were major contributing factors for mental health and behavioral concerns during the COVID-19 lockdown.⁶

US national surveys made before (2018) and during the pandemic (2020) showed that psychological disturbances increased from 3.9% in 2018 to 13.6%; furthermore, 13.8% (95% Confidence Interval (CI), 11.4%-16.6%) of the adults in 2020 often felt lonely.⁷

Social isolation and loneliness are in older adults a serious problem, often neglected,⁸ since low social participation (Relative Risk (RR): 1.41 (95% CI: 1.13-1.75)), less frequent social contact (RR: 1.57 (95% CI: 1.32-1.85)), and more loneliness (RR: 1.58 (95% CI: 1.19-2.09)) are significantly associated with incident dementia;⁹ furthermore, loneliness mediates the effect of social isolation upon subjective cognitive impairment.¹⁰

In emerging adults, from 18 to 25 years of age, higher loneliness was significantly associated with worse self-rated health, higher marijuana consequences, less weekday sleep, and greater odds of feeling bothered by disturbed sleep; the interactions with sexual activity frequency, race/ethnicity, and sexual/gender minority (SGM) status were not significant.¹¹

Australian authors stress the multifold COVID impact upon loneliness. These effects might vary in different groups, such as: singles, physically and mentally disabled, carers and in those with

low social capital; ‘pruning’ of social networks with digital interaction unable to substitute the lost physical contact; younger people isolated due to COVID life disruptions (they are unable to travel, or to attend university and amusements);¹² persistent mourning of those who died during the pandemic; infection worries; persistent isolation of elders living in nursing homes with family forbidden visits, etc.

In a loneliness study and its relations with stringency measures conducted in 5 European countries it was found that age (younger groups), gender (female), education, and cohabitation status play important roles in loneliness severity; furthermore they observed changes in social interactions across the variations in lockdown policies; they also found a marked heterogeneity in loneliness across individuals, and stressed the need to take it into account in order to propose adequate public policies.¹³

The possible mechanisms underlying the health consequences of loneliness would result from the activation of the sympathetic and hypothalamic-pituitary-adrenocortical (HPA) nervous systems.¹⁴ However, a recent experimental study did not find increased cortisol levels associated with loneliness and subjective health in both genders of middle age and older individuals, therefore rendering questionable the HPA role in this relation.¹⁵

Portugal had some specificities concerning the COVID pandemic: together with Slovenia and Spain, it is among the three countries with highest variability in COVID incidence;¹⁶ the stringency measures were quite high, being top when compared with EU countries in several pandemic periods, and had, among EU members, the most significant drop in real GDP.¹⁷ Furthermore, Portugal ranks 4th in depression risk.¹⁸ Since the risk of depression in EU, besides increasing from 20 to 21, is higher in females, young adults, unemployed, and in those complaining of financial difficulties.¹⁹

Since these factors are similar to the loneliness risks, we hypothesized that a higher loneliness prevalence during COVID should be expected in our country. So far, the loneliness risks currently considered are mainly related to physical and mental health. We hypothesized a broader level of risks, which, in an ecologic perspective, includes lifestyles, attitudes and housing.

Among young people, loneliness is assuming a growing relevance, namely with the increasing use of information and communication technologies (ICTs), which, while facilitating communication between distant or isolated people, have been shown to isolate each on their own screen, reducing face-to-face interpersonal contact and sometimes constituting a psychopathology of addiction without substance.²⁰ The relations between screen time and depression have been often evaluated and discussed; a significant number of papers demonstrates increased depression levels in high media users, but recently a bidirectional relation between depression and social media use has been proposed, verifying that higher depression is associated with increased use.²¹ COVID-19 pandemic has not only heightened this use and abuse of technologies for the purposes of socialization, as it came to bring a new way of interacting with others. Confinements for the purpose of controlling the epidemic and fear of the other as a contact agent increased loneliness dimension, in spite of connecting the individuals in the virtual space.^{20,22}

In Portuguese adolescents social distancing from peers has ambivalent effects: it reduces health risks such as alcohol, tobacco, drug use, violence involvement (fights, bullying victimization and injuries), while decreasing the perception of wellbeing and life satisfaction and increasing the psychopathological symptoms.²²

Considering these facts and their known impact upon mental health and specifically upon loneliness a study focused on the associated factors and risks is required to evaluate regional data and further possible sources of loneliness heterogeneity. The study’s main objective is to understand and characterize, from an ecological perspective, the factors linked to risk and protection in relation to loneliness in a pandemic context.

Materials and methods

Participants

The sample includes 5230 participants, 67.7% female, mean age 48.6 years and SD 14.30, range from 18 to 90 years. The exclusion criteria adopted included being under 18 years of age, reporting incomplete questionnaires, and providing erroneous information.

Instruments/measures

The survey had 177 questions: demographics, health status; confinement characteristics; mood, attitudes, behaviors; calamity scales; sleep; physical activity; multimedia use; nutrition; toxics and addictions.

Health status included yes/no questions to: being healthy or suffering from the following: insomnia, sleep apnea, depression, anxiety/panic, other psychiatric disorder, sleep-related movement disorders, narcolepsy or hypersomnia, delayed sleep-wake phase disorder, shift work disorder, burnout or stress, parasomnias, cognitive deterioration/dementia, epilepsy, parkinsonism, headache/migraine, fibromyalgia, diabetes, hypertension, cardiovascular, cerebrovascular, respiratory, allergies, gastrointestinal, rheumatologic, endocrinologic/metabolic, autoimmune, orthopedic, cancer, renal, dermatologic, neurologic, hematologic, gynecologic, urologic, ear-nose-throat (ENT), ophthalmologic, chronic pain, fatigue, dizziness.

Morbidities index (MI) equals the sum of all referred symptoms/morbidities at baseline, COVID-19 Worsening (Morbidities worsening index (MWI))

Confinement attitudes and behaviors were evaluated by yes/no answers. The average and number of both positive and negative attitudes and behaviors were computed per subject.

Stress at pre-pandemic work was measured using a 1 to 10 scale; idem for depression, anxiety, and irritability.

CECL used VAS (Visual Analog Scales) of 1 to 10 and was validated.²³

Moral or sexual harassment pre-COVID, loneliness, conflicts and traumas during COVID were evaluated by yes/no answers.

Sleep included data relative to weekdays and weekends: Subjective sleep duration (hours), latency (min), night awakenings (number) and sleep and awakening quality in a 1-10 scales.

The Frequency of Sexual Activity was evaluated in a VAS, ranging from 1 (absent) to 10 (very frequent).

Physical activity (PA): hours/week. TV, social networks, mobile phone, gaming were quantified in hours/day.

Nutrition included: meals/day. Calculation of recommended food considered their frequency and type according to Portuguese Health authorities’ recommendations.

Smoking: yes/no; cigarettes/day. Alcoholic intake: Yes/No; glasses/day of beer, wine, aperitive wine, brandy. Drugs: no; occasionally; sometimes; regularly.

Lockdown housing included yes/no questions concerning: Housing (same home, family home, country house); Type of house (flat, villa, condominium, farm house, free comments); House location (City, Small town, Village, Isolated zone, Degraded zone); Number of people living with (alone, +1,+2,+3,+4, >5). Free comments in all subitems and in description of those living together were possible.

Lockdown attitudes and circumstances were evaluated by questions of yes/no answer of several categories:

- 1) Negative attitudes: fed up or tired, cannot stand it, loneliness, missing family or friends, felt in imprisonment /claustrophobia, had worries and fears, had unexpected conflicts, cannot stand companion, cannot stand children, cannot stand elderly, fed up with the children tele-school
- 2) Trauma/Violence: had traumatic events, had domestic violence, there was violence against children
- 3) Positive attitudes: felt OK, had less stress, made important discoveries. Free comments. The average and number of positive, negative and violent attitudes were computed for each subject.

Lockdown behaviors were evaluated by the following yes/no answers: 1) Positive behaviors: tidying up, new type of work, phone friends, decided life changes, write a book/ articles/ memories, learned new abilities, gardening/ agriculture, invented funny or spiritual things, worked, walking/ gym / sports, Reading/Music/Studying, domestic work 2) 1) Negative behaviors: developed new addictions, get bored, mourned all time, slept as much as possible. Free comments. The average and number of both positive and negative behaviors were computed for each subject.

Procedures

The overall project was approved by CENC's Ethical Committee 1/2020.

Online surveys were disseminated on the iSleep website. The study includes data from all country: Continent and Islands (Madeira and Azores). Support and dissemination of several entities was an important help. Among them figure the Portuguese professional Associations of Medical Doctors, Nurses, Psychologists, Pharmacists;

Scientific Societies of Neurology, Sleep and Sleep Dentistry; a Network of Portuguese Sleep Labs and CENC.

Survey Legend® platform was used. Surveys were anonymous, for adults (>18y) allowing data analysis and statistical use. The first page included: purpose, authors, Ethical reference, contact person and supporting entities, and a question of whether data analysis was permitted. It was online during the 1st COVID-19 wave, from April to August 2020.

Statistics

Loneliness was defined as the subjective feeling of being lonely during lockdown. Data was divided in 2 groups: Loneliness YES or NO. For each subgroups qualitative variables were described by absolute frequencies, while quantitative variables were calculated by the mean or median depending on data distribution. The effect of variables of interest was evaluated using Chi-square tests (qualitative answers/frequency tables) or ANOVA (unidirectional analysis of variance). For Some variables resulting from computation such as number of attitudes and Behaviors the Percentile 75 was computed, and variables transformed into categorical: higher versus lower than P75. Categorical variables with low prevalence (less than 50 cases) were not used.

Binary Logistic Regression was calculated using the variables significantly different in One-way-ANOVA as covariates (those highly correlated were excluded), and loneliness YES/NO as dependent variable; Omnibus Tests of Model Coefficients was used to check whether the new model is an improvement over the baseline model and goodness of fit was evaluated by 2log likelihood, R2 Cox and Snell, R2 Nagelkerke; the final classification was obtained comparing group membership of predicted and observed values. Regression was computed for the global population and for each gender, using the same covariates. Significance was set at 0.05; SPSS® v25 was used.

Results

During the first COVID wave the prevalence of loneliness was 12,3%, ie, 647 subjects in a population of 5251 individuals. The demographic data are in Table 1. Average values of age and BMI were significantly lower in the loneliness group (LG); Loneliness was more frequent in females and in emerging adults in those without a couple (single, widows and divorced), in those with a master's degree, and in those living alone, in a flat, in a big city.

Table 1 Demographic data

	Loneliness	N	Mean	St Dev	Minimum	Maximum		df	Z	Sig.
Age	No	4584	49.01	14.207	18	90	Between Groups	1	39.755	<.0001
	Yes	646	45.24	14.542	22	90	Within Groups	5228		
	Total	5230	48.55	14.301	18	90	Total	5229		
BMI	No	4579	25.82	5.024	14.82	68.40	Between Groups	1	13.591	<.0001
	Yes	645	25.04	4.995	13.96	46.88	Within Groups	5222		
	Total	5224	25.72	5.027	13.96	68.40	Total	5223		
Weight diff	No	4534	0.20	3.260	-33.0	55.00	Between Groups	1	1.838	0.175
	Yes	637	0.01	3.742	-28.0	17.00	Within Groups	5169		
	Total	5171	0.17	3.324	-33.0	55.00	Total	5170		
Gender %		Female (%)	Male (%)					Chi2	df	p
	No	66.2	33.8					37.494	1.00	<.001
	Yes	78.2	21.8							
	Total	67.7.	32.3							

Table 1 Continued...

Loneliness	N	Mean	St Dev	Minimum	Maximum	df	Z	Sig.	
Age Groups %	Young	Adults	Elder			Chi2	df	p	
No	8.0	74.7	17.3			28.389	2.00	<.001	
Yes	14.1	72.3	13.5						
Total	8.8	74.4	16.8						
Education level %	Primary	Secondary	Professional	Bachelor	Graduate	Master	PhD	df	p
No	1.7	8.5	3.2	3.2	51.7	27.8	3.9	6	<.001
Yes	1.6	8.7	0.9	2.0	49.1	36.8	2.5		
Total	1.6	8.3	2.9	3.1	51.4	28.9	3.7		
Marital Status %	Married	Single	Widows	Divorced	Union		Chi2	df	p
No	56.6	19.9	2.0	8.8	12.7		284.301	4	<.001
Yes	36.4	42.7	5.7	15.0	10.2				
Total	52.9	22.7	2.5	9.6	12.4				
Type of House %	Flat	Moradia	Condominium	Farm			Chi2	df	p
No	58.2	34.4	4.5	2.8			40.358	3	<.001
Yes	70.9	24.2	4.0	0.9					
Total	58.8	33.2	4.4	2.6					
House Location %	City	Small Town	Village	Degraded	Other		Chi2	df	p
No	73.4	15.6	10.8	0	0.2		9.039	4	0.060
Yes	78.1	14.5	7.2	0	0.2				
Total	74	15.5	10.3	0	0.2				
Number of persons %	One	Two	Three	Four	Five	> Six	Chi2	df	p
No	10.6	36.5	22.7	20.6	5.7	3.9	518.658	5	<.001
Yes	44.6	26.3	15.1	9.1	2.7	2.1			
Total	14.8	35.30	21.7	19.2	5.3	3.7			

Table 2 presents data concerning Stress and subjective evaluation of Mental health. Stress, depression, anxiety, irritability, worries, CECL, economic problems were significantly higher in LG, while the way people were living during the pandemic was worse and the frequency of sexual activity lower.

Table 2 Stress and Mental data

	Loneliness	N	Mean	St Dev	Minimum	Maximum		df	Z	Sig.
Work stress before Covid	No	4368	2.80	1.265	0	5	Between Groups	1	8.629	0.003
	Yes	612	2.96	1.125	0	5	Within Groups	4978		
	Total	4980	2.82	1.250	0	5	Total	4979		
How are you living in confinement	No	4318	6.71	1.778	1	10	Between Groups	1	184.947	<.0001
	Yes	622	5.67	1.753	1	10	Within Groups	4938		
	Total	4940	6.58	1.808	1	10	Total	4939		
Depression	No	4379	3.56	2.310	1	10	Between Groups	1	315.910	<.0001
	Yes	628	5.31	2.307	1	10	Within Groups	5005		
	Total	5007	3.78	2.381	1	10	Total	5006		
Anxiety	No	4361	4.52	2.476	1	10	Between Groups	1	210.141	<.0001
	Yes	631	6.04	2.389	1	10	Within Groups	4990		
	Total	4992	4.71	2.517	1	10	Total	4991		
Irritability	No	4373	4.51	2.493	1	10	Between Groups	1	145.618	<.0001
	Yes	628	5.79	2.420	1	10	Within Groups	4999		
	Total	5001	4.67	2.519	1	10	Total	5000		
Economic problems	No	4350	2.94	2.107	1	10	Between Groups	1	17.767	<.0001
	Yes	624	3.33	2.361	1	10	Within Groups	4972		
	Total	4974	2.99	2.144	1	10	Total	4973		
Worries versus uncertainty	No	4346	5.92	2.435	1	10	Between Groups	1	114.207	<.0001
	Yes	625	7.02	2.213	1	10	Within Groups	4969		
	Total	4971	6.05	2.436	1	10	Total	4970		

Table 2 Continued...

	Loneliness	N	Mean	St Dev	Minimum	Maximum		df	Z	Sig.
CECL	No	4408	4.58	2.018	0.75	10.00	Between Groups	1	272.438	<.0001
	Yes	634	5.98	1.883	0.75	10.00	Within Groups	5040		
	Total	5042	4.75	2.055	0.75	10.00	Total	5041		
Frequency of your sexual activity	No	4312	4.13	2.353	1	10	Between Groups	1	140.140	<.0001
	Yes	625	2.94	2.222	1	10	Within Groups	4935		
	Total	4937	3.98	2.370	1	10	Total	4936		

Table 3 includes Sleep data. Sleep duration in weekdays and weekends, Sleep quality and Sleep awakening quality were significantly lower in LG; while Sleep latency and Awakenings were increased both during weekdays and weekends together with nightmares.

Table 3 Sleep data

	Loneliness	N	Mean	St Dev	Minimum	Maximum		df	Z	Sig.
Sleep quality Covid	No	3686	5.83	2.152	1	10	Between Groups	1	117.57	<.0001
	Yes	543	4.76	2.063	1	10	Within Groups	4227		
	Total	4229	5.69	2.17	1	10	Total	4228		
Sleep waking quality Covid	No	3680	5.94	2.102	1	10	Between Groups	1	126.802	<.0001
	Yes	540	4.86	1.991	1	10	Within Groups	4218		
	Total	4220	5.8	2.119	1	10	Total	4219		
Sleep duration weekdays COVID	No	3743	6.76	1.772	0.29	20	Entre Groups	1	18.337	<.0001
	Yes	554	6.41	1.853	2	20	Nos Groups	4295		
	Total	4297	6.71	1.786	0.29	20	Total	4296		
Sleep duration weekends COVID	No	3736	7.56	2.186	0.29	20	Entre Groups	1	11.566	0.001
	Yes	549	7.22	2.076	2	20	Nos Groups	4283		
	Total	4285	7.51	2.175	0.29	20	Total	4284		
Sleep latency weekdays COVID	No	3569	30.47	31.773	0	300	Entre Groups	1	80.601	<.0001
	Yes	527	44.47	42.876	0	240	Nos Groups	4094		
	Total	4096	32.27	33.73	0	300	Total	4095		
Sleep latency weekends COVID	No	3558	30.05	32.733	0	302	Entre Groups	1	71.606	<.0001
	Yes	525	43.58	42.904	0	240	Nos Groups	4081		
	Total	4083	31.79	34.503	0	302	Total	4082		
Awakenings weekdays COVID	No	2885	2.75	2.633	0.5	30	Entre Groups	1	6.431	0.011
	Yes	455	3.08	2.615	1	30	Nos Groups	3338		
	Total	3340	2.79	2.632	0.5	30	Total	3339		
Awakenings weekends COVID	No	2759	2.37	1.864	0.1	30	Entre Groups	1	7.739	0.005
	Yes	434	2.64	1.733	1	14	Nos Groups	3191		
	Total	3193	2.41	1.849	0.1	30	Total	3192		
Nightmares COVID	No	3789	1.23	0.423	1	2	Between Groups	1	73.789	<.0001
	Yes	562	1.4	0.491	1	2	Within Groups	4349		
	Total	4351	1.26	0.436	1	2	Total	4350		

Table 4 shows the conventional habits. There were no differences in nutrition habits (number of meals and type of food recommended yes or no) and hours of practicing physical activity; LG group drank lower amounts of alcohol. Screen time in TV, Mobile, Social networks was higher in LG group, no difference in games.

Table 4 Habits

	Loneliness	N	Mean	St Error	Minimum	Maximum		df	Z	Sig.
Meals day Covid	No	3575	3.84	0.901	1	5	Between Groups	1	0.982	0.321
	Yes	527	3.80	0.924	1	5	Within Groups	4100		
	Total	4102	3.84	0.904	1	5	Total	4101		
Food RECYES	No	3545	5.32	2.250	0	14	Between Groups	1	3.604	0.058
	Yes	517	5.12	2.188	1	12	Within Groups	4060		
	Total	4062	5.29	2.243	0	14	Total	4061		
Food REC NO	No	3561	11.57	2.348	1	17	Between Groups	1	0.622	0.430
	Yes	523	11.65	2.459	1	16	Within Groups	4082		
	Total	4084	11.58	2.362	1	17	Total	4083		

Table 4 Continued...

	Loneliness	N	Mean	St Error	Minimum	Maximum		df	Z	Sig.
Alcohol COVID	No	2328	9.64	21.070	0.00	563.50	Between Groups	1	4.961	0.026
	Yes	291	6.82	13.352	0.00	120.00	Within Groups	2617		
	Total	2619	9.32	20.375	0.00	563.50	Total	2618		
Hours Physical Activity COVID	No	2721	2.73	3.916	0	60	Between Groups	1	0.001	0.977
	Yes	371	2.73	3.748	0	30	Within Groups	3090		
	Total	3092	2.73	3.895	0	60	Total	3091		
TV h Day COVID	No	3277	3.03	2.352	0.1	20.0	Between Groups	1	17.942	<.0001
	Yes	463	3.54	2.931	0.1	20.0	Within Groups	3738		
	Total	3740	3.09	2.437	0.1	20.0	Total	3739		
Social Networks h Day COVID	No	2831	2.37	2.248	0.0	20.0	Between Groups	1	17.234	<.0001
	Yes	441	2.87	2.741	0.5	20.0	Within Groups	3270		
	Total	3272	2.44	2.326	0.0	20.0	Total	3271		
Mobile h Day COVID	No	3162	2.51	2.596	0.0	20.0	Between Groups	1	9.374	0.002
	Yes	468	2.91	2.549	0.2	20.0	Within Groups	3628		
	Total	3630	2.56	2.593	0.0	20.0	Total	3629		
Games h Day COVID	No	770	1.90	1.784	0.1	20.0	Between Groups	1	0.002	0.961
	Yes	129	1.91	1.930	0.5	20.0	Within Groups	897		
	Total	899	1.90	1.804	0.1	20.0	Total	898		

Table 5 presents attitudes and behavior during pandemic restriction; LG had more negative attitudes and negative behaviors and less positive attitudes, with no differences in the remaining.

Table 5 Attitudes and Behaviours

	Loneliness	N	Mean	St Error	Minimum	Maximum		df	Z	Sig.
Number Positive Attitudes	No	4592	0.60	0.748	0	3	Between Groups	1	122.301	<.0001
	Yes	647	0.26	0.541	0	3	Within Groups	5237		
	Total	5239	0.56	0.734	0	3	Total	5238		
Number Negative Attitudes	No	4592	0.97	0.918	0	7	Between Groups	1	1307.525	<.0001
	Yes	647	2.40	1.118	1	7	Within Groups	5237		
	Total	5239	1.15	1.057	0	7	Total	5238		
Number Trauma Violence	No	4592	0.01	0.115	0	2	Between Groups	1	2.913	0.088
	Yes	647	0.02	0.146	0	1	Within Groups	5237		
	Total	5239	0.01	0.120	0	2	Total	5238		
Number Positive doings	No	4591	1.96	1.520	0	8	Between Groups	1	2.954	0.086
	Yes	647	1.85	1.490	0	7	Within Groups	5236		
	Total	5238	1.94	1.517	0	8	Total	5237		
Number Negative doings	No	4591	0.54	0.776	0	5	Between Groups	1	195.026	<.0001
	Yes	647	1.02	0.991	0	4	Within Groups	5236		
	Total	5238	0.60	0.820	0	5	Total	5237		

Table 6 shows that LG had higher levels of dependences from TV, Social networks and Games, more morbidities, and more worsening of previous morbidities, but no differences in alcohol dependence.

Table 6 Dependences and Morbidities

	Loneliness	N	Mean	St Error	Minimum	Maximum		df	Z	Sig.
TV dependence	No	3416	3.28	2.039	1	10	Between Groups	1	16.562	<.0001
	Yes	490	3.68	2.319	1	10	Within Groups	3904		
	Total	3906	3.33	2.081	1	10	Total	3905		
SN dependence	No	3420	3.54	2.337	1	10	Between Groups	1	50.763	<.0001
	Yes	492	4.35	2.520	1	10	Within Groups	3910		
	Total	3912	3.64	2.376	1	10	Total	3911		
Games dependence	No	3411	1.64	1.481	1	10	Between Groups	1	7.725	0.005
	Yes	489	1.85	1.827	1	10	Within Groups	3898		
	Total	3900	1.67	1.530	1	10	Total	3899		

Table 6 Continued...

	Loneliness	N	Mean	St Error	Minimum	Maximum		df	Z	Sig.
Alcohol dependence	No	3413	1.47	1.157	1	10	Between Groups	1	0.083	0.774
	Yes	489	1.48	1.201	1	10	Within Groups	3900		
	Total	3902	1.47	1.163	1	10	Total	3901		
Morbidities Worse	No	3796	1.61	1.754	0	13	Between Groups	1	139.565	<.0001
	Yes	544	2.59	2.176	0	11	Within Groups	4338		
	Total	4340	1.73	1.841	0	13	Total	4339		
N Morbidities	No	4595	1.58	1.762	0	16	Between Groups	1	79.153	<.0001
	Yes	645	2.26	2.025	0	12	Within Groups	5238		
	Total	5240	1.67	1.810	0	16	Total	5239		

Among the survey responders only 29.1% considered themselves healthy; the percentage of being subjectively healthy was lower in the LG. Loneliness group suffered more frequently of insomnia, narcolepsy/hypersomnia, shiftwork, depression, anxiety/panic, burnout, headaches, fatigue, respiratory diseases, allergies, endocrine, autoimmune, and dermatologic disorders, tinnitus and dizziness.

There were no differences in Movement sleep disorders, Chronic Pain, Rheumatologic disorders, Diabetes, Hypertension, Heart diseases, Gastrointestinal, Rheumatologic, Orthopedic and Ophthalmologic Disorders, Cancer, ENT. Loneliness was less frequent in Sleep apnea patients. Table 7 presents data from health and diseases in the LG.

Table 7 Loneliness and health and medical disorders

Medical disorders	Loneliness			Statistics		
	No	Yes	Total	Chi2	df	p
Healthy	1360 30.1%	142 22.4%	1502 29.1%	15.877	1	0.000
Insomnia	770 17.0%	193 30.4%	963 18.7%	65.918	1	0.000
OSAS	771 17.0%	68 10.7%	839 16.3%	16.308	1	0.000
Movement Disorders	81 1.8%	12 1.9%	93 1.8%	0.033	1	0.857
Narcolepsy Hypersomnia	148 3.3%	32 5.0%	180 3.5%	5.202	1	0.023
Shift Work	148 3.3%	35 5.5%	183 3.5%	8.213	1	0.004
Depression	366 8.1%	105 16.6%	471 9.1%	48.063	1	0.000
Anxiety Panic	487 10.8%	143 22.6%	630 12.2%	72.052	1	0.000
Burnout	454 10.0%	126 19.9%	580 11.2%	53.897	1	0.000
Headache	374 8.3%	73 11.5%	447 8.7%	7.398	1	0.007
Fibromyalgia	79 1.7%	8 1.3%	87 1.7%	0.788	1	0.375
Fatigue	308 6.8%	70 11.0%	378 7.3%	14.657	1	0.000
Chronic Pain	142 3.1%	25 3.9%	167 3.2%	1.146	1	0.284
Rheumatologic disorders	101 2.2%	14 2.2%	115 2.2%	0.002	1	0.968
Diabetes	91 2.0%	12 1.9%	103 2.0%	0.04	1	0.841
Hypertension	453 10.0%	49 7.7%	502 9.7%	3.309	1	0.069
Heart diseases	124 2.7%	19 3.0%	143 2.8%	0.134	1	0.714

Table 7 Continued...

	Loneliness			Statistics		
Respiratory diseases	254	57	311	11.175		0.001
	5.6%	9.0%	6.0%			
Allergies	581	103	684	5.589		0.018
	12.8%	16.2%	13.3%			
Gastrointestinal disorders	138	26	164	1.991		0.158
	3.1%	4.1%	3.2%			
Endocrinologic disorders	141	31	172	5.417		0.020
	3.1%	4.9%	3.3%			
Autoimmune disorders	167	37	204	6.726		0.010
	3.7%	5.8%	4.0%			
Orthopedic Disorders	115	16	131	0.001		0.977
	2.5%	2.5%	2.5%			
Cancer	89	6	95	3.208		0.073
	2.0%	0.9%	1.8%			
Dermatologic	83	26	109	13.799		0.000
	1.8%	4.1%	2.1%			
ENT	50	11	61	1.885		0.170
	1.1%	1.7%	1.2%			
Tinnitus	115	28	143	7.242		0.007
	2.5%	4.4%	2.8%			
Dizziness	143	34	177	8.129		0.004
	3.2%	5.4%	3.4%			
Ophthalmologic	95	16	111	0.473		0.492
	2.1%	2.5%	2.2%			

Data from Logistic Binary Regression for the all sample and for the genders male and female show that only a small set of variables predicts loneliness for all of them, namely Civil Status: OR 2.0 (95% CI 1.3 – 3.08), Living alone OR 0.17 (95% CI 0.10 – 0.26), CECL OR 1.23 (95% CI 1.1 – 1.37), Negative attitudes OR 5.5 (95% CI 3.58–8.41) (Table 8).

Table 8 Loneliness - logistic binary regression

Males have a high probability of negative attitudes OR 13.9 (95% CI 5.1 – 38.1) while in females OR 4.6 (95%CI 2.8 –7,5); for positive attitudes the values are not significant for males but are significant for females with OR <1 (OR=0.16 (95% CI 0.04 – 0.7). Negative behaviors are significant in males OR=3.52 (95% CI 1.5 – 8.5) and not in females. The Civil status (living together legally or not) association with loneliness is significant in both genders but the OR are much higher in males. Living alone is significant with similar OR for loneliness in both genders; idem for CECL. Females have significant differences in sleep latency both during weekdays and weekends, but the ORs are close to 1.

The classification achieved for group membership of Loneliness YES /NO was 90.2% correct for the all group, 93.6% for males and 89.0 for females.

Discussion

The loneliness prevalence data obtained in our study (12.6%) are in line with data of the pre COVID era in Germany – 10.5%⁴ and with those from USA during COVID 13.8%.⁷ Our first hypothesis that the prevalence would increase in our country due the high variability of COVID stringent measures was not verified.

Loneliness was more frequent in females and in emerging adults, in those without a couple (single, widows and divorced), in those with a master's degree, and in those living alone, in a flat, in a big city.

In synthesis the following variables were higher in LG: Stress, depression, anxiety, irritability, worries, CECL, economic problems, Sleep latency and Awakenings, Screen time in TV, Mobile, Social networks, negative attitudes and negative behaviors, dependences from TV, Social networks and Games, morbidities, and worsening of previous morbidities, nightmares. Sleep duration in weekdays and weekends, Sleep quality and Sleep awakening quality, positive attitudes were significantly lower.

LG complain or suffer more frequently of insomnia, narcolepsy/hypersomnia, shiftwork, depression, anxiety/panic, burnout, headaches, fatigue, respiratory diseases, allergies, endocrine, autoimmune, and dermatologic disorders, tinnitus and dizziness and less frequently from Sleep apnea. No differences in Movement Sleep disorders, Chronic Pain, Rheumatologic disorders, Diabetes, Hypertension, Heart diseases, Gastrointestinal, Rheumatologic, Orthopedic and Ophthalmologic Disorders, Cancer, ENT.

The higher female prevalence in consensual in many studies. Females clearly have a different risk profile of loneliness when compared to males.

Some studies found, as observed in this study, a higher prevalence in emerging adults,^{11–13} while other studies point to the elderly (being than a risk for cognitive impairment and dementia).¹⁰ The differences concerning the elder in our study are likely related to two factors: the elders answering the survey are dwelling elders and do not live in nursing homes; furthermore, Portugal is a southern country and therefore keeps still often the family home with 2 or 3 generations living either together or close by Caro JC.¹³

Concerning education only those with a master's degree had a higher loneliness prevalence; the PhDs and those with lower education had similar prevalence values. We have no clearcut explanation for that; but a possible explanation is that their jobs predominate in Science,

Education and Health, all three sectors with lot of job difficulties due either to hard work, job insecurity or both. Masters have in fact less economic problems when compared with the other education groups, except graduates and PhDs, but had the highest CECL value of all education groups, but with no significant differences, exception made for the PhD group (lowest CECL and different from the others).

Living alone is associated with increased loneliness frequency but is not a loneliness risk factor, since the OR is smaller than 1: OR=0.17 (95%CI 0.1 – 0.3). Living with more people, although preventing loneliness, increases, however, the contamination risk¹³ and the risk of conflicts. Living in a flat or in a big city, represents the modern paradigm of being alone surrounded by many people. Nowadays many modern buildings have no balconies, terraces or gardens. The COVID pandemic and the associated social isolation showed how important it is the open-air exposure. Those living in a villa or in a farm had a lower loneliness prevalence, among other factors, walking outside was easier for them.

Work stress before COVID, depression, anxiety, worries and CECL are all higher in LG, but only CECL is a significant predictor of loneliness: OR= 1.23 (95% CI 1.1 – 1.4).

Sleep disturbances (latency, awakenings, sleep and awakening quality, sleep<5h and nightmares) were more prevalent in LG but only sleep latency had predictive value with low OR.

Item for the frequency of sexual activity, lower in LG, with small OR. The same interaction with sexual activity was described by others.¹¹

Loneliness was more prevalent in sleep disorders (insomnia, narcolepsy/hypersomnia, shiftwork). There is a consensus that Sleep was particularly affected during COVID.²⁴⁻²⁶ Insomniacs worries, narcolepsy vulnerabilities and shift work disorders. In a period with marked and unexpected modifications in daily life and work habits had reasons for feeling loneliness more acutely.

Our data are in line with other publications concerning the higher loneliness prevalence in Mental disorders (depression, anxiety/panic, burnout).³ Confinement restrictions impacted negatively upon habits and addictions.²⁸ Altogether these facts increase loneliness, but, in our data they are not a risk for it, as others observed before COVID.⁴

Before COVID chronic disorders (respiratory diseases, allergies, autoimmune, endocrine, dermatologic headaches, fatigue, tinnitus and dizziness) –were significantly associated with Loneliness, with a special reference of cardiovascular disorders.³

In this study, during COVID, we detected this association with Loneliness in respiratory, allergic and autoimmune diseases, which altogether are in a higher of a viral infection. Headache, fatigue, tinnitus and dizziness and dermatologic disorders share the significant increase in worries versus uncertainty and have high CECL values.

The classification achieved by Binary Logistic Regression in group membership: Loneliness YES /NO was good 90.2% correct for the entire population, with gender differences (93.6% for males and 89.0% for females). For the Omnibus Tests of Model Coefficients, the results were statistically significant and the values of 2log likelihood relatively high. However, values of the markers of goodness of fit, R2 Cox and Snell, R2 Nagelkerke, were relatively low.

For the general population 9 variables were loneliness predictors: CECL; Frequency of sexual activity; Negative attitudes; Positive attitudes; Negative Behaviors; Civil status; Living alone; Sleep latency weekdays; Sleep latency weekends. For Males the loneliness

predictors were: CECL, Negative attitudes; Negative behaviors, Civil status and living alone.

For Females the predictors were: CECL, Negative attitudes; Negative behaviors, Civil status, Living alone, Sleep latency weekdays; Sleep latency weekends.

These predictors are in accordance with our second hypothesis concerning broader ecologic risks of loneliness.

Study limitations concerning the type of sample, the limitations of an internet survey and the cross-sectional design, the must be taken into consideration together with the possibility of a reverse causation has it has been observed in the relations between depression and social media.²¹

Conclusion

The prevalence of Loneliness during COVID was 12.3%. The prevalence was higher in females, in emerging adults, in those living alone, in a flat, and in a big city. These data imply recommendations both for supporting the most fragile groups and for architectural planning in big cities.

Loneliness is associated with a dark constellation of symptoms and factors, namely: Stress, depression, anxiety, irritability, worries, CECL, economic problems, Sleep latency and Awakenings, Screen time in TV, Mobile, Social networks, negative attitudes and negative behaviors, dependences from TV, Social networks and Games, morbidities (insomnia, narcolepsy/hypersomnia, shiftwork, depression, anxiety/panic, burnout, headaches, fatigue, respiratory diseases, allergies, endocrine, autoimmune, and dermatologic disorders, tinnitus, dizziness, nightmares).

The study allows us to conclude that loneliness during the COVID-19 pandemic was associated with physical and mental health, psychological, behavioral and lifestyles, and housing factors. There are gender similarities and differences regarding the predictors of loneliness.

It can be concluded that loneliness is explained by the ability to adapt to the pandemic, particularly in relation to the uncertainty and associated constraints. Marital status and negative or positive attitudes towards lockdown also affect the perception of loneliness. In terms of lifestyles, sleeping habits and sexual activity were also important predictors. Sleep was particularly relevant as predictor in women.

In conclusion loneliness is a very important aspect in people's mental health, adaptation and lifestyle. Protective factors in relation to loneliness allow for better adaptation and health. It is important to evaluate the medium and long-term impacts of this perceived loneliness and other less healthy impacts of the pandemic. On the other hand, for future pandemic or calamity situations, promote intervention in the prevention of loneliness and promotion of healthy lifestyles as prevention of psychosocial health risks.

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Gaspar de Matos.; software, Teresa Paiva; validation Gina Tomé.; data curation, all authors.; writing—original draft preparation, Teresa Paiva, Tania Gaspar, Margarida Gaspar de Matos.; writing—review and editing, all authors.

Institutional review board statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of CENC, Lda (Dra Teresa Paiva, Centro de Electroencefalografia e Neurofisiologia Clínica, Lda; approval date 15th June 2020 for studies involving humans.

Informed consent statement

Informed consent was obtained from all subjects involved in the study.

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The authors declare no conflict of interest.

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