

## Article

# Previous functional social and behavioral rhythms affect resilience to COVID-19-related stress among old adults

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## Abstract

**Background:** Functioning of Social Behavioral Rhythms (SBRs) may affect resilience toward stressful events across different age groups. However, the impact of SBRs on the coronavirus disease of 2019 (COVID-19) in elder people is yet to ascertain, representing the aim of the present report.

**Design and methods:** Follow-up of a peer-reviewed randomized controlled trial on exercise on old adults (≥65 years), concurrent to the onset of the pandemic-related lockdown. Post-RCT evaluations occurred after further 12 and 36 weeks since the beginning of the lockdown phase. People with Major Depressive Episode (MDE) at week-48 (follow-up endpoint) were deemed as cases, people without such condition were considered controls. MDE was ascertained using the Patient Health Questionnaire-9 (PHQ-9); SBRs functioning at week 12 onward, through the Brief Symptom Rating Scale (BSRS).

**Results:** Seventy-nine individuals (53.2%, females) entered the RCT-follow-up phase. The frequency of MDE did not significantly change before versus during lockdown (OR 2.60, CI95%=0.87-9.13). People with BSRS>1 standard deviation of the whole sample score at week-12 had an inflated risk of DE during lockdown (OR=5.6, 95%CI:1.5-21.4) compared to those with lower BSRS scores. Such odd hold after excluding individuals with MDD at week-12. The *post-hoc* analysis could be potentially affected by selection bias.

**Conclusions:** Overall, older adults were resilient during the first phase of the pandemic when functioning of pre-lockdown was still preserved, in contrast to the subsequent evaluations when the impairment of daily rhythms was associated with impaired reliance.

## Introduction

During the coronavirus disease of 2019 (COVID-19) pandemic, the elder population showed more severe complications and a higher mortality rate in comparison with other age groups.<sup>1</sup> Also, old-age people suffered significant psycho-social disruption due to limited social contacts with friends, relatives, and healthcare workers, interruption of daily routine activities, limited access to care (including telemedicine).<sup>2</sup> Surprisingly, several surveys proved a low rate of stress and depressive disorders in several high-income countries,<sup>3,4</sup> possibly suggesting different coping skills and resilience across different regions, populations, or circumstances.

According to the American Psychological Association, resilience refers to “the process of adapting well in the face of adversity, trauma, tragedy, threats, or even significant sources of stress”.<sup>5</sup> While this definition is useful, it does not reflect the complex nature of resilience<sup>6</sup> nor its potential variability across different samples.<sup>7</sup>

Among other populations, older adults and their putative psychobiological mechanisms underlying resilience represent a major research target, which has been recently investigated over the follow-up period of a randomized controlled trial (RCT) on exercise, started in the year 2019. The follow-up period post-RCT conclusion happened to occur when the Italian COVID-19 lockdown started, in April 2020.<sup>8,9</sup> The RCT evaluated the role played in the quality of life by social and behavioral rhythms (SBRs), such as habits of eating, sleeping, and having regular and constant social contacts; physical exercise may regulate and could also be a mediator of well-being in the elderly.<sup>9,10</sup> The impairment of the SBRs was found to be associated with Major Depressive Disorder

## Significance for public health

*The study confirms the resilience of older adults against depression during the pandemic. The lockdown during the COVID-19 pandemic did not lower the perception of health-related quality of life in older adults living at home. The functionality of social behavioral rhythms seems to be an early determinant of the resilience of older adults against depression during lockdown and pandemic.*

(MDD)<sup>11</sup> and, to a bigger extent, with bipolar disorders (BD).<sup>12</sup> Recently, it has been shown that, in BD, adopting regular social rhythms can potentiate the efficacy of interventions to enhance favorable illness perceptions and may improve mood outcomes. Moreover, it was found that a more stringent lockdown increased the risk of a major depressive episode (MDE) among people with BD comparing areas with different degrees of lockdown during the COVID-19 pandemic.<sup>13</sup> Elderly adults showed greater functioning in biological and social rhythms compared to younger people.<sup>14</sup> This latter issue could be related to the greater resilience shown in this age group during COVID-19 pandemics and the subsequent lockdown, which represented a factor of induction of disruption of social rhythms. From this perspective, it is worth investigating the relationship between the risk of depression, social rhythms, and pandemics in elderly adults, considering that the rates of depression are high among elder people.<sup>15</sup>

The present study aimed to assess the prevalence of MDE and perception of the health quality of life in a sample of old adults living at home at the end of the RCT, and during the COVID-19-related lockdown. Based on the relevant impact of lockdown measures on daily life and biological rhythms,<sup>16</sup> the study focused on the functionality of SBRs before the implementation of the lockdown as a potential determinant of resilience against depression.

## Design and methods

A cohort study and a case-control study on the cohort were performed at the end of the peer-reviewed, RCT;<sup>8</sup> people with MDE at the end of the cohort were deemed as cases, people without MDE represented the controls.

A total of 120 elderly individuals were randomly exposed to the experimental (12-weeks of aerobic/anaerobic exercises of moderate-intensity with three sessions/week) or the control protocol (cultural activities). The study, which was designed to assess the real-life role of physical exercise, was based on mild to moderate exercise to avoid the exclusion of the elderly with chronic medical conditions (10% had suffered from cancer in the past, 40% had hypertension, and 11% type II diabetes). A hundred and five (87.5%) participants completed the trial and were then evaluated at week-12, at the end of the RCT (mean  $\pm$ SD] age 72.3 $\pm$ 4.7 years, of whom 56% women). After further 36 weeks (week 48 of the present cohort follow-up), they were contacted during the first wave of the COVID-19 pandemic.

The outcome measure was the comparison of week-48 scores against week-12 ones: the Patient Health Questionnaire-9 (PHQ9)<sup>17,18</sup> is a self-administered tool. The score is the sum of the value of 9 items, one for each core symptom of Diagnostic and Statistical Manual of Mental Disorders (DSM) criteria, and is coded from 0 to 4 as minimal symptoms; 5-9 mild; 10-14, moderate; 15-19 moderately severe and 20-27 severe depression.<sup>17</sup> The functionality of Functioning of Social Behavioral Rhythms SBRs at week-12 was measured through the Italian version of the Brief

Social Rhythms Scale (BSRS),<sup>19</sup> where high scores indicate a worse functioning. Scores above one standard deviation (SD) of the mean were associated with rhythm dysfunction, stating the lack of a standardized cut-off.

The differences in depression according to previous exposure to dysfunctional SRB were measured through the McNemar test for nominal variables (considering differences by time and group of exposed/not exposed). As SBRs were found to be associated with the diagnosis of MDE in older adults, the prediction of MDE at week-48 was based on SBRS at week-12, with and without the exclusion of people with MDD at week-12. The latter approach was meant to exclude the potential confounding factor of the association between SBRs and MDE at week-12 as a determinant of the same association at week-48 (i.e., that the association between MDE and SBRs at week-18 could be the consequence of dysfunctionality of SBRs in depressed people, rather than depression. The Committee of the "Azienda Ospedaliero-Universitaria di Cagliari", Cagliari, Italy, approved the study on October 25<sup>th</sup>, 2018 (reference number PG/2018/15546).

## Results

Seventy-nine (53.2%, females =42) individuals were evaluated during follow-up because 24% (n= 5) were lost-to-follow-up at week-12 (Table 1). The Huntington Quality of Life Instrument (H-QoL) improved during the lockdown period: the mean (SD) 12-Item Short Form Survey (SF-12) score raised from 34.0 $\pm$ 6.5 at week-12 to 37.6 $\pm$ 4.3 at week-48 (one-way ANOVA way for repeated measure 1,156 df, F=16.576, p<0.01).

The frequency of mild to severe depression (PHQ<sup>3</sup>4) did not significantly change [10 (12.7%) vs 18 (22.8%), McNemar test=2.77, p=0.10, OR=2.60 (C.I.95%=0.87-9.13)]. The frequency of moderate to severe depression (PHQ<sup>3</sup>10) did not increase compared to the pre-lockdown period [4 MDE at week-12 (5.1%) vs 5 at t48weeks (6.3%), McNemar test=0.125, p=1.1, OR=1.33 (C.I.95%=0.26-9.12)]. The prevalence of moderate/severe depression (PHQ<sup>3</sup>10) was lower when compared with that of an Italian non-elderly sample evaluated during the lockdown using the same tool and cut-off (6.3% vs 30.0%; p<0.01).<sup>20</sup>

The mean  $\pm$ SD score at BSRS at week-12 was 19.1 $\pm$ 7.9. A score above +1SD at week-12 was significantly associated with depression during the lockdown. Six people with MDE at week-48 (33.3%) had dysfunctional BSRs at week-12 vs 5 (8.1%) of people without MDD at week-48;  $\chi^2=7.327$ , 1 df, p<0.01 OR=5.6, 95%CI=1.5-21.4). The association did not change after the exclusion of 10 individuals with MDE at t12 weeks [individuals with BSRS dysfunctional score at week-12 with MDE at week-48 were 4 (33.3 %) vs 3 (5.3%) in people without MDE at week-48; (Fisher' exact test, p<0.04 OR=5.4, 95%CI=1.2-24.4)].

**Table 1. Characteristics of the sample and factors associated with resilience/risk of depression during the lockdown.**

	Depressed mild/severe at week-48 n= 18 (22.8%)	Not depressed at week-48 n=61 (% 77.2%)	p-value OR (CI 95%)
Mean (SD) age (ANOVA)	71.6 (4.6)	72.5 (4.7)	0.34
Female (McNemar test)	11 (61.1%)	31 (53.4)	0.44 1.5 (0.5-4.4)
BSRS $\geq$ 1 SD from the mean (week-12) (McNemar test)	6 (33.3)	5 (8.1%)	0.007 5.6 (1.5-21.4)

ANOVA, analysis of variance; OR, odd ratio; BSRS, Brief Social Rhythms Scale.

## Discussion

The present study confirms a strong resilience of older adults during the first phase of the COVID-19 pandemic despite the “life-threatening climate” in Italy, exemplified by the local media repeatedly broadcasting rows of military trucks with coffins.<sup>21</sup> The frequency of MDE did not change during the lockdown period and the H-QoL was surprisingly better than that measured 48 weeks before. This result is coherent with several surveys that found low rates of stress and depressive disorders in old adults during the COVID-19 pandemic and lockdown.<sup>3,4,22</sup> However, this finding seems even more pronounced in our sample. It may be that the lockdown saw a belt of solidarity tighten around the elderly in Italy. This has sensitized families but also institutions and social solidarity. The family, which in Southern Italy includes an enlarged circle of cousins and grandchildren, has maintained very close contacts also through phone calls and social networks with their elders. An agreement between the municipality of Cagliari (where the study took place) and non-profit organizations made it possible to distribute home shopping and drugs to the elderly, to prevent exposing themselves to risk. These may have been the reasons for this surprising result, but at present, they are heuristic hypotheses that will have to be verified over time and with adequate comparisons.

In general, older adults appear to show better stress responsiveness and emotional regulation than younger adults,<sup>23</sup> thus proving the resilience of the elderly to the consequences of the pandemic.<sup>2,24</sup> However, sudden changes in time cues related to automatic biological answers might impair mental well-being.<sup>25</sup> It is well known that disruption of SBRs, such as habits of eating, sleeping, and having regular and constant social contacts, affect circadian rhythms and, consequently, mental health.<sup>26,27</sup> The study appears to confirm our hypothesis on the role played by dysfunctional rhythms before lockdown: they can increase individual vulnerability during the pandemic by altering biological rhythms after the implementation of lockdown restrictions. But having functional SBRs appears to be a factor of resilience to stress due to disruption of daily rhythms during the lockdown. The difference of SBRs between older adults and other age groups is unclear, but scientific findings show more regular circadian rhythms in elderly people.<sup>10,28</sup> If SBRs have more similar differences by age than circadian rhythms, the regularity of SBRs in the elderly could be recognized as a factor of age-dependent resilience. Although we were not able to further stratify the sample at this time, yet there are chances that people who developed an MDE had prominent atypical features of depression, which in turn are more related to circadian rhythm impairments, and are, indeed, part of the bipolar realm. According to the ‘allostatic load model’ based on the integrative perception of late-depressive symptoms that occur because of a combination of psychological and physiological determinants, older people with high allostatic load are those who are at increased risk for depression in the community.<sup>29</sup>

Our study, which was not designed ahead to study the impact of lockdown, has several limitations, such as selection bias due to its post-RCT-extension nature, and limited sample size; furthermore, a case-finding on MDE can be carried out with brief questionnaires such as the PHQ-9 but these tools cannot allow diagnosis of MDD, which is a lifetime diagnosis. It may be possible that a person with a current depressive episode has experienced mania or hypomania in the past. In this case, the lifetime diagnosis is not MDD, but BD.

## Conclusions

Therefore, the study does not clarify whether the association between ED and SBRs occurs in people with a vulnerability to MDD, BD, or both. The assessment of functional biorhythms as a possible predictor of resilience in the elderly requires further analyses with increased statistical power and the use of adequate diagnostic tools. Moreover, a detailed comparison of age groups in the elderly considering key confounding variables (*e.g.*, socioeconomic status, educational level) may help to better understand the psycho-social dynamics associated with the COVID-19 pandemic. Studies should be conducted in the future phases of the pandemic, for which lockdowns do not seem to be excluded, with the outcome to proactively identify the most vulnerable individuals among the elder population and to implement optimal public health and socio-economic interventions across different recipients and cultures.

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**Key words:** Social and behavioral rhythms; major depressive disorder; health-related quality of life; COVID-19; resilience.

**Contributions:** The study was initially designed by MGC, GC, and GS and then discussed with MP, FV, LA, GK, SC, and CIAG. The methodology was decided by MGC, GS, and GC. MGC conducted the data analysis. The results were discussed collectively. MGC, GC, and GS drafted the paper, or its revisions (MF). All authors read and approved the final manuscript.

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**Conflict of interest:** The authors declare no conflict of interest.

**Availability of data and materials:** The datasets are not available with open access: the agreement shared with the participants and partners as stated in the presentation for authorization to the Ethics Committees was that the project leader will be guarantors and they will review all access requests. Requests for access to the datasets (with anonymous records) are to be directed to the corresponding author.

**Ethics approval and consent to participate:** The Ethical Committee of the “Azienda Ospedaliero-Universitaria di Cagliari” approved the study on 25 October 2018 (reference number PG/2018/15546). During evaluations, the researchers provided information about the aims of the study and informed participants about the possibility of discontinuing the interview if they wished. The researchers explained that data would be collected in an anonymous database. Each participant signed informed consent. The study procedure was in accordance with the ethical standards of research and with the 1964 Helsinki declaration and its later amendments.

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