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COVID-19

Longitudinal Impact of Social Restrictions on Sexual Health in the Italian Population



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ABSTRACT

Background: Several trials have reported on the impact of social restrictions due to SARS-CoV-2 (COVID-19) pandemic on sexual function and psycho-physical well-being. However, data showing modifications of these outcomes over time and at the end of lock-down are scant.

Aim: We investigated the longitudinal changes in sexual function during social restrictions for COVID-19 pandemic in Italy.

Methods: A web-based survey was administered to Italian citizens of legal age via social networks. The Beck Depression Inventory Primary Care, the General Health Survey, Female Sexual Function Index, International Index of Erectile Function, UCLA Loneliness Scale-version 3 questionnaires were used to test mental, physical and sexual well-being. The questionnaires were administered at the beginning of the lockdown (T0), 15 days from the first assessment (T1) and 1 month after the end of the restrictions in 2020 (T2).

Outcomes: Descriptive statistics and multiple regression analysis were applied to investigate changes in sexual function over and at the end of social restrictions.

Results: Data were available for 2543 people (47.2% of men; 43.4% women; 9.4% undefined). Mean age was 48.3 ± 15.1 years for males and 43.9 ± 13.4 for females. Overall, 2.6% reported depressive symptoms according to Beck Depression Inventory Primary Care, 7.4% reported a high level of UCLA loneliness and 19.4% low levels of general mental health. Mild to severe erectile dysfunction was reported by 59.1% of men at T0, while 68.4% of women reported sexual dysfunction. Sexual function levels remain generally unchanged at further follow-up over the social restriction time period (T1), although those who were sexually active at baseline showed a decrease in sexual function scores. At T2, there was an overall improvement in sexual function scores with a rate of severe erectile dysfunction decreasing from 37.1% to 24.1% from T0 to T2 among males and a significant decrease of female sexual dysfunction from 68.4% to 51.2%.

Clinical Implications: Young individuals and those with good mental and physical health were more likely to improve sexual function at the end of social restrictions.

Strengths & Limitations: Valid and reliable questionnaires and longitudinal approach design represent strengths; a large but convenient sample and lack of pre-pandemic baseline data represent limits.

Conclusion: Social restrictions due to COVID-19 pandemic led to an increase in sexual dysfunctions in both genders. However, these conditions appeared temporary since an overall improvement was observed at the end of lockdown and especially in younger individuals with higher psycho-physical well-being. **Vedovo F, Capogrosso P, Di Blas L, et al. Longitudinal Impact of Social Restrictions on Sexual Health in the Italian Population. J Sex Med 2022;19:923–932.**

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INTRODUCTION

A novel coronavirus pneumonia was first identified in Wuhan City and referred to as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by the World Health Organization, on December 31, 2019. On March 10, 2020, general social distancing rules were applied with a general lock-down in the whole Italy. The COVID-19 pandemic was the first in Europe in the contemporary age.

The psychological and sexual impact of these restrictions and the consequent concerns due to the changes in daily habits and interpersonal relationships have been widely investigated. Studies conducted so far, both in Italy and in other countries, have revealed above all a reduction in the frequency of sexual intercourses and an expansion of the sexual repertoire by incorporating new activities.^{1–9} Being younger, living alone, and feeling stressed and lonely were all related to experiencing novel habits such as sexting, new sexual positions, and sharing sexual fantasies.⁵ In this scenario and in line with the previous literature, female participants experienced higher anxiety and depressive levels compared to men, with a negative impact on their sexual desire.^{2,3}

However, most of the studies published to date are cross-sectional surveys that report the effect of quarantine using a single timing of assessment, without the possibility to understand changes of psychological distress and sexual function from baseline or even longitudinally over the lock-down period and even more important, they do not allow to evaluate the eventual recovery of sexual function at the end of the social restrictions. Moreover, a limitation of many of the data published so far is the use of non-validated questionnaires, which makes the conclusions of these studies poorly generalizable.^{2,8,10} Another critical issue is the deviation from the recommended standard for conduction and reporting web-based survey, which may have affected the quality of these researches.¹¹ Overall, such data lead to speculative conclusions which may not reflect the real social impact of this pandemic.^{2–4,8}

Collecting valid data about the psycho-sexual effects of the COVID-19 outbreak is important, not only to understand the related pandemic changes but also to have useful information to design policy and health responses that reduce conditions of vulnerability.

For these reasons we designed a longitudinal study and administered validated questionnaires, with the aim of observing self-reported sexual function in a representative sample of the Italian population, during and after the first lock-down in 2020.

MATERIAL AND METHODS

Study Design and Sample

Participants were Italian citizens of legal age recruited for a study on “General and Sexual Health during quarantine” on the 23rd of March through advertisements on local newspapers,

television news, Twitter, Instagram and Facebook groups. The survey begun with a cover letter, which described the format of the study and included informed consent and privacy policy and was sent to inhabitants from all regions of Italy in order to avoid local biases in their responses. The study was approved by the ethical institutional review board (protocol number N.O. 104/2020) and it was sponsored by the *Società Italiana di Andrologia*. The survey was designed in accordance to the Checklist for Reporting Results of Internet E-Surveys¹² and collected demographic, social and medical information: age, region of residence, gender identity, educational level, sexual orientation, marital status, tobacco and alcohol consumption, drug therapy, comorbidities, COVID positivity, hospitalized relatives for COVID, workplace (home/office), quarantined alone or with family members.

Questionnaires

To assess the psychological and sexual well being of the participants the Italian versions of the Beck Depression Inventory Primary Care (BDI-PC),¹³ the General Health Survey (SF-36),^{14–17} the Female Sexual Function Index (FSFI),^{18–20} the International Index of Erectile Function-15 (IIEF)²¹ and the UCLA Loneliness Scale-version 3 questionnaires (UCLA LS3)^{22,23} were web-based administered.

Both genders filled the BDI-PC, UCLA-3 and SF-36 questionnaires. The BDI-PC is a 7-items tool to screen depression by focusing on symptoms of sadness, pessimism, failure, loss of pleasure, self-dislike, self-criticalness and suicidal thoughts. Each item is rated on a scale ranging from 0 to 3. Scores in the range of 0 to 3 indicate low depression, 4 to 6 mild depression, 7 to 9 moderate depression and 10 to 21 severe depression.^{13,24} The UCLA LS3 is a 20-items self-report measure that evaluates loneliness on a 4 point Likert type scale. Nine items are positively formulated and score-reversed to obtain high total values indicating greater feelings of loneliness (score range: 20–80).^{22,25} The SF-36 is a self-report questionnaire assessing generic health status with 8 domains covering physical, social, emotional and medical health. Scores on each scale range from 0 to 100, with a score of 100 indicating the highest rating of health.^{15,16}

Female sexual function was investigated by using the FSFI, a 19-items validated tool assessing 6 domains: desire, arousal, lubrication, orgasm, satisfaction and sexual pain. Weighted scale scores are summed to obtain a general FSFI score, with higher scores indicating greater satisfaction. A FSFI total score less than 26.55 has been determined to be the cut-off for considering a women at risk of sexual dysfunction.^{18,19,26}

Male participants completed the IIEF, a 15-items self-report instrument designed to evaluate 5 domains of male sexuality: erectile (EF) and orgasmic function, sexual desire, intercourse and overall satisfaction. A total score less than 25 in the EF domain has been proven to be the cut-off for the presence of erectile dysfunction (ED) with further sub-classification of ED

severity (22–25 mild, 17–21 mild to moderate, 11–16 moderate, ≤ 10 severe ED).²¹

The questionnaires were administered at three time points over the pandemic period: at the beginning of the quarantine from March 23 to April 9 (T0), 15 days from the first assessment, from April 6 to April 26 (T1), and 1 month after the end of the lockdown, from June 4 to June 17 (T2), in 2020. Participants filled out the questionnaires referring to the last 4 weeks in phase T0 and the last 2 weeks in phase T1 and T2.

An email address of a designated psychologist was made available to all participants in case of psychological distress after completing the questionnaires.

Outcomes

The outcome was to assess changes in sexual function over time. Moreover, we investigated how well-established risk variables for social function such as mental and physical health as well as social distancing, feelings of loneliness, and depression contributed to affect sexual function across time.

In details: baseline data at T0 were analyzed with the aims of *a) describing a reference point picture*, and *b) reporting the average profile of those women and men who referred critical levels of sexual functioning*. Data collected at the second time point assessment (T1) were inspected so as to reveal whether *a) a longer lockdown condition affected sexual functioning* and *b) who suffered more*. Lastly, the third time-point (T2) was aimed to understand whether *a) living back without restrictive COVID rules positively impacted sexual functioning*, and *b) who was still referring critical levels in sexual functioning*.

Statistical Analysis

Baseline. Descriptive statistics were used to report on demographic characteristics of the entire cohort as well as mean scores of the study variables and prevalence of sexual dysfunction. Linear multiple regression analysis was used to examine concurrent predictors of sexual function levels using the IIEF and FSFI score as continuous dependent variables. Quantitative independent variables entered in the regression model were: Age, daily intake of drugs, BDI-PC, UCLA, SF36 MH and PH scores; qualitative independent variables entered in the regression model and dummy coded were: Sexual orientation; COVID Risk areas; Education; Work condition; Health professional; Engaged in a stable relationship; Lockdown condition; Psychotropic drugs; Alcohol assumption; Smokers; Relatives infected by COVID; children younger than 18 yrs.

Repeated Measurements. We investigated changes across different measurement occasions in terms of absolute continuity, rank-order continuity, and individual continuity, in order to understand how the impact of social distancing on sexual

functioning during lockdown itself (T0 to T1 changes) and after lockdown (T0 and T1 to T2). Of note, the three forms of continuity are not interchangeable, because each provide a complementary piece of information. *Absolute continuity* compares mean levels of psychometric scores and reveals whether people remain stable or not over the investigated time period, on average; we applied ANOVA for repeated measures to test differences in mean scores between time points, further applying ANOVA for mixed design in order to inspect interaction effects, that is, whether different sub-samples reported comparable mean differences between time points. *Rank-order continuity* allows to verify whether inter-individual differences across time remain stable. We used test-retest correlations to provide a measure of rank-order stability; according to this test, the higher the correlation, the higher the stability of inter-individual differences. We further applied cross-lagged regression analysis in order to investigate risk factors of sexual function decrease across time. Lastly, *individual changes* were tested by applying the reliable change index, which allows to find out who has changed his/her scores between time points beyond random or measurement error, thus representing a prerequisite for the clinical significance of any change.

RESULTS

Population Characteristics and Questionnaires Results at the Baseline

The study involved 2692 participants, however, 5.6% of the questionnaires were incomplete and therefore the final sample at the T0 assessment included 2543 people: 1202 (47.2%) men and 1104 (43.4%) women (9.4% did not provide gender information). The baseline socio-demographic characteristics are reported in Table 1. Men were slightly older than women ($P \leq .001$) with a mean age of 48.3 ± 15.1 years compared to 43.9 ± 13.4 for females.

Overall, 78% of the participants declared to have a stable relationship; 26.2% to have children younger than 18 years; 85.5% of the responders defined themselves as heterosexual, and among males 17.5% and among females 27.2% were sexually inactive as they reported on IIEF and FSFI questionnaires. Of all, 22.9% of the respondents lived in the worst affected Regions with more than 4,000 cases of COVID-19 as of March 23, 2020 (Lombardia, Piemonte, Emilia-Romagna, Veneto, and Liguria); the majority of the respondents were from the Northeast area of Italy. Although all the educational levels were represented in the present sample, higher educational levels were over-represented in comparison with distribution in the Italian population (ISTAT Census, 2011). As to work conditions, 25.3% reported that nothing had changed for them, 33.3% had to switch to smart working, whereas the remaining participants were retired or had no work position; 18.9% were health professionals. The majority of the participants spent the restrictive lockdown together with their partner and/or their children (64.3%), whereas 17.3% reported to be alone.

Table 1. Descriptive statistics of the study sample at T0, T1 and T2 assessment occasions.

	T0	T1	T2
<i>Demographic variables</i>			
<i>N</i>	2543	1291	934
<i>Sex</i>			
Females	1104 (43.6)	589 (45.6)	418 (44.8)
Males	1202 (47.2)	659 (51.0)	475 (50.9)
<i>Sexually inactive⁽¹⁾</i>			
Females	300 (27.2)	211 (35.8)	107 (25.6)
Males	211 (17.5)	129 (19.6)	63 (13.2)
<i>Partner's sex</i>			
Opposite gender	2173 (85.5)	1149 (89)	754 (80.7)
Same gender	132 (5.2)	64 (5.0)	34 (3.6)
<i>Northeast area</i>			
<i>COVID High risk Region⁽²⁾</i>	582 (22.9)	325 (25.2)	214 (22.4)
<i>Education</i>			
Lower level (up to 11 yrs)	248 (9.8)	112 (8.7)	82 (8.5)
Middle level (up to 16 yrs)	1166 (45.9)	577 (44.7)	445 (46.6)
Higher level (Master degree and higher)	1129 (44.3)	602 (46.6)	429 (44.8)
<i>With children younger than 18 yrs</i>	667 (26.2)	312 (24.2)	224 (25.5)
<i>Work Conditions</i>			
Unemployed/Retired	1053 (41.4)	554 (42.9)	417 (43.6)
Smart-working	847 (33.3)	448 (34.7)	340 (35.6)
As usual	643 (25.3)		199 (20.8)
<i>Health professional</i>	481 (18.9)	232 (18.0)	143 (15.0)
<i>Stable romantic relationship</i>	1984 (78)	1001 (77.5)	745 (77.9)
<i>Spending Lockdown with</i>			
Nobody	447 (17.6)	238 (18.4)	173 (18.1)
Partner and/or children	1655 (64.3)	874 (67.3)	633 (66.2)
Relatives or Friends	441 (17.3)	176 (13.6)	150 (15.6)
<i>Health variables</i>			
<i>COVID positive relatives</i>	39 (1.5)	20 (1.5)	40 (0.4)
<i>COVID positive participants</i>	17 (0.7)	8 (0.6)	8 (<0.1)
<i>Taking at least 1 drug</i>	973 (38.3)	528 (40.9)	393 (41.1)
<i>Taking psychotropic drugs</i>	79 (3.1)	72 (5.6)	48 (5.0)
<i>Smoker</i>	631 (24.8)	289 (22.4)	196 (20.5)
<i>Daily Alcohol user</i>	410 (16.1)	223 (17.3)	181 (18.9)
<i>Psychosexual variables</i>			
<i>IIEF-Erectile Function ≤ 10 raw score</i>	419 (37.1)	232 (35.2)	113 (24.1)
<i>FSFI-Total ≤ 26.55 raw score</i>	646 (68.4)	354 (60.1)	212 (51.2)
<i>BDI-PC Depression ≥ 10 raw score</i>	66 (2.6)	33 (2.6)	26 (2.9)
<i>UCLA Loneliness ≥ 52⁽³⁾raw score</i>	211 (7.4)	124 (9.6)	91 (9.7)
<i>SF-36 Mental Health ≤ 35 T score</i>	407 (19.4)	211 (17.7)	126 (14.4)
<i>SF-36 Physical Health ≤ 35 T score</i>	42 (1.9)	26 (2.2)	28 (3.2)

Note. ⁽¹⁾ Sexually inactive men were those who reported they had no sexual activity on all the IIEF items 1 to 10; females those who reported they had no sexual activity on FSFI items 3 to 5, 7 to 14, 17 to 19⁽²⁾ conversely, we defined as sexually active those men who reported they had some sexual activity, on each of the IIEF items 1 to 10; similarly for women on the FSFI items 3 to 5, 7 to 14, 17 to 19. High risk areas were Lombardia, Piemonte, Veneto, Emilia Romagna, Liguria. ⁽³⁾ At the baseline, 93rd percentile = 52.

BDI-PC = Beck Depression Inventory Primary Care; FSFI = Female Sexual Function Index; IIEF = International Index of Erectile Function; SF-36 = Short Form General Health Survey.

As to the health conditions, a marginal but representative percentage of the participants reported that themselves (0.7%) or their relatives (1.5%) were diagnosed and hospitalized as COVID positive, respectively; 38.3% diagnosed with illness

reported to regularly take one drug at least and 3.1% to take psychotropic drugs.

Overall, 2.6% expressed severe BDI-PC depressive symptoms, in line with ISTAT report on mental health in Italy, 2015

Table 2. Mean values and test-retest correlations for sexual functioning variables in women and men.

	Mean \pm SD			Mean differences (η^2)	Test-retest correlations		
	Lockdown period		Post-lockdown		Lockdown and post-lockdown periods	Lockdown and post-lockdown periods	Fisher's r to z test
	T0	T1	T2	Lockdown T0 and T1			
<i>N</i> (men)	1128	650	468	381	604	370	
IIEF EF	17.11 \pm 10.90	17.20 \pm 10.76	20.45 \pm 10.45	3.47* (0.16)	0.78*	0.69*	2.98*
IIEF OF	6.87 \pm 4.18	6.88 \pm 4.19	7.61 \pm 3.82	0.63* (0.03)	0.62*	0.62*	0
IIEF SD	7.19 \pm 2.26	6.82 \pm 2.53	7.08 \pm 2.49	0.22 (0.01)	0.72*	0.73*	-0.32
IIEF IN	5.55 \pm 5.55	5.49 \pm 5.48	7.21 \pm 5.40	1.78* (0.13)	0.77*	0.63*	4.21*
IIEF OS	5.90 \pm 2.70	5.73 \pm 2.79	6.56 \pm 2.72	0.74* (0.11)	0.74*	0.68*	1.83
<i>N</i> (women)	948	570	414	353	526	368	
FSFI Desire	3.19 \pm 1.41	3.22 \pm 1.53	3.65 \pm 1.52	0.21* (0.03)	0.76*	0.70*	1.89
FSFI Lubrication	2.67 \pm 2.57	2.86 \pm 2.59	3.43 \pm 2.51	0.65* (0.08)	0.71*	0.62*	2.38
FSFI Orgasm	2.66 \pm 2.01	2.81 \pm 2.56	3.40 \pm 2.48	0.57* (0.06)	0.69*	0.60*	2.27
FSFI Satisfaction	3.20 \pm 1.75	3.15 \pm 1.97	3.77 \pm 2.04	0.55* (0.10)	0.69*	0.61*	2.04
FSFI Pain	2.56 \pm 2.80	2.85 \pm 2.83	3.49 \pm 2.70	0.78* (0.10)	0.72*	0.61*	2.91
FSFI Arousal	2.78 \pm 2.15	2.77 \pm 2.47	3.40 \pm 2.40	0.58* (0.08)	0.70*	0.63*	1.85
FSFI Total	17.06 \pm 11.64	17.70 \pm 12.70	20.87 \pm 12.75	3.53* (0.10)	0.76*	0.65*	3.24*

Note. No mean differences between T0 and T1 assessment occasions were statistically significant, at $P \leq .001$. Mean differences between lockdown and post-lockdown periods were calculated after aggregating T0 and T1 scores (lockdown scores) vs T2 scores (post-lockdown scores). Test-retest correlations were estimated from $r = 1.000$ bootstrap replications.

FSFI = Female Sexual Function Index; IIEF EF = Erectile Function; IN = Intercourse Satisfaction; OF = Orgasmic Function; OS = Overall Satisfaction; SD = Sexual Desire.

* $P \leq .001$.

–2017; 7.4% reported high levels of UCLA Loneliness; and 19.4% reached low levels of general mental health.

Table 2 presents mean levels for the male and female participants' sexual function at the baseline. The prevalence of severe to mild ED was 59.1%, with 667 men achieving an IIEF score < 25 . More in detail, data showed that 37.1% of men referred severe ED (IIEF-EF ≤ 10 , Table 1), 14.4% reported moderate ED, 3.8% mild to moderate ED and 5.1% mild ED. A total of 68.4% of women reported a FSFI total score < 26.55 (Table 1), that is, severe to mild sexual dysfunction.

Concurrent predictors for sexual function were also explored via multiple linear regression analysis (but see also Table 4 for

Table 3. Baseline data set: multiple linear regression analysis for predicting IIEF-EF and FSFI total scale scores: standardized beta values are reported.

	IIEF EF	FSFI
Age	-0.33	-0.34
UCLA Loneliness	-0.18	-0.17
Health professional	0.10	
In a stable relationship		0.12
Lockdown Condition D1	-0.35	-0.13
Lockdown Condition D2	-0.39	-0.32
R_{ADJ}^2	0.28	0.24

All coefficients are significant at $P \leq .001$.

FSFI = Female Sexual Function Index; IIEF = International Index of Erectile Function.

concurrent correlations) (Table 3). Higher IIEF-EF scores were reported when men were younger, felt a lower sense of loneliness, were spending the restrictive lockdown period together with their partner and/or children rather than alone or together with friends or other relatives, and were health professionals; the pattern of associations did not significantly change when sexually active vs inactive men were compared to each other. As to women, a comparable, though not identical, regression model emerged, with women who reported to be younger, feeling lower loneliness, being engaged in a stable relationship, and spending the lockdown period with their family referring higher FSFI scores; only higher SF-36 Mental Health scores ($\beta = 0.34$, $P \leq .001$) and younger age ($\beta = -0.21$, $P \leq .001$) predicted higher sexual function in sexually active women. In brief, men and women referred lower sexual function when older and when their loneliness and solitude levels were higher.

Questionnaires Results at T0–T1

A total of 1,291 (50.7%) participants completed the second phase of the study, filling out the questionnaires between April 22 and May 5 (T1). Overall, 659 males (mean age equal to 48.7 ± 15.3) and 589 females (mean age equal to 42.9 ± 13.3) were included (Table 1).

Preliminarily, we checked whether any systematic difference emerged between those T0 participants who further took part at the second measurement occasion and those who did not. Chi square and ANOVA for between group comparisons showed

that the two T0–T1 subsamples were comparable along the study variables. Table 2 present IIEF and FSFI mean levels observed at the second measurement occasion, when the participants still were in lockdown. When T0 and T1 mean values were compared via ANOVA for repeated measurements, no significant differences emerged ($P \leq .001$) for men or women, that is, a longer social distancing period had no effect on average sexual function. However, results from mixed-design ANOVA showed that IIEF-EF scores significantly decreased in men who referred to be sexually active at baseline. In female participants, the same interaction effect emerged as well ($\eta^2 = 0.04$, $P \leq .001$). In other words, in sexually active participants, lockdown quickly negatively and substantially impacted sexual function. Table 2 also presents test-retest correlations showing a substantial rank-order consistency across the two measurement occasions, thus confirming no significant changes in levels of sexual function between T0 and T1 measurements; test-retest correlations were not statistically different when men who reported T0 EF vs not were compared to each other. When we investigated predictors of rank-order changes in IIEF-EF from T0 to T1, after controlling for baseline IIEF-EF and age, we found that higher baseline SF-36 Physical Health scores significantly predicted increase in sexual function scores ($sr = 0.12$, $R^2_{change} = 0.02$, $P \leq .001$) thus suggesting that a better physical health was associated with improvement of EF over the social distancing period (Table 4); nevertheless, among sexually active men (see Note in supplementary Table 1) at T0, in a stable relationship ($sr = 0.18$, $R^2_{change} = 0.03$) in addition to being physically healthier ($sr = 0.19$, $R^2_{change} = 0.04$) significantly ($P \leq .001$) favored increases in IIEF-EF scores. For the female sample, no predictors emerged when FSFI scale scores were analyzed.

When looking at individual changes in sexual function from T0 to T1 along IIEF EF and FSFI scale scores, we found that 4% ($N = 24$) of men increased their IIEF-EF scores, and 5% ($N = 30$) referred a reduction in EF; binary regression analysis, confirmed that baseline SF-36 Physical Health was the only predictors of EF improvement ($\exp(\beta) = 1.15$, 95% CI 1.03–1.28,

$P \leq .05$). Likewise 29 women (5.9%) reliably increased their sexual activity (T0 FSFI $M = 7.04 \pm 2.73$, T1 FSFI $M = 29.62 \pm 3.15$, $P \leq .001$), and 31 (5.5%) reliably decreased it (T0 FSFI $M = 26.38 \pm 3.84$, T1 FSFI $M = 4.56 \pm 1.60$, $P \leq .001$); yet no study estimator helped predicting such changes.

Questionnaires Results at T2

Participants who collaborated across all the measurement occasions were 934 adults, 475 males (mean age of 50.1 ± 15.4) and 418 females (mean age of 43.9 ± 13.5). No age differences emerged when males ($P > .05$) and females ($P > .05$) who took part at all measurement occasions vs did not were compared. Table 1 provides some descriptive statistics on the sample and shows that drop outs did not substantially change sample composition from T0 to T2.

Rank-order, absolute as well as individual quantitative indices already presented indicated that continuity largely prevailed over change from T0 to T1. Therefore, we aggregated T0 and T1 scores so as to enhance their reliability and then compared the averaged psychometric scores to T2 or post-lockdown scores. Table 2 shows that mean levels of sexual function significantly and substantially increased for both women and men. Considering that both the IIEF-EF and the FSFI scores could be biased by the sexual activity status of the subject, we have looked at changes in sexual function scores in both subjects who declared to be sexually active and those who declared to be non-sexually active at all over the lockdown phase (supplementary Table 1). We observed a significant improvement from T0 to T2 of both IIEF-EF and FSFI scores non-sexually active subjects, while they only slightly change for those who declared to be sexually active over the entire follow-up.

Table 2 shows test-re-test correlations for IIEF-EF and FSFI scores between T0/T1 and T2. Data shows that rank-order stability significantly decreased, confirming that sexual function changed from lockdown to post-lockdown. Table 4 shows that no quantitative study variable helped predict increases in IIEF-

Table 4. Concurrent and across-time associations between study variables and IIEF-EF and FSFI Total scores.

	Baseline (T0)		Lockdown period		Lockdown to post-lockdown	
	IIEF-EF	FSFI	IIEF-EF	FSFI	IIEF-EF	FSFI
Age (baseline)	-0.11*	-0.25*	-0.03	-0.05	-0.12	-0.21*
UCLA Loneliness	-0.28*	-.25*	-0.05	-0.07	-0.05	0.01
BDI-PC Depression	-0.21*	-0.15*	-0.03	-0.04	-0.09	-0.06
SF-36 Mental Health	0.18*	0.11*	0.01	0.03	-0.07	-0.01
SF-36 Physical Health	0.10*	0.12*	0.12*	0.03	0.09	-0.01

Note. Simple correlations were observed at the baseline (N Males = 1069–1128, Females = 905–944). Semi-partial correlations (and partial correlations) were reported from cross-lagged regression analysis when changes were inspected from one measurement occasion to a successive one. Lockdown period: T1 IIEF/FSFI scores were regressed on the study variables, after controlling for T0 IIEF/FSFI scores (N Males = 563, N Females = 506). Lockdown to post-lockdown periods: T2 IIEF/FSFI scores were regressed on the study variables (ie, aggregated T0 and T1 scores), after controlling for aggregated T0 and T1 IIEF/FSFI scores (N Males = 342, Females = 329).

BDI-PC = Beck Depression Inventory Primary Care; FSFI = Female Sexual Function Index; IIEF = International Index of Erectile Function; SF-36 = Short Form General Health Survey.

* $P \leq .001$.

EF; nevertheless, increase in IIEF-EF correlated with decrease in BDI levels ($r = -0.19, P \leq .001$). Table 4 also shows that younger women increased their FSFI total scores from lockdown time to T2; moreover, increase in sexual functioning substantially correlated with decrease in loneliness ($r = -0.31, P \leq .001$). Such an effect was stronger when inspected among those female participants who did not spend the lockdown with their partner and/or children ($r = -0.44, P \leq .001$), conversely, decrease in BDI scores correlated with increase in sexual function ($r = -0.24, P \leq .001$) in women who spent lockdown with their partner and/or children. Lastly, just younger age predicted ($P \leq .001$) increases in outcome in both male and female respondents who reported to be sexually inactive at T0, after equating the participants on T0 UCLA, BDI-PD and SF-36 variables.

When reliable changes were investigated, the results showed that 2 men only decreased reliably their IIEF-EF scores after lockdown compared to baseline, whereas 22 (5.8%) increased their scores reliably; among women 3 of them decreased their scores, and 35 (10%) increased their FSFI scores reliably.

DISCUSSION

Main Findings

The psychological and sexual impact of COVID pandemic has been widely investigated, however we have here reported the results of a longitudinal study assessing the population in several phases of the lockdown and at the end of the restrictions to provide reliable data on the impact of this conditions on sexual life over time.

Overall our findings showed that social restrictions had a significant negative impact over both male and female sexual function and that this effect was greater for individual living alone and for those who were more sexually active. Conversely, individual with overall greater physical health and living with partner or relatives, were less likely to experience a reduction in sexual function levels. Interestingly after the end of lockdown there was an overall improvement of sexual function scores in both male and females thus suggesting that the negative effect of social restrictions on sexual function was only temporary.

Results in the Context of Previous Studies

The multitude of studies conducted on this topic around the world have substantially shown a decrease in the frequency of sexual intercourse, a reduced sexual satisfaction, but an expansion of the sexual repertoire with the experimentation of new practices.^{1,2,5-9} This scenario is a predictable consequence of the measures of social distancing and the reduction of opportunities for people to meet. Furthermore, the cancellation of entertainment events (eg, sports, concerts, exhibitions) and recreational activities has prompted people to overcome boredom by stimulating their imaginations at home.

Unsurprisingly, in most studies participants engaged in a stable relationship reported higher frequency of sexual intercourse

than single peers.^{1,10} However is interesting to note that in the study conducted by Mollaioli D. et al, the 26.7% of sexually active people did not spent the lockdown with their partner, whereas 7.3% of sexually inactive ones lived with their partners.²⁷

In our sample, for both genders, the best levels of sexual function were reported by participants engaged in a stable relationship, quarantined with their partner. These results support our initial hypothesis that the novelty of spending more time together and the slowdown of the hectic pre-lockdown life, could have had a positive impact on the sexuality of the couples.

At the beginning of social restrictions we observed a prevalence of female sexual dysfunction (FSD) of 68.4%. These results are in line with those reported by Schiavi M.C. et al in a study on Italian women of reproductive age conducted on April 2020 (FSFI mean score 19.2, FSD 67%).⁷ However, these values differ from the Italian normative data which report a prevalence of FSD of 37%.^{19,28} The prevalence of severe ED was 37.1%, far higher than the 19.9% reported in a large cross-sectional study on Italian men conducted by Mirone et al.²⁹ These differences underline how social restrictions were able to reduce overall sexual function even in the short time.

Unlike what was found in men, being a healthcare workers was not a predictor of sexual well-being in women. Reconfirming that, as it is known for other clinical sets, the female gender is more susceptible to stressful conditions.³⁰

The majority of published studies on this topic reported data at a single timing of assessment thus showing a picture of the impact of social restrictions only at a specific time-point of the lock-down phase. This strategy does not allow to evaluate the eventual worsening of sexual function with the increase length of social restrictions as well as the possible recovery at the end of the lock-down. Conversely, in our study, after the baseline evaluation (T0) we performed a first follow-up assessment (T1) at a later stage from the beginning of the restrictions and a second follow-up (T2) at 1 month from the end of the lock-down.

We observed a substantial stability of the average sexual function scores over the lock-down period, although individuals that were more sexually active were more likely to observe a further decrease in sexual function while those with better physical health may even improved their scores over time.

In men, good levels of physical health at the T0 baseline were found to be the only predictor of sexual function improvement as the lockdown period continued. Sexual health is strictly related with general health in both genders.³¹ However, no predictors of sexual function improvement emerged when we analyzed the female scores. Although several types of medical conditions (eg, diabetes, cardiovascular disease, obesity), certain health risk behaviors (eg, smoking and alcohol use), and medication use (eg, b-blocker use) were strongly correlated with ED, female sexual

function appears to be associated rather with psychosocial variables (eg, anxiety, emotional satisfaction with relationship).³² In addition, sexual health can be affected not only by chronic illnesses and disorders of sexual function per se, but also by diseases with no immediately obvious connection to sexuality.³³

At the end of social restrictions we observed an overall improvement of sexual function in both genders. The prevalence of female sexual dysfunction (51.2%) and severe ED (24.1%) decreased, resembling Italian normative data. Men who had spent the lockdown period alone or with friends or relatives other than partner reported higher IIEF-EF scores than participants quarantined with their partner and/or children. This result was quite predictable, as these men, with the end of the restrictions, were able to meet their sexual partners again with a positive impact on their sexual satisfaction. Being young and having good mental and physical health during the lockdown period were found to be predictive factors of improved male sexual function 1 month after the end of restrictions. Even in this measurement, for men, physical health appears to impact sexuality, whereas nothing similar emerged for women.

Younger female participants significantly improved their FSFI total score. Although higher age is associated with increased sexual dysfunction and less sexual activity in both sexes, the relationship between older age and sexual satisfaction is rather contradictory.³² In a recent study conducted by Mollaioli D. et al, sexual dysfunctions were not age-dependent and the age seems to lose its weight as a predictor for sexual dysfunction during COVID lockdown. Conversely, in our study, younger participants expressed better sexual function both during the lockdown and at the end of the isolation period. This could be explained by the youngsters' better ability to entertain themselves with online recreational activities compared to older participants (eg, social media, dating apps, porn sites). In addition, older participants, on whom their family's economic support depended, may have been more affected by socio-economical concerns due to the pandemic.

Finally, in males and especially in females there was a correlation between sexual function amelioration and improvement of psycho-physical well-being scores. This result is in line with what emerged from an Italian case control study, in which a good sexual function was found to be a predictor of psycho-physical well-being.²⁷

Given the nature of the IIEF-EF and FSFI questionnaires we expected that the observed modifications in the sexual function scores could be different for participants who declared not be sexually active over the lockdown phase as compared for those who had the chance of being sexually active. Indeed, our data showed that the detrimental effect of the social restrictions was mainly observed in respondents who were non-sexually active due over the lockdown. Still, they showed to improve and recover their sexual function at the end of social restrictions (T2) thus confirming our findings.

We are aware that our baseline (T0) findings may not represent pre-pandemic levels of sexual function. However, we still believe these results are of value since we showed modifications of the outcomes (sexual function and general health) over time during the social distancing time period and at the end, thus revealing the impact of the pandemic on the sexual life of the subjects.

Study Limitations

This study is not devoid of limitations. First, although we have performed a baseline assessments few days after the beginning of social restrictions, we lack a pre-pandemic evaluation of sexual function thus hampering to provide exact data on sexual function recovery at the end of social restrictions. Second, the use of web-based platforms for conducting this survey may have created a selection bias related to the possibility to have access to the survey itself thus selecting only a specific profile of the respondents. These limits relating to the convenience sample, which may not be representative of the general Italian population, imply a cautious interpretation of our results. Last, the non-negligible rate of patients who were lost to follow-up may have affected the final results.

CONCLUSION

Social restrictions due to the COVID-19 pandemic had a detrimental impact on sexual function of both genders especially for sexually active patients living in loneliness and those with worse physical health-being. Conversely, individual with overall greater physical health and living with partner or relatives, were less likely to experience a reduction in sexual function levels. However a significant recovery was observed at the end of the restrictions thus suggesting that the psycho-physical impact of the pandemic should not leave permanent consequences on sexual function.

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SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at [doi:10.1016/j.jsxm.2022.02.004](https://doi.org/10.1016/j.jsxm.2022.02.004).