SPECIAL SECTION: IMPACT OF COVID-19 ON SEXUAL HEALTH AND BEHAVIOR

An Investigation of Sexual and Relationship Adjustment During COVID-19

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Abstract

The COVID-19 pandemic and the mitigation measures put in place have resulted in universal disruption in the usual ways of life for individuals. The current study sought to investigate how aspects of sexual health (well-being and functioning) and relationship satisfaction changed or remained stable during the pandemic. During two separate time points (Time 1 including Time 1 and a retrospective baseline, Time 2), participants completed online measures of sexual well-being (sexual pleasure, partnered and solitary orgasm frequency, sexual distress), sexual functioning, and relationship satisfaction. Participants reported slight declines in sexual pleasure, frequency of orgasms with a partner, and frequency of solitary orgasms from pre-COVID-19 (retrospective baseline) to Time 1, with no significant differences in sexual distress and relationship satisfaction. For individuals with vulvas, sexual functioning improved from Time 1 to Time 2, whereas no significant differences in sexual functioning were observed for individuals with penises. Aspects of sexual health and relational satisfaction did not sufficiently change across time points to be considered meaningful health outcome changes. Given that minimal disruptions were noted in pre-COVID-19 to COVID-19 sexuality, these results highlight the potential resiliency of individuals' sexuality when facing sudden changes in their daily lives. Implications of COVID-19's effects on sexual well-being and relationship satisfaction research are broadly discussed.

Keywords COVID-19 · Sexual functioning · Sexual health · Relationship satisfaction · Physical distancing

Introduction

Over a brief period of time, the COVID-19 pandemic and the mitigation measures put into place to manage the spread of this highly contagious and potentially fatal disease have resulted in changes to usual ways of life for many individuals, communities, and nations. Specifically, the stay-at-home and physical distancing guidelines recommended worldwide have posed unique challenges to human interactions in all aspects of life, including school, work, travel, and socializing. Within the sphere of socializing, the ways in which people sexually connect with each other has likely changed significantly due to physical distancing and the fact that any form of close contact can spread the virus (Addi et al., 2020). In addition, significant life changes and new stressors (e.g., financial stressors, children attending school from home, reduced privacy) have

likely emerged as a result of COVID-19 and these changes can possibly have wide-ranging impacts on intra- and interpersonal sexual relationships.

Initial studies examining the impact of COVID-19 on sexuality have generally found that individuals report declines in sexual functioning and well-being since the start of the global pandemic. Cross-sectional studies have indicated that compared to their retrospective recall of their pre-COVID-19 functioning, individuals perceive decreases in various domains of sexuality, such as desire (Ballester-Arnal et al., 2021; Li et al., 2020a), frequency (Fuchs et al., 2020; Jacob et al., 2020; Ko et al., 2020; Li et al., 2020a, 2020b; Schiavi et al., 2020), quality (Lehmiller et al., 2021; Yuksel & Ozgor, 2020), satisfaction (Cocci et al., 2020), and function (Fuchs et al., 2020; Schiavi et al., 2020), as well as increases in sexual distress (Schiavi et al., 2020). Some of these negative outcomes appear to be related to stress and worry (Ballester-Arnal et al., 2021; Panzeri et al., 2020).

Although the results described thus far seem to suggest that there may be an overall decline in aspects of sexuality due to the pandemic, some studies have indicated that a large

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proportion of participants report no changes to their sexual frequency (Arafat et al., 2020; Ko et al., 2020; Panzeri et al., 2020) or quality (Ko et al., 2020; Lehmiller et al., 2021). Indeed, some studies have even reported positive sexual outcomes during the pandemic. For example, in Arafat et al.'s (2020) study, 50% of participants reported positive changes in their sex lives, Yuksel and Ozgor (2020) reported significantly higher levels of sexual desire and intercourse frequency (in two independent samples of women), Mahanty et al. (2021) noted reports of increased sexual frequency in women, and Li et al. (2020b) reported increases in masturbation frequency. In addition, in Lehmiller et al.'s (2021) study, almost 14% of the sample reported that their sex lives had improved, with one in five participants stating that they had added new activities to their repertoire of sexual behaviors.

Relationship factors may play a role in some of the observed changes in sexual and other outcomes over the course of the pandemic. Although discourses on relationship satisfaction have emerged in the popular media (e.g., increases in divorce rates, e.g., Stevenson, 2020; increased conflict, e.g., Bielski, 2020; Moss, 2020), there has been little scientific research on this topic. Pietromonaco and Overall (2021) developed a conceptual framework based on the vulnerability-stress-adaptation (VSA) model (Karney & Bradbury, 1995) in order to describe how the COVID-19 pandemic was likely to impact couples' relationships. This model posits that external stressors caused by the pandemic (including economic insecurity and social isolation) will likely lead to negative impacts to adaptive dyadic relationship processes (such as affection and shared activities). These disruptions will in turn impact relationship quality and stability. Importantly, many of these model paths are bidirectional; couples with less positive dyadic relationship processes will be less able to manage external stressors, and relationship quality will likewise impact relationship processes. Pre-existing contextual vulnerabilities (such as age and social class), as well as individual vulnerabilities (such as attachment style and mental health), also moderate the components of the model.

Relationship satisfaction may be particularly important to consider, as relationship quality has been associated with physical, mental, and sexual health outcomes during the COVID-19 pandemic and more generally. For example, during the COVID-19 pandemic, Rodrigues and Martins (2020) found that relationship satisfaction and intimacy were positively associated with perceived physical health. Furthermore, Pieh et al. (2020) reported that people who rated their relationship quality as good fared significantly better in terms of their mental health during the pandemic than those who reported poor relationship quality and those who were not in a relationship. Luetke et al. (2020) also found that one-third of their sample (34%) reported some degree of COVID-19-related conflict with their partners, with those experiencing more frequent conflict being more likely to report decreased

frequencies of solitary and partnered sexual and intimacy behaviors, underscoring the importance of assessing relationship quality when considering aspects of sexuality.

Stress and other variables related to mental health (e.g., anxiety) can also play a role in one's sexuality. Declines in sexual health and well-being during COVID-19 may potentially be related to increases in stress and mental health concerns that have occurred during this time (Xiong et al., 2020). Indeed, Ballester-Arnal et al. (2021) found that "worries" and "stress" were the top two reasons for lower sexual frequency in their sample and that more women than men endorsed stress as a reason for this lower frequency during the COVID-19 pandemic. Individuals in this study with higher levels of stress also reported worse outcomes in terms of their sexual lives than those with lower levels of stress. These results speak to the association between mental health and sexual outcomes.

The research to date in the areas of sexual and relationship adjustment to the COVID-19 pandemic and resulting restrictions has contributed much valuable and unique information to the literature and has allowed for snapshots of behaviors in specific countries (e.g., Austria, Pieh et al., 2020; Italy, Cocci et al., 2020; Schiavi et al., 2020; Portugal, Rodrigues & Martins, 2020) as well as multinationally (e.g., Lehmiller et al., 2021) during an unprecedented time. This research, however, sampled participants over a period of a few to several weeks mostly during the initial lockdown orders, which provides a limited, short-term view into sexuality and relationship adjustment in response to an initial, urgent situation. There is currently no information regarding sexual and relationship outcomes in the longer term, when the situation becomes prolonged and further adjustments are made. However, it is possible that people can adapt to their circumstances and adjust to a "new normal" as demonstrated by a study indicating that at a three-month follow-up during the pandemic, people reported less distress than they did initially (Slatcher et al., 2020). Although some people may habituate, life event research has exemplified the cumulative effects of stress (Andrade, 2020). The implication of such findings is that the unavoidable stresses associated with the COVID-19 pandemic may result in a cumulative negative effect, with some populations being disproportionately impacted. For example, in addition to the general stress of the pandemic, the toxic stress of poverty, racism, unemployment, and discrimination faced by communities of color are being magnified during the COVID-19 pandemic (Fortuna et al., 2020).

The present study, therefore, contributes a longitudinal examination of sexuality and relationship outcomes collected over the following time points: (1) a retrospective reporting of pre-COVID functioning on certain measures collected in May to June 2020 (retrospective Baseline); (2) current sexual and relationship functioning in May to June 2020, two months after the start of the pandemic in North

America (Time 1); and (3) sexual and relationship functioning in August to November 2020, approximately 6 months following the start of the pandemic in North America (Time 2). The main research question was: How do aspects of sexual well-being, sexual functioning, and relationship satisfaction change over time from pre-pandemic to 6 months following the initial lockdown period? By including multiple time points, the current study will allow us to extend research from the initial lockdown period to examine how sexual and relational outcomes change or remain stable over the course of the pandemic.

Method

Participants

Individuals were recruited via social media (e.g., Facebook, Instagram, and Twitter) and through paid advertisements on Facebook to participate in the first time point of an online study called "An investigation into sexual well-being and relationship satisfaction during physical distancing (COVID-19)." Participants were asked at the end of the Time 1 survey if they would like to participate in future time points of this study. Participants who consented to future time points were asked to provide their email address and were sent a link to participate in Time 2 approximately 3 months after completing Time 1.

Data were collected from May to June 2020 (Time 1, which included Time 1 measures and retrospective baseline measures of pre-COVID-19 sexual and relationship well-being) and 3 months later (end of August to beginning of November 2020; Time 2). Eligible participants were at least 18 years of age, fluent in English, and comfortable answering questions about sexual functioning, masturbation, pornography use, and COVID-19. A total of 527 participants met eligibility criteria and completed Time 1. Of those participants, 487 also provided their email addresses to participate in Time 2, resulting in a final sample size of 316 participants who completed both the Time 1 and Time 2 surveys.

Participants' demographic characteristics are presented in Table 1. The average age of participants was 30.2 years old (SD = 10.3, range: 18–81, $n = 316$), and the majority of participants were in a relationship ($n = 233$, 73.7%) and located in Canada at the time of participation ($n = 203$, 64.2%).

Measures

The online survey was administered through Qualtrics survey software (Qualtrics, Provo, UT). The survey included a combination of adapted and validated measures as well as researcher-generated items. Reliability values for the sample for each measure were calculated with Omega Total (ω_{total}), which can be interpreted using the same cutoffs as Cronbach's

Table 1 Summary of demographic characteristics

Variable	$N = 316\ n$ (%)
Age (M (SD))	30.16 (10.32)
Ethnicity	
Asian	24 (7.59)
Black	5 (1.58)
Hispanic	19 (6.01)
Indigenous	8 (2.53)
Middle Eastern	5 (1.58)
White	275 (87.03)
Other (e.g., biracial)	5 (1.58)
Current country of residence	
Australia	3 (0.95)
Canada	202 (63.92)
European Country	12 (3.80)
Latin American Country	5 (1.58)
Southeast Asian country	4 (1.27)
UK	8 (2.53)
USA	78 (24.68)
Other (South Africa, Israel, New Zealand, United Arab Emirates)	4 (1.27)
Birthplace	
Africa/Middle East	2 (0.63)
Asia/China/India	14 (4.43)
Australia/Oceania/Pacific Islands	5 (1.58)
Canada	178 (56.33)
Europe	23 (7.28)
Latin/South America	9 (2.85)
USA	85 (26.90)
Educational background	
Grade school	3 (0.95)
High school	19 (6.01)
Post-high school (e.g., university)	294 (93.04)
Occupational information	
Status	
Employed	182 (57.59)
Retired	7 (2.22)
Student	100 (31.65)
Unemployed	43 (13.61)
Other (e.g., homemaker)	30 (9.49)
Status changed since COVID-19	89 (28.16)
Income	
0–$29,999	86 (27.22)
$30,000–$59,999	64 (20.25)
$60,000–$89,999	51 (16.14)
$90,000–$119,999	47 (14.87)
$120,000 and over	44 (13.92)
Gender Identity	
Man (unspecified)[a]	92 (29.11)
Nonbinary	26 (8.23)
Trans man	2 (0.63)
Woman (unspecified)[a]	191 (60.44)

Table 1 (continued)

Variable	$N=316$ n (%)
Other (e.g., agender, questioning)	3 (0.95)
Sex assigned at birth	
Intersex	1 (0.32)
Male	97 (30.70)
Female	216 (68.35)
Intersex	1 (0.32)
Sexual orientation	
Asexual	3 (0.95)
Bisexual	90 (28.48)
Gay/Lesbian	25 (7.91)
Heterosexual	153 (48.42)
Queer	34 (10.76)
Other (e.g., pansexual)	11 (3.48)
Relationship information	
In a relationship	233 (73.73)
Status	
Committed/married	185 (58.54)
Divorced/widower	9 (2.85)
Single	98 (31.01)
Other (e.g., polyamorous)	35 (11.08)
Status changed since COVID-19	27 (8.54)
Living situation information	
Status	
Alone	43 (13.61)
With a partner, no kids	92 (29.11)
With a partner and kids	53 (16.77)
With family members	104 (32.91)
With roommate(s)	38 (12.03)
With others as a caregiver	2 (0.63)
Other (e.g., with kids only)	7 (2.22)
Status changed since COVID-19	70 (22.15)

Due to missing data, rounding, and multiple response options, not all percentages add up to 100

[a]These individuals did not specify whether they were cis or trans. Of these individuals, 91 of the men were assigned boy at birth, 1 of the men was assigned girl at birth, 1 of the women was assigned boy at birth, 190 of the women were assigned girl at birth

alpha, such that values above 0.70 are considered acceptable (Cortina, 1993).

Demographics

Participants completed a demographics questionnaire, which included questions regarding age, racial and ethnic background, education, occupational status, changes to occupational status since COVID-19, income, changes to income since COVID-19, sexual orientation, gender identity, sex assigned at birth, relationship status, changes to relationship status since COVID-19, current living situation, and changes

to living situation since COVID-19. Participants were also given the opportunity to opt in or out of questions related to sexual functioning and masturbation; however all participants who completed the study opted in. Participants were then asked to select between answering sexual functioning questionnaires specific to vulvas/vaginas or penises/testes.

Sexual Pleasure

Participants completed the Sexual Pleasure Scale (SPS; Pascoal et al., 2016) three times; twice at Time 1: once in reference to their sex life since physical distancing due to COVID-19, and once with regard to their sex life before physical distancing due to COVID-19 (i.e., retrospective Baseline), and then at Time 2, participants responded in reference to their sex life since the Time 1 survey. The scale consists of three items, and participants indicated the extent to which they find sexual intercourse, sexual activities, and sexual intimacy pleasurable on a 7-point scale from 1 (*Not pleasurable*) to 7 (*Very pleasurable*). Item scores were summed to create a total score, which could range from 3 to 21, with higher scores indicating greater sexual pleasure. The SPS has demonstrated good internal consistency in both community and clinical samples, and significant positive correlations with measures of sexual functioning and satisfaction (Pascoal et al., 2016). In the current sample, ω_{total} coefficient was 0.80 at retrospective Baseline, 0.82 at Time 1, and 0.83 at Time 2.

Orgasm Frequency (Partnered and Solitary)

For this study, we adapted the Female Orgasm Scale (McIntyre-Smith & Fisher, 2011) to be applicable to participants of all gender/sexes, and to include items on solitary sexual activity. Participants completed the Female Orgasm Scale three times; twice at Time 1: once in reference to their experiences since physical distancing due to COVID-19, and once with regard to their sex life before physical distancing due to COVID-19 (i.e., retrospective Baseline). At Time 2, participants responded in reference to their experiences since the Time 1 survey. Although the full scale consists of six items, for the present study, we used only two items: frequency of orgasm with a partner, and frequency of orgasm during masturbation. Participants rated orgasm frequency on an 11-point scale from 0 to 100%; a *Does not apply* response option was also presented.

Sexual Functioning

Participants completed either the International Index of Erectile Functioning (IIEF; Rosen et al., 1997) or the Female Sexual Function Index (FSFI; Rosen et al., 2000), based on their choice as indicated in the demographics questionnaire. Participants completed the IIEF/FSFI twice, once at Time

1 (no retrospective baseline) and once at Time 2. The IIEF consists of 15 items across five domains: Erectile Function, Orgasmic Function, Sexual Desire, Intercourse Satisfaction, and Overall Satisfaction. Items were rated on a scale from 0 to 5, with scale anchors varying depending on the question. Item scores were summed to create domain and total scores; the maximum possible total score is 75, and higher scores indicate better sexual functioning. The IIEF full scale and domains have demonstrated good internal consistency, and significant, positive correlations with independent clinician ratings of sexual functioning (Rosen et al., 1997). In the current sample, at Time 1, ω_{total} coefficient was 0.91 for the full scale, and 0.88 (Erectile Function), 0.50 (Orgasmic Function), 0.71 (Sexual Desire), 0.87 (Intercourse Satisfaction), and 0.74 (Overall Satisfaction) for each of the respective subscales. At Time 2, ω_{total} coefficient was 0.91 for the full scale, and 0.85 (Erectile Function), 0.47 (Orgasmic Function), 0.69 (Sexual Desire), 0.87 (Intercourse Satisfaction), and 0.75 (Overall Satisfaction) for the respective subscales.

The FSFI consists of 19 items across six domains: Desire, Arousal, Lubrication, Orgasm, Satisfaction, and Pain. Items were rated on a scale from 0 to 5, with scale anchors varying depending on the question. Item scores were summed and then multiplied by domain-specific factors to create domain scores; a total score was computed by summing the domain scores. Scores could range from 2 to 36, with higher scores indicating better sexual functioning. The FSFI full scale and domains have demonstrated good internal consistency (Rosen et al., 2000). In the current sample, at Time 1, ω_{total} coefficient was 0.95 for the full scale, and 0.74 (Desire), 0.91 (Arousal and Lubrication), 0.85 (Orgasm), 0.84 (Satisfaction), and 0.89 (Pain) for each of the respective subscales. At Time 2, ω_{total} coefficient was 0.95 for the full scale, and 0.74 (Desire), 0.91 (Arousal and Lubrication), 0.86 (Orgasm), 0.84 (Satisfaction), and 0.89 (Pain) for each of the respective subscales.

Sexual Distress

Participants completed the Sexual Distress Scale-Short Form (SDS-SF; Santos-Iglesias et al., 2020) in order to assess distress related to sexual problems. The scale consists of 5 items, and participants rated the frequency that they have felt the experience listed for each item (e.g., distressed about your sex life, frustrated by your sexual problems) on a scale from 0 (*Never*) to 4 (*Always*). Participants completed the SDF-SF three times; twice at Time 1: once in reference to their sex life since physical distancing due to COVID-19, and once with regard to their experiences before physical distancing due to COVID-19 (i.e., retrospective Baseline), and then at Time 2, participants responded in reference to their experiences since the Time 1 survey. Item scores were summed to create a total score, with higher scores indicating greater sexual distress.

This scale has demonstrated excellent internal consistency in men and women, as well as a significant, positive correlation with sexual bother, and a significant, negative correlation with sexual satisfaction (Santos-Iglesias et al., 2020). In the present sample, ω_{total} coefficient was 0.89 at retrospective Baseline, and 0.87 at Time 1 and Time 2.

Relationship Satisfaction

Participants completed the Relationship Assessment Scale (RAS; Hendrick, 1988), a measure of relationship satisfaction three times. At Time 1, they completed the RAS twice: once in reference to before physical distancing due to COVID-19 (i.e., retrospective Baseline), and again since physical distancing. At Time 2, they completed the RAS in reference to the time period since completing the Time 1 survey. This scale consists of 7 items (e.g., how well does your partner meet your needs, how good is your relationship), each rated on 5-point scales with varying anchors. Two items were reverse-coded, and item scores were summed to create a total score. Scores could range from 7 to 35, with higher scores indicating greater relationship satisfaction. The items of the RAS have been shown to correlate with other relationship measures, and the scale has demonstrated good internal consistency (Hendrick, 1988). In the present sample, ω_{total} coefficient was 0.87 at retrospective Baseline, and 0.88 at both Time 1 and Time 2.

Procedure

To recruit participants for the Time 1 survey, we posted a link to the study on our research social media pages (Twitter, Facebook, and Instagram) and had two paid Facebook advertisements ($200 each): one for individuals living in Canada and the other for individuals living in the USA. Both ads had the same target demographic settings for age (18–65 +), gender (all genders), and languages (all languages). Participants accessed the combined letter of information and informed consent through clicking on the online survey link. After providing their informed consent, participants were asked questions to determine eligibility. Eligible individuals proceeded to the full survey, which took approximately 45 min to complete. Upon completion of the survey, participants were provided with the option to sign up for Time 2 of this study and were provided with a debriefing letter. After the debriefing, participants were redirected to a separate survey link where they could provide an email address for interest in future studies, results of this study, and/or entry for a chance to win one of 25 prize draws of $50 CAD Amazon gift cards.

For the Time 2 survey, participants were emailed the online survey link directly via the email address provided in Time 1. The procedures mirrored Time 1 of this study; after the debriefing, participants were given the option to sign up

for Time 3 (data not included in the present manuscript) of this study and provide an email address for a chance to win one of 50 prize draws of $50 CAD Amazon gift cards, plus an additional chance to win one of 5 gift cards of $100 CAD each.

Results

Data Analysis

Analyses of variance (ANOVAs) were conducted to determine whether participants who completed both Time 1 and Time 2 differed on the outcome variables from individuals who did not complete all components. There were no statistically significant differences on any of the dependent variables across the three groups of participants: participants who completed Time 1 and opted out of Time 2, participants who completed Time 1 and opted in but did not complete Time 2, and participants who completed both Time 1 and Time 2. Participants who did not meet eligibility criteria or who completed less than 20% of the survey were removed from the dataset. For each analysis, individuals who were missing responses to more than 10% of the items on any of the relevant questionnaires were excluded. For participants with less than 10% of missing data, missing values were replaced with the individual's mean response on that questionnaire.

Examination of skewness and kurtosis values; visual inspection of histograms, stem-and-leaf plots, and Q-Q plots; and Shapiro–Wilk tests of normality indicated that the data were not normally distributed. Therefore, analyses were conducted both with and without square-root transformations to transform the data into a normal distribution. As the pattern of results from the untransformed data was not different from the transformed results, the untransformed results are presented below for ease of interpretation.

Exploratory analyses examined demographic characteristics, relationship satisfaction, and COVID-19-related stressors as predictors of changes in sexual health. Two-stage hierarchical multiple regressions predicting sexual pleasure at Time 1 and Time 2 indicated that greater relationship satisfaction was related to greater sexual pleasure at Time 1 and Time 2, less perceived stress was related to greater sexual pleasure in the Time 1 model, and men were more likely to report greater sexual pleasure in the Time 2 model. Time 1 and Time 2 models predicting orgasm frequency with a partner indicated that the relationship between these variables differed across the time points; additional analyses revealed that greater relationship satisfaction and lower perceived stress were related to less sexual distress at Time 1 and Time 2 and that greater relationship satisfaction at both time points was associated

with higher sexual functioning scores. However, these analyses were exploratory and were not the focus of this study; therefore, they are not discussed further (see Supplementary Materials for more details).

Changes in sexual well-being, sexual functioning, and relationship satisfaction were examined by comparing across time points using repeated measures ANOVA (RM ANOVAs) with Bonferroni corrections for follow-up pairwise comparisons when comparing across retrospective baseline, Time 1, and Time 2 (sexual well-being and relationship satisfaction), and t-tests when comparing only between Time 1 and Time 2 (sexual functioning), such that the observed p values were multiplied by three to account for the three comparisons ($p = .0167$). When comparing only between Time 1 and Time 2 (sexual functioning), t-tests were calculated ($p = .025$). RM ANOVAs and follow-up pairwise comparisons and regressions were conducted using SPSS (Version 26), and Cohen's d effect sizes for all pairwise comparisons were calculated with an effect size calculator developed by Uanhoro (2017). We additionally conducted mixed model ANOVAs to assess whether our pattern results were moderated by gender (cis/trans man, cis/trans woman, and non-binary) or relationship status (single, in a relationship). Interested readers can see the supplemental materials for exploratory two-stage hierarchical multiple regressions which were conducted to examine whether demographic characteristics (age, gender, sexual orientation, children in household), relationship satisfaction, and stressors during COVID-19 (fear of COVID-19, economic stress related to COVID-19, general perceived stress) were significantly related to outcome variables. We also conducted equivalence tests in R (R Core Team, 2020) using the TOSTER package (Lakens, 2017) to evaluate whether the scores were statistically equivalent across time points (i.e., the difference across time points is smaller than what is considered meaningful). As a standard deviation of 0.5 is considered to be the minimally important difference in health outcomes (Norman et al., 2003), we set the smallest effect size of interest (SESOI) to 0.5 for the Test of Statistical Equivalence (TOST). We also provide the results with a SESOI of 0.3, as this smaller effect size may be of interest to some social scientists even though it is unlikely to be clinically meaningful.

As post hoc power analyses are generally not advised (e.g., Lakens, 2021), we do not report the observed power for our analyses; however, we conducted an a priori within-factors power analysis with the correlation between repeated measures set to 0.5 using G*Power 3.1.9.7 (Faul et al., 2009); to aim for 80%, 85%, 90%, and 95% power, we would have required a sample size of $n = 163, 184, 213,$ and 259, respectively, to detect a small effect ($f = 0.10$), and a sample size of $n = 28, 31, 36,$ and 43, respectively, to detect a medium effect size ($f = 0.25$).

Sexual Functioning, Sexual Well-Being, and Relationship Satisfaction Changes During COVID-19

Differences in Sexual Well-Being and Relationship Satisfaction Across Retrospective Baseline, Time 1, and Time 2

Null Hypothesis Significance Tests Significant differences were found across the time-points in sexual pleasure ($p = .044$), frequency of orgasms with a partner ($p = .03$), and frequency of solitary orgasms ($p = .03$; see Table 2 for full results of the RM ANOVAs and pairwise comparisons). There were no statistically significant differences across the time points in sexual distress ($p = .10$) or relationship satisfaction ($p = .38$). Pairwise follow-up comparisons indicated that participants reported significantly higher sexual pleasure scores at retrospective pre-COVID-19 baseline than at Time 1, $t(201) = 2.43$, $p = .048$. Participants also reported significantly greater fre-

quency of orgasms with partners, $t(194) = 3.13$, $p = .006$, and during solitary masturbation, $t(276) = 3.88$, $p < .001$, at retrospective baseline than at Time 1. Effect sizes (Cohen's d) for all pairwise comparisons with 95% confidence intervals are presented in Fig. 1. Confidence intervals (error bars) that do not span zero indicate a statistically significant test result at $p < .05$ (two-tailed). None of the above-mentioned effects were significantly moderated by gender or relationship status.

Tests of Statistical Equivalence The TOST results are presented in Table 3.

When evaluated against an SESOI of 0.5 (the minimally important difference for healthcare outcomes), sexual well-being and relationship satisfaction were statistically equivalent across time points (i.e., the TOST confidence interval did not go beyond the SESOI confidence interval). Measures of sexual well-being and relationship satisfaction were also statistically equivalent across all time points when evaluated with an SESOI of 0.3 with the exception for solitary orgasms

Table 2 Results from 5 repeated measures ANOVAs and 13 paired samples t-tests examining changes in sexual well-being and relationship satisfaction across time points

Measure	Descriptives				RM ANOVAs results			
	N	Baseline M (SD)	Time 1 M (SD)	Time 2 M (SD)	Mauchly's W	F	df	η^2
Pleasure	**202**	**18.63 (3.42)**[a]	**18.03 (3.80)**[a]	**18.23 (3.64)**	**.99**	**3.17***	**2, 402**	**.016**
Orgasm								
With partner	**195**	**73.44 (30.00)**[a]	**68.77 (34.78)**[a]	**71.49 (32.29)**	**.91***	**3.66***	**1.84, 356.14**	**.019**
Solitary	**277**	**89.46 (21.44)**[a]	**86.46 (24.04)**[a]	**87.47 (22.68)**	**.76***	**4.08***	**1.61, 445.34**	**.02**
Sexual distress	297	6.60 (4.97)	7.04 (4.96)	6.65 (4.59)	.84**	0.93	1.73, 331.50	.005
Relationship satisfaction	193	29.13 (5.40)	29.14 (5.40)	28.83 (5.40)	.96**	2.34	35.30, 567.59	.008
	Descriptives				t-test results			
	N	Baseline M (SD)	Time 1 M (SD)	Time 2 M (SD)		t	df	Cohen's d
Sexual functioning								
IIEF[1] total score	73	–	56.19 (16.27)	57.79 (13.84)	–	− 1.079	72	− 0.13
Erectile function	71	–	24.80 (7.66)	25.93 (6.24)	–	− 1.44	70	− 0.17
Orgasmic function	96	–	8.07 (2.61)	7.97 (2.50)	–	0.35	95	0.04
Sexual desire	96	–	8.14 (1.75)	8.21 (1.78)	–	− 0.45	95	− 0.05
Intercourse satisfaction	96	–	7.26 (5.94)	7.64 (5.63)	–	− 0.94	95	− 0.10
Overall satisfaction	68	–	6.85 (2.64)	6.74 (2.58)	–	0.41	64	0.05
FSFI[1] total score	**189**	–	**23.05 (9.62)**[a]	**24.40 (9.24)**[a]	–	**− 1.35***	**188**	**− 0.14**
Desire	205	–	3.75 (1.37)	3.79 (1.35)	–	− 0.44	204	− 0.03
Arousal	204	–	4.05 (1.92)	4.22 (1.86)	–	− 1.32	203	− 0.09
Lubrication	**199**	–	**4.33 (2.07)**[a]	**4.62 (1.92)**[a]	–	**− 2.03***	**198**	**− 0.14**
Orgasm	204	–	4.01 (1.99)	4.05 (1.89)	–	− 0.29	203	− 0.02
Satisfaction	**199**	–	**3.18 (2.17)**[a]	**3.58 (2.12)**[a]	–	**− 2.76***	**198**	**− 0.20**
Pain	205	–	3.66 (2.61)	3.95 (2.44)	–	− 1.77	204	− 0.12

Bold values indicate statistically significant

IIEF the International Index of Erectile Functioning, *FSFI* the Female Sexual Function Index

*$p < .05$, **$p < .001$ two tailed. Entries with the same superscript differ statistically

[1]Data for the IIEF and FSFI were only collected for Time 1 and Time 2
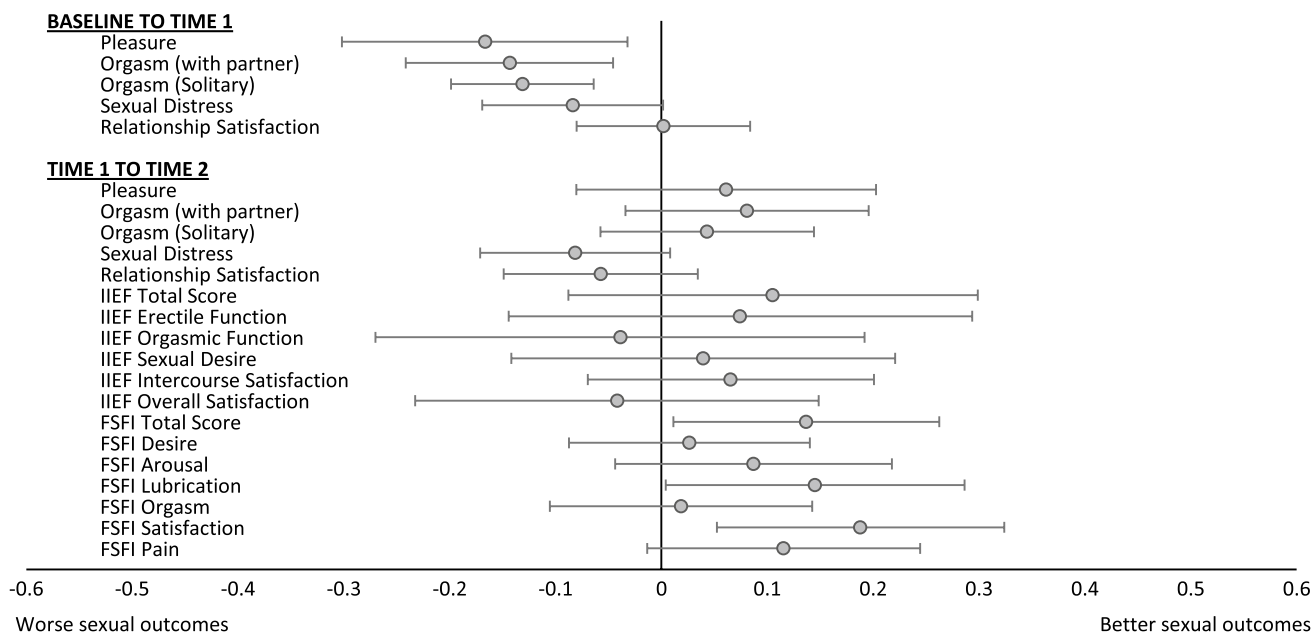
Fig. 1 Effect sizes for all *t*-tests comparisons for changes in sexual outcomes over time. *Note*: Scores to the right of the figure represent positive changes in sexual outcomes between time points, scores to the left of the figure represent negative changes in sexual outcomes between time points. 95% confidence intervals (error bars) that do not span or include zero indicate a statistically significant test result at *p* < .05 (two-tailed)

and partnered orgasms which were not statistically equivalent and increased from baseline to Time 1.

Differences in Sexual Functioning Between Time 1 and Time 2

Null Hypothesis Significance Tests Differences in sexual functioning between Time 1 and Time 2 were observed for individuals with vulvas but not for those with penises (see Table 2). Specifically, overall self-reported sexual functioning (FSFI total scores), lubrication, and satisfaction significantly improved between Time 1 and Time 2 surveys. Effect sizes for all *t*-tests comparisons are presented in Fig. 1.

Tests of Statistical Equivalence All domains of sexual functioning were statistically equivalent with an SESOI of 0.3 and 0.5; see Table 3 for full TOST comparisons.

Discussion

The current study used a longitudinal design to understand how aspects of sexual well-being, sexual functioning, and relationship satisfaction have changed during the COVID-19 pandemic across retrospective baseline, Time 1 (May–June 2020), and Time 2 (August–November 2020). There was an overall pattern of slight decreases in sexual well-being factors between retrospective baseline (pre-COVID-19) to Time 1; however, few significant differences in sexual outcomes were observed between Time 1 and Time 2. The effect sizes for these observed differences were all trivial in magnitude. Indeed, results of the equivalence testing indicated that all aspects of sexual well-being were statistically equivalent when compared to the threshold for what would be considered minimally important differences in health-related quality of life measures (see Norman et al., 2003 for a review), meaning that changes are likely to be too small to be of interest to clinicians or require intervention. Furthermore, except for solitary and partnered orgasms, sexual well-being factors were also statistically equivalent when compared to a small effect size threshold (*d* = 0.3), meaning these changes are also unlikely to be considered substantial to social scientists. No differences in relationship satisfaction were observed across any of the time points.

Changes in Sexual Well-Being, Sexual Functioning, and Relationship Satisfaction

Overall, there was a slight decrease in sexual well-being factors from retrospective baseline to Time 1. Specifically, there were trivial decreases (Cohen's *d* range = 0.13–17) in self-reported sexual pleasure, frequency of orgasms with a partner, and frequency of solitary orgasms from retrospective baseline to Time 1, with no significant differences in sexual distress. There were no statistically significant differences in sexual well-being factors between Time 1 and Time 2. When

Table 3 Results from test of statistical equivalence sexual well-being and relationship satisfaction across time points

Variable	Comparison	SESOI		TOST 90% CI	TOST Sig	
		|0.3|	|0.5|		SESOI 0.3	SESOI 0.5
Sexual pleasure	Baseline–Time 1	1.05	1.75	[0.20, 1.01]	Y	Y
	Time 1–Time 2	1.02	1.70	[−0.60, 0.20]	Y	Y
Orgasm self	Baseline–Time 1	3.84	6.39	[1.73, 4.26]	N	Y
	Time 1–Time 2	6.16	10.27	[−3.05, 1.03]	Y	Y
Orgasm partner	Baseline–Time 1	6.73	11.21	[2.01, 7.32]	N	Y
	Time 1–Time 2	8.14	13.57	[−5.93, 0.49]	Y	Y
Sexual distress	Baseline–Time 1	1.09	1.81	[−0.80, −0.10]	Y	Y
	Time 1–Time 2	1.13	1.88	[0.03, 0.75]	Y	Y
Relationship satisfaction	Baseline–Time 1	0.94	1.57	[−0.31, 0.30]	Y	Y
	Time 1–Time 2	1.05	1.75	[−0.02, 0.65]	Y	Y
IIEF total score	Time 1–Time 2	3.81	6.34	[−4.08, 0.87]	Y	Y
IIEF erectile function	Time 1–Time 2	1.98	3.30	[−2.43, 0.18]	Y	Y
IIEF orgasmic function	Time 1–Time 2	0.89	1.48	[−.40, 0.60]	Y	Y
IIEF sexual desire	Time 1–Time 2	0.48	0.80	[−0.34, 0.20]	Y	Y
IIEF intercourse satisfaction	Time 1–Time 2	1.17	1.95	[−1.04, 0.29]	Y	Y
IIEF overall satisfaction	Time 1–Time 2	0.63	1.05	[−0.33, 0.54]	Y	Y
FSFI total score	Time 1–Time 2	2.51	4.18	[−2.36, −0.35]	Y	Y
FSFI desire	Time 1–Time 2	0.34	0.57	[−0.17, 0.09]	Y	Y
FSFI arousal	Time 1–Time 2	0.54	0.90	[−0.38, 0.04]	Y	Y
FSFI lubricant	Time 1–Time 2	0.61	1.01	[−0.52, −0.05]	Y	Y
FSFI orgasm	Time 1–Time 2	0.53	0.88	[−0.24, 0.16]	Y	Y
FSFI satisfaction	Time 1–Time 2	0.62	1.04	[−0.64, −0.16]	Y	Y
FSFI pain	Time 1–Time 2	0.71	1.19	−0.56, −0.02]	Y	Y

Test of statistical equivalence 90% confidence intervals (TOST 90% CI) that are within the bounds of the SESOI regions are considered statistically equivalent

IIEF the International Index of Erectile Functioning, *FSFI* the Female Sexual Function Index

compared to a threshold of what changes would constitute a meaningful health change, measures of sexual well-being were statistically equivalent across all time points. When examining changes in sexual functioning between Time 1 and Time 2, there was an improvement in sexual functioning for individuals with vulvas (i.e., those who responded to the FSFI a measure of sexual functioning for individuals with vulvas) between Time 1 and Time 2 such that there were trivial increases in overall sexual functioning, lubrication, and sexual satisfaction (Cohen's *d* range = 0.14–0.19). Sexual functioning did not improve between Time 1 and 2 for individuals with penises (i.e., those who responded to the IIEF a measure of sexual functioning for individuals with penises). Sexual functioning for both individuals with vulvas and penises, however, did not change in a clinically impactful way between Time 1 and Time 2.

As the majority of the individuals with vulvas identify as women, it is also possible that for these individuals, the differences reflect gender differences in the stressors or roles for women during the pandemic. The closures of schools, for example, may have a disproportional increased care burden for these individuals (e.g., Czymara et al., 2021; Gabster

et al., 2020; Power, 2020). These differences in overall mental health and wellness may have impacted these individuals' sexual functioning to a greater extent from baseline to Time 1 (e.g., during initial school closures), and thus, we may be more likely to detect changes from Time 1 to Time 2 due to there being a greater 'recovery range'. Although we do not have retrospective baseline measures of mental health and wellness and are unable to directly assess how changes in sexual functioning for individuals with vulvas compare to pre-COVID-19 levels, our samples' mean sexual functioning levels are lower than control sample scores in the literature ($M = 30.5$; Rosen et al., 2000). Our samples' mean sexual dysfunction scores ($M_{\text{Time1}} = 23.05$, $M_{\text{Time2}} = 24.40$) fell below the clinical cutoff for female sexual dysfunction of 26 (Wiegel et al., 2005) on the FSFI. However, when individuals who indicated 'no sexual activity' (a response of zero) to the FSFI were excluded, the means at Time 1 and Time 2 ($M_{\text{Time1}} = 27.96$, $M_{\text{Time2}} = 28.10$) were no longer below the clinical cutoff, thus suggesting that a lack of sexual activity, which is conceptually different from sexual functioning (Meyer-Bahlburg & Dolezal, 2007), may be underestimating sexual functioning. Due to social determinants of health and

restricted access to healthcare, individuals with trans experience (e.g., individuals with vulvas who identify as men, nonbinary, or agender) have been more impacted by mental health challenges than individuals with cis experience during the COVID-19 pandemic (Hawke et al., 2021), which in turn may have impacted their sexual health.

When examining the overall pattern of effect sizes (Fig. 1) for sexual well-being and sexual functioning, we see an overall trend of minute decreases in sexual well-being between retrospective baseline and Time 1 and movement toward recovery of sexual wellness between Time 1 and Time 2 (although this difference was not statistically significant). Given the timing of our Time 2 (pre- to early second wave of the pandemic in Canada, where the majority of our participants resided), it is possible that participants were moving toward an adjustment period of "the new normal". Future time points will allow us to examine whether this movement toward recovery does or does not become statistically significant, or whether sexuality will be responsive to fluctuations in stress due to, for example, the re-introduction of restrictions and stressors with rising case numbers in December 2020.

There were no statistically significant differences in relationship satisfaction across time points. This maintenance of relationship satisfaction is encouraging given that relationship and sexual satisfaction tend to be highly correlated (Fallis et al., 2016; Quinn-Nilas, 2020; Vowels & Mark, 2020). The lack of significant changes in relationship satisfaction from pre-COVID, however, is contradictory to popular media reports documenting declines in relationships (e.g., Watts, 2020) and increased filings for divorce (Prasso, 2020), as well as a recent conceptual framework (Pietromonaco & Overall, 2021) and empirical findings of increased relationship difficulties following COVID-19 lockdowns (Luetke et al., 2020). It is possible that our sample may represent regional differences, or other demographic differences between the samples. For example, the number of COVID-19 cases, lockdown and mitigation measures, provision of financial support, and other pandemic related factors/circumstances differed greatly across (and within) nations (with the majority of the present sample being located in Canada at the time of participation, compared to Li et al., 2020a, 2020b and Luetke et al., 2020 who recruited only individuals from China and the USA, respectively). Therefore, it is possible that differences in pandemic contextual factors between Canada and other nations may be connected to the observed maintenance of relationship satisfaction in the present sample, as compared to the declines previously documented in samples from other nations.

Furthermore, differences in average age across samples may connect to other contextual factors, including differences in relationship satisfaction and relationship challenges and decline across samples/studies given that patterns in relationship satisfaction have been observed to fluctuate across the lifespan (Fincham et al., 2018; Lavner & Bradbury, 2010; Lavner et al., 2014; Meyer et al., 2016). The present study observed a mean age of 30.2 years (range of 18–81 years), compared to a mean age of 26.6 years in Li et al., 2020a, 2020b (range = 16–35), as well as a relatively older sample in Luetke et al., 2020 (mean age not reported, range of 18 to 94 years).

A majority of participants (73%) in the younger sample observed by Li et al., (2020a, 2020b) also endorsed being students and living with their parents during the pandemic, compared to approximately one-third of participants being students and approximately 58% being employed in the present sample. In the present sample, approximately 30% of participants endorsed living with family, and 46% endorsed living with a partner (with or without children). As such, differences in living situation, as well as differences across the contexts of being employed versus being a student, may also be relevant to maintenance versus decline of relationship functioning and satisfaction. Stress connected to sudden life transitions (e.g., elevations in student stress levels during pandemic-related closures and transitions; von Keyserlingk et al., 2021, and increased anxiety and loneliness for students who experienced relocation; Conrad et al., 2021) may be connected to changes, or lack thereof, in relationship quality and satisfaction. Indeed, although the COVID-19 pandemic has been associated with increased mental health concerns across the lifespan, when compared to older cohorts, young adults in the USA (ages 18–24; Czeisler et al., 2020) and Belgium (Glowacz & Schmits, 2020) reported higher rates of anxiety, depression, and uncertainty than any other age cohort.

Overall, the results of this study indicate that sexual health and relational satisfaction remained stable during the COVID-19 pandemic. Collectively, these results highlight the potential resiliency of individuals' sex lives during the COVID-19 pandemic. Future research is needed to identify specific risk and protective sociodemographic factors associated with decline in relationship satisfaction during times of increased stress—such as a pandemic—to better identify couples who may be at risk.

Limitations and Future Directions

As with most online research, the reliance on self-report measures for data collection represents a limitation of the present study as participants may over- or under-represent their responses to survey items (e.g., given the sample is primarily from Canada, participants may over-report sexual functioning and pleasure given the importance placed on these in modern North American society). Furthermore, as participants were asked to retrospectively report on their pre-COVID-19 (approximately 2 months prior) functioning and well-being, retrospective baseline data may not be an accurate measure of participants' functioning and/or well-being

at the time in question. Retrospective recall may be subject to a number of biases (e.g., consistency bias, influence of current context and affect, Colombo et al., 2020; Hipp et al., 2020) that affect the accuracy of the participants' estimation of their pre-COVID-19 sexual functioning and well-being. However, because the present study was undertaken in response to COVID-19, a baseline measurement from this specific sample prior to the start of the pandemic was not possible. Questions were designed to reduce bias by providing participants with a specific time frame to anchor their responses (e.g., before the outbreak of COVID-19; Hipp et al., 2020). Overall, the results may be best thought of as the participants' perceptions of their pre-COVID-19 functioning and well-being.

With regard to participant characteristics, the majority of participants were Canadian, Caucasian, highly educated, and identified as women or men. As such, the results may not generalize to individuals from diverse cultural backgrounds or diverse gender identities. Our sample was also young and sexually healthy, and it is possible that the pattern of results observed would differ for older adults (who may be at higher risk for COVID-19-related complications) and for individuals with pre-existing sexual dysfunctions. In addition, individuals who are experiencing a significant negative impact of COVID-19 on their health, stress, or circumstances may not have volunteered to complete the survey. The heterogeneity of the present sample with regard to current country of residence combined with insufficient cell sizes across countries also does not allow for close inspection of nuances across regions of the world, which may be especially important to consider in the context of the COVID-19 pandemic given different responses to the pandemic across countries and regions, as well as across different regions within countries (for example, differences in case rates and imposed regulations). As such a further limitation of the present study (related to the obtained sample of participants) is that the samples are composed of individuals from different countries which may contribute to variance across each of the time points due to differences across countries in lockdown restrictions over time, differences in the progression and intensity of the pandemic, and other contextual factors at the national level.

In some cases, only specific sections or questions from validated measures were used in the present study, as opposed to the entire measure, which may impact the underlying psychometric properties of the measures.

While the present study faced limitations with regard to power for detecting small effect sizes, a trend of recovery across some domains of sexual well-being began to be apparent from Time 1 to Time 2. As such, continuing to follow these changes over time could assist in further clarifying the nature of this pattern and allow for a more comprehensive analysis of trends in sexual and relational well-being over the course of the pandemic. As the majority of existing research on sexual health during the COVID-19 pandemic has been cross-sectional, the present longitudinal study adds unique information to the body of literature examining changes in sexual and relational well-being during the COVID-19 pandemic. By collecting data across multiple time points following the initial lockdown period, this paper elucidates how sexual health shifts or remains stable across longer pandemic periods.

Conclusion

Overall, a pattern of slight decreases in sexual health-related factors between retrospective baseline (pre-COVID-19) and Time 1 was observed; however, these changes were not practically different health changes. Changes in sexual functioning from Time 1 to Time 2 were only observed for individuals with vulvas. All effect sizes for observed differences across time points were trivial in magnitude and are not of practical significance. No differences in relationship satisfaction were observed across any of the time points. These results of practical equivalence in sexual outcomes highlight the potential resiliency of individuals' sexuality when facing sudden changes in their daily lives. Future research that helps to identify individuals who may be at risk for relationship difficulties or increased stress may allow clinicians to identify individuals who are experiencing worse sexual outcomes during COVID-19.

Declarations

Ethics Approval The research described in this manuscript has been reviewed and approved by the Queen's University Research Ethics Board (GPSYC-985–20).

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