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The Impact of Loosening COVID-19 Restrictions and Live-in Partner Status on Sexual and Mental Health in a Canadian Sample

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ABSTRACT

Objectives: We examined changes in frequency of sexual behaviors, dyadic sexual desire, relationship satisfaction, and COVID-19 stress in Canadians across the pandemic, considering partner status. **Methods:** Participants completed online questionnaires. **Results:** Participants with live-in partners and single participants decreased in dyadic sexual behaviors. In August–September 2020, participants with live-in partners engaged in more dyadic sexual behaviors than single participants. In November 2021, all partnered participants engaged in more dyadic sexual behaviors than single participants. Decreases in COVID-19 stress were observed. **Conclusions:** Findings suggest that despite decreases in COVID-19 stress, there may be long-lasting pandemic impacts on sexual behaviors.

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KEYWORDS

COVID-19; relationship satisfaction; dyadic sexual desire; COVID-19 related stress; partner status; dyadic sexual behavior

Introduction

The declaration of COVID-19 as a global pandemic resulted in the worldwide tightening of public health measures, such as the introduction of social distancing policies that restricted in-person contacts, with only essential services remaining open in some countries (Ayouni et al., 2021). In Canada, these guidelines have been adjusted depending on the transmission rates in and decisions made by provincial governments, with a progressive loosening of restrictions from the initial lockdown. Research evaluating mental health during COVID-19 has revealed drastic deteriorations in mental health and coping ability due to the pandemic and its accompanying restrictions (Jenkins et al., 2021). The link between mental health and sexual wellbeing has been well documented, such that poor mental health is associated with poor sexual health (Field et al., 2016; Flanders et al., 2017; Hensel et al., 2016).

Several studies have examined the impact of the COVID-19 pandemic and its accompanying restrictions on sexual health (e.g., Brotto et al., 2022; Effati-Daryani et al., 2021; Fuchs et al.,

2020; Lehmiller et al., 2021; Li et al., 2020; Sanchez et al., 2020; Tan et al., 2021). Sexual health consists of physical, emotional, mental, and social wellbeing with regards to sexuality, including considerations of relationships, pleasure, sexual behavior, and more (Douglas & Fenton, 2013). One China-wide online study ($n = 459$) evaluating sexual behaviors conducted early in the pandemic found that 37% of participants reported a decrease in partnered sexual frequency, and 44% reported a decline in their number of sexual partners (Li et al., 2020). Thirty-two percent of men and 18% of women participants also reported planning to increase their number of sexual partners or engagement in risky sexual behaviors once the COVID-19 “outbreak” was over (Li et al., 2020). Lehmiller et al. (2021) similarly observed reductions in self-reported frequencies of dyadic sexual behavior in their largely North American-based sample. Further, findings of declines in number of sexual partners were replicated in American samples (Gleason et al., 2021; Sanchez et al., 2020), with 51.3% of participants in one study endorsing this decline (Sanchez et al., 2020). In addition,

significant decreases were observed for frequency of sexual interactions with casual partners (Gleason et al., 2021), with 68% of participants in a sample of men-who-have-sex-with-men reporting fewer opportunities to engage in dyadic sexual activity (Sanchez et al., 2020). Additionally, Gleason et al. (2022) found that several participants expressed hesitations at engaging with new casual partners due to concerns related to COVID-19 transmission and expressed decreased opportunity to meet new sexual partners. Partnered sexual behaviors have changed as a result of the COVID-19 pandemic and its accompanying restrictions, and it is important to continue to evaluate these changes as restrictions loosen.

While overall declines in frequency and opportunity for dyadic sexual activity have been reported by samples from around the world, other studies have found that differences in the frequency of dyadic sexual activity were affected by the presence of a live-in partner (Brotto et al., 2022; Tan et al., 2021). Brotto et al. (2022) conducted a Canada-wide longitudinal study evaluating the effects of COVID-19 related social changes on sexual health. Participants' sexual health was assessed between April and August 2020, which loosely coincided with social restriction changes eventually allowing for increased in-person contact. Increases in frequency of dyadic sexual activity among those without a live-in partner were observed in each subsequent time point after the original one in April 2020, while these activities decreased for individuals with a live-in partner (Brotto et al., 2022). Results from Tan et al. (2021) indicated that, when compared to the frequency of dyadic sexual activities in the three months prior to the implementation of COVID-19 pandemic control measures, Singaporean participants without a live-in partner or who were single reported a greater decrease in dyadic sexual activities than their counterparts with live-in partners. Of note, the two studies also collected data at different timepoints, while different public health measures were in place. Stricter measures occurred universally in April 2020, which was captured by Tan et al. (2021), while Brotto et al. (2022) sampled from April to August 2020. The observed differences in dyadic

and solitary sexual frequency may also be partially accounted for by Singapore's strictly enforced COVID-19 distancing restrictions (Tan et al., 2021), beyond what was seen in Canada. For example, enforcement officers in Singapore were permitted to enter private residences without a warrant to inspect COVID-19 restriction compliance (Tan, 2021). Thus, participants in Tan et al.'s (2021) study may have experienced greater barriers to accessing potential sexual partners than Canadian participants.

While poor mental health has historically been associated with poor sexual health (Field et al., 2016; Flanders et al., 2017; Hensel et al., 2016), research has shown that pandemic stress has also been associated with increases in sexual desire and exploration. For instance, Lehmiller et al. (2021) reported that the likelihood of engaging in new sexual behavior, such as trying new sex positions or sharing sexual fantasies with a partner, was associated with increased levels of self-reported stress and loneliness. Brotto et al. (2022) found comparable results, whereby higher stress was associated with increased dyadic sexual desire. These results may be partially explained by findings that sexual activity reduces stress responses (Ulrich-Lai et al., 2010), and by the association between loneliness and sexual risk-taking behaviors (Su et al., 2018). Indeed, some participants in a qualitative investigation during the pandemic endorsed utilizing sexual activity as a source of pleasure to balance out negativity (Gleason, 2022). While neither Lehmiller et al. (2021) nor Brotto et al. (2022) identified causal factors of the relationship between increased stress and increased desire, it remains possible that sex was used as a strategy to handle stress during the pandemic.

Though pandemic stress has been positively associated with engaging in new sexual behaviors (Lehmiller et al., 2021), decreases in dyadic sexual desire were also observed in some samples. Declines in sexual desire in a female Polish sample were reported during the period of social quarantine, with the largest decreases in individuals who did not work and the smallest changes in those who worked outside of the house (Fuchs et al., 2020). Domestic isolation with a live-in partner, which is amplified with the loss of jobs

and socialization opportunities during the COVID-19 pandemic, can increase conflicts in relationships (Döring, 2020), and could lead to reductions in partnered desire and relationship satisfaction. Increases in domestic isolation due to unemployment, resulting in extended time at home with their partner, may explain Fuchs et al.'s (2020) finding that reductions in sexual desire were associated with employment status. Similarly, in an Italian study limited to participants with live-in partners, though most respondents stated they did not perceive any decrements, 18.2% of men and 26.4% of women reported decreases in sexual desire (Panzeri et al., 2020). Stress and forced co-living were some of the predominantly cited reasons for decreased sexual desire (Panzeri et al., 2020). Those with live-in partners may spend increased time in closed quarters with their partners during COVID-19 due to restrictions, leading to increased conflicts and failure to benefit from the concept of “distance makes the heart grow fonder” (Perel, 2007), which may manifest in reduced partner desire.

Current study

Pandemic-induced mental health issues have the potential to become long lasting psychological problems (Shaukat et al., 2020; Torales et al., 2020). While several studies have sought to understand the impacts of the COVID-19 pandemic restrictions on sexual health (e.g., Brotto et al., 2022; Lehmiller et al., 2021; Li et al., 2020), how long-term impacts of COVID-19 related social isolation may influence sexual health and relationships remains unknown. As relationship and sex life quality may be negatively impacted by COVID-19 related declines in mental health (Döring, 2020), further investigation is needed on changes that may occur as pandemic restrictions loosen. In this study, we examined changes in COVID-19 related stress, sexual desire, sexual behavior, and relationship satisfaction from August to September 2020, when relatively stricter COVID-19 pandemic guidelines were in place, to November 2021, when restrictions loosened as vaccination rates increased. As the previously surveyed research on sexual health during the pandemic identified differential outcomes

dependent on partner status, partner status (live-in partner versus non live-in partner versus no partner) was examined as a moderating variable to build on our understanding of how partner status may differentially impact individuals' sexual behaviors as pandemic measures change. We hypothesized that those with a live-in partner would experience increases in frequency of dyadic sexual behaviors, dyadic sexual desire, and relationship satisfaction as pandemic control measures lifted. We also hypothesized that COVID-19 related stress would decrease as COVID-19 related restrictions loosened.

Materials and methods

Participants

The sample was recruited from the existing pool of participants who had taken part in an earlier study (Brotto et al., 2022). These participants had been initially recruited through social media posts (e.g., Facebook, Instagram, Twitter) and Vancouver Coastal Health's email broadcast. Of the 259 participants who provided survey responses in August–September 2020, 194 consented to being contacted for future studies and were contacted via email and invited to participate in this study. A total of $n = 129$ began the study questionnaire, and $n = 124$ of those participants completed the study in full. Table 1 contains a detailed overview of participant demographics.

Procedure

Participants were invited to participate via email and were provided with a Qualtrics survey link. The survey link directed participants to an online questionnaire package, which included questions about demographics and measures assessing COVID-19 stress, sexual desire, relationship satisfaction, frequency of sexual behaviors, and depression, anxiety and stress. To proceed through the questionnaire, participants must have indicated that they read, understood, and consented to study procedures. Participants who completed the questionnaire were entered into a prize draw for a \$50 gift card. All study procedures were approved by the University of British

Table 1. Sociodemographic Information for Participants.

Measure	Live-In Partner	No Live-In Partner	No Partner	Total
Number of participants	53	40	33	126
Gender, <i>N</i> (%)				
Man	20 (37.7)	16 (40.0)	20 (60.6)	56 (44.4)
Woman	29 (54.7)	22 (55.0)	12 (36.4)	63 (50.0)
Other	4 (7.5)	2 (5.0)	1 (3.0)	7 (5.6)
Age (years), mean \pm SD	33.70 \pm 12.68	32.53 \pm 11.31	29.39 \pm 78.51	32.20 \pm 11.333
Province, <i>N</i> (%)				
Alberta	2 (3.8)	5 (12.5)	2 (6.1)	9 (7.1)
British Columbia	29 (54.7)	19 (47.5)	13 (39.4)	61 (48.4)
Manitoba	1 (1.9)	3 (7.5)	1 (3.0)	5 (4.0)
Newfoundland and Labrador	1 (1.9)	0 (0.0)	1 (3.0)	2 (1.6)
Northwest territories	0 (0.0)	0 (0.0)	1 (3.0)	1 (0.8)
Nova Scotia	2 (3.8)	0 (0.0)	1 (3.0)	4 (3.2)
Ontario	6 (11.3)	8 (20.0)	6 (18.2)	20 (15.9)
Quebec	7 (13.2)	3 (7.5)	6 (18.2)	16 (12.7)
Saskatchewan	2 (3.8)	1 (2.5)	0 (0.0)	3 (2.4)
Yukon	3 (5.7)	0 (0.0)	2 (6.1)	5 (4.0)
Relationship status, <i>N</i> (%)				
Common-law	14 (26.4)	0 (0.0)	0 (0.0)	14 (11.1)
Dating	3 (5.7)	13 (32.5)	2 (6.1)	18 (14.3)
Married	22 (41.5)	3 (7.5)	0 (0.0)	25 (19.8)
Never married	3 (5.7)	5 (12.5)	14 (42.4)	22 (17.5)
Single	0 (0.0)	4 (10.0)	31 (93.9)	35 (27.8)
Separated	0 (0.0)	1 (2.5)	1 (3.0)	2 (1.6)
Divorced	0 (0.0)	1 (2.5)	0 (0.0)	1 (0.8)
Widowed	0 (0.0)	2 (5.0)	0 (0.0)	2 (1.6)
Monogamous relationship	29 (54.7)	17 (42.5)	0 (0.0)	46 (36.5)
Polyamorous relationship	0 (0.0)	9 (22.5)	0 (0.0)	9 (7.1)
Other	2 (3.8)	6 (15.0)	1 (3.0)	9 (7.1)
COVID-19 Vaccination Status, <i>N</i> (%)				
Unvaccinated	1 (1.9)	2 (5.0)	1 (3.0)	4 (3.2)
Fully Vaccinated	51 (98.1)	37 (94.9)	32 (97.0)	120 (96.8)
Received Booster	5 (6.3)	2 (5.0)	4 (12.1)	11 (8.9)
Ethnicity, <i>N</i> (%)				
Arab/West Asian	2 (3.8)	1 (2.5)	0 (0.0)	3 (2.4)
Black	1 (1.9)	0 (0.0)	0 (0.0)	1 (0.8)
Chinese	3 (5.7)	3 (7.5)	2 (6.1)	8 (6.5)
Filipino	0 (0.0)	1 (2.5)	0 (0.0)	1 (0.8)
Hispanic or Latin American	2 (3.8)	1 (2.5)	0 (0.0)	3 (2.4)
Indigenous	3 (5.7)	1 (2.5)	0 (0.0)	4 (3.2)
South Asian	4 (7.5)	0 (0.0)	0 (0.0)	4 (3.2)
Southeast Asian	1 (1.9)	0 (0.0)	2 (6.1)	3 (2.4)
White	33 (62.3)	29 (72.5)	25 (75.8)	87 (70.2)
Other	3 (5.7)	4 (10.0)	3 (9.1)	10 (8.1)
Sexual orientation, <i>N</i> (%)				
Asexual	0 (0.0)	0 (0.0)	1 (3.0)	1 (0.8)
Bisexual	12 (22.6)	10 (25.0)	6 (18.2)	28 (22.4)
Demisexual	1 (1.0)	2 (5.0)	1 (3.0)	4 (3.2)
Heterosexual	28 (62.8)	15 (37.5)	11 (33.3)	54 (43.2)
Gay/Lesbian	6 (11.3)	8 (20.0)	11 (33.3)	25 (20.0)
Pansexual	6 (11.3)	5 (12.5)	2 (6.1)	13 (10.4)
Education (years), mean \pm SD	16.09 \pm 2.99	16.47 \pm 4.13	17.24 \pm 2.91	16.52 \pm 3.38
Education, <i>N</i> (%)				
Some high school	0 (0.0)	1 (2.5)	0 (0.0)	1 (0.8)
High school	4 (7.5)	3 (7.5)	1 (3.1)	8 (6.4)
Some college	7 (13.2)	6 (15.0)	6 (18.8)	19 (15.2)
Graduated 2 year college	6 (11.3)	4 (10.0)	5 (15.6)	15 (12.0)
Graduated 4 year college	23 (43.4)	18 (45.0)	10 (31.3)	51 (40.8)
Post-Graduate degree	13 (24.5)	8 (20.0)	10 (31.3)	31 (24.8)
Employment, <i>N</i> (%)				
Full-time	28 (52.8)	20 (50.0)	15 (45.5)	63 (50.0)
Part-time or casual	10 (18.9)	7 (17.5)	6 (18.2)	23 (18.3)
On Disability	2 (3.8)	1 (2.5)	1 (3.0)	4 (3.2)
Retired	2 (3.8)	2 (5.0)	0 (0.0)	4 (3.2)

(continued)

Table 1. Continued.

Measure	Live-In Partner	No Live-In Partner	No Partner	Total
Self-employed	6 (11.3)	1 (2.5)	3 (9.1)	10 (7.9)
Student	9 (17.0)	10 (25.0)	10 (30.3)	29 (23.0)
Unemployed	3 (5.7)	7 (17.5)	6 (18.2)	16 (12.7)
Other	2 (3.8)	3 (7.5)	0 (0.0)	5 (4.0)
Income, <i>N</i> (%)				
Less than \$20, 000	6 (11.5)	7 (18.4)	6 (19.4)	19 (15.7)
\$20, 000–\$39, 999	7 (13.5)	9 (23.7)	3 (9.7)	19 (15.7)
\$40, 000–\$59, 999	6 (11.5)	3 (7.9)	6 (19.4)	15 (12.4)
\$60, 000–\$79, 999	7 (13.5)	11 (28.9)	7 (22.6)	25 (20.7)
\$80, 000 to \$99, 999	8 (15.4)	2 (5.3)	3 (9.7)	13 (10.7)
\$100, 000–\$119, 999	8 (15.4)	2 (5.3)	1 (3.2)	11 (9.1)
\$120, 000–\$139, 999	1 (1.9)	2 (5.3)	2 (6.5)	5 (4.1)
\$140, 000–\$159, 999	1 (1.9)	1 (2.5)	0 (0.0)	2 (1.7)
\$160, 000–\$179, 999	2 (3.8)	0 (0.0)	1 (3.2)	3 (2.5)
\$180, 000–\$199, 999	1 (1.0)	0 (0.0)	0 (0.0)	1 (0.8)
\$200, 000–\$219, 999	3 (5.8)	0 (0.0)	1 (3.2)	4 (3.3)
\$260, 000–\$279, 999	1 (1.9)	0 (0.0)	0 (0.0)	1 (0.8)
More than \$300, 000	1 (1.9)	1 (2.5)	1 (3.2)	3 (2.5)
Dwelling type, <i>N</i> (%)				
Apartment or condo	18 (34.0)	16 (40.0)	18 (54.5)	52 (41.3)
Basement suite or suite in a house	6 (11.3)	7 (17.5)	1 (3.0)	14 (11.1)
Duplex/townhouse	8 (15.1)	3 (7.5)	1 (3.0)	12 (9.5)
Single family house	19 (35.8)	13 (32.5)	13 (39.4)	45 (35.7)
Student residence/housing	1 (1.9)	1 (2.5)	0 (0.0)	2 (1.6)
Other	1 (1.9)	0 (0.0)	0 (0.0)	1 (0.8)
Sexual difficulties, <i>N</i> (%)	23 (45.1)	9 (23.1)	5 (15.6)	37 (30.3)
Medical condition, – (%)	22 (41.5)	12 (30.0)	9 (27.3)	43 (34.1)
Report non-consensual sexual contact, <i>N</i> (%)	26 (49.1)	23 (57.5)	17 (53.1)	66 (52.8)
As an adult	15 (57.7)	17 (73.9)	14 (82.4)	46 (69.7)
As a child	15 (57.7)	9 (39.1)	4 (23.5)	28 (42.4)

Columbia's Behavioral Research Ethics Board (H20-01078).

Measures

Demographics

Participants responded to questions regarding their relationship status, current living situation, current health status (including COVID-19 vaccination status), and sexual history (including number of past sexual partners, sexual difficulties, and non-consensual sexual experiences). Participants were also asked two open ended questions on COVID-19 related and other factors leading to changes in their sexuality.

Depression, anxiety and stress

Depression, anxiety and stress was assessed using the *Depression Anxiety Stress Scales* (DASS-42; Lovibond & Lovibond, 1995). The DASS-42 is a 42-item measure consisting of three subscales with 14 items each, evaluating depression (i.e., *I couldn't seem to experience any positive feeling at all*), anxiety (i.e., *I had a feeling of faintness*) and stress (i.e., *I found it hard to wind down*). Individual items were endorsed on a four-point

scale ranging from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*). Scores for the three subscales were obtained by summing the individual scores for each subscale, with higher scores indicating higher depression, anxiety or stress. For the depression subscale, a Cronbach's alpha of 0.95 and McDonald's omega of 0.95 were observed. For the anxiety subscale, a Cronbach's alpha of 0.90 and a McDonald's omega of 0.90 were observed. For the stress subscale, a Cronbach's alpha of 0.96 and a McDonald's omega of 0.95 were observed.

COVID-19 related stress

At the time that participants took part in the original study (early 2020), there were no validated measures of COVID-19 related stress, so an investigator-developed measure to evaluate COVID-19 related stress was used (Brotto et al., 2022). The items asked participants about the degree to which they worried about the impact of the pandemic on factors such as their own physical health, the health of a loved one, and financial impacts. These items were rated on a 7-point scale from 1 (*not at all worried*) to 7 (*very much*

worried). A total score was calculated by summing individual items and higher total scores indicated higher levels of COVID-19 related stress. Cronbach's alpha of 0.84 and McDonald's omega of 0.83 were observed.

Frequency of sexual behaviors

An investigator-developed measure was used to evaluate sexual behavior frequency (Brotto et al., 2022). This measure consisted of two items – one that assessed the frequency of solitary sexual activity (i.e., *how many times did you engage in sexual activity alone – solitary sexual activity, solo masturbation*), and another that assessed the frequency of dyadic sexual activity (i.e., *how many times did you engage in in-person sexual activity with a partner – partnered or dyadic sexual activity*). Participants were asked to answer with respect to their sexual behavior in the last month. Responses were given on a 7-point numerical scale: (0) not at all; (1) once; (2) a few times a week – less than 4; (3) about once a week; (4) 2–3 times a week; (5) almost every day; (6) more than once a day. Only the item asking about dyadic sexual activity was considered in data analysis.

Sexual desire

Dyadic sexual desire was assessed using the dyadic subscale of the *Sexual Desire Inventory* (SDI-2; Spector et al., 1996). The SDI-2 is a 14-item measure that assesses the frequency and strength of solitary and dyadic sexual desire (i.e., *how important is it for you to fulfill your sexual desire through activity with a partner, how important is it for you to fulfill your desires to behave sexually by yourself*). Each item is measured on a Likert scale with nine options increasing in frequency or desire. The SDI-2 has shown strong test-retest reliability (i.e., $r=0.76$ over a 1-month period) (Spector et al., 1996). In our sample, we observed a Cronbach's alpha of 0.84 and a McDonald's omega of 0.85.

Relationship satisfaction

The *Relationship Assessment Scale* (RAS; Hendrick et al., 1988) was used to measure relationship satisfaction. This measure includes seven items (i.e., *how much do you love your partner*)

that participants score on a 5-point numerical scale ranging from 1 to 5, where 1 represents the lowest satisfaction and 5 represents the highest. The mean of the seven items was used as a summary measure of relationship satisfaction, with higher scores indicating greater relationship satisfaction. Cronbach's alpha and McDonald's omega for our sample was 0.89 and 0.91, respectively.

Data analysis

The impact of time (i.e., changes in COVID-19 related restrictions) and live-in partner status (participants with a live-in partner, participants in a relationship without a live-in partner, and participants without a partner, who are onwards referred to as single participants) on depression, anxiety, stress, sexual desire, sexual behavior and relationship satisfaction were evaluated using mixed effects ANOVAs. Data collected from a previous study (Brotto et al., 2022) in August–September 2020 were compared to data collected by the current study in November 2021. Partner status was determined by responses participants gave in November 2021. A paired samples t-test was used to evaluate differences in COVID-19 stress over time in the entire sample. When reporting effect sizes, we used partial eta-squared for the mixed effects ANOVA and Cohen's d for our post-hoc comparisons. Assumptions of normality, homogeneity of variance and sphericity were tested for all mixed effects ANOVAs and none were violated.

Results

Depression, anxiety and stress

Depression

The three (group: live-in partner, no live-in partner, and single) by two (time: August–September 2020 and November 2021) mixed effects ANOVA revealed a significant two way interaction, $F(2, 115) = 4.04$, $p = .020$, partial $\eta^2 = 0.66$. Post hoc tests were performed to analyze simple effects. Post hoc tests revealed that participants with a live-in partner, $p = 0.003$, $d = 0.5$, reported increased depression over time, while single participants and participants without a live-in partner did not (Table 2).

Table 2. Mean and Standard Deviation for Frequency of Dyadic Sexual Behaviors, COVID-19 Related Stress, Dyadic Sexual Desire and Relationship Satisfaction.

Variable	Group (n=f)	August–September 2020		November 2021	
		M	SD	M	SD
COVID-19 related stress ^a	All participants (n = 118)	3.82*	1.198	3.30*	1.312
Depression ^b	Live-in partner (n = 51)	8.98†	9.341	12.98†	10.908
	No live-in partner (n = 36)	11.59	10.085	9.78	7.993
	No partner/single (n = 31)	10.81	11.158	11.61	10.623
Anxiety ^b	Live-in partner (n = 51)	4.98	6.221	6.94	7.048
	No live-in partner (n = 36)	5.11	5.497	5.75	7.420
	No partner/single (n = 31)	5.80	6.913	5.55	5.767
Stress ^b	Live-in partner (n = 51)	13.29	10.895	14.57	10.242
	No live-in partner (n = 36)	12.97	9.608	12.31	9.789
	No partner/single (n = 31)	12.74	9.723	12.87	9.882
Frequency of dyadic sexual behaviors ^c	Live-in partner (n = 48)	2.77*†	1.387	2.13*†	1.265
	No live-in partner (n = 34)	2.18	1.732	2.24*	1.415
	No partner/single (n = 29)	1.34*†	1.518	0.79*†	1.114
Dyadic sexual desire ^d	Live-in partner (n = 51)	32.10	11.522	32.62	10.037
	No live-in partner (n = 36)	37.03	9.779	35.53	11.044
	No partner/single (n = 31)	35.32	13.432	35.36	12.616
Relationship satisfaction ^e	Live-in partner (n = 49)	4.37	0.623	4.27	0.659
	No live-in partner (n = 28)	4.08	0.772	4.10	0.864

^aPossible range of scores: 1 to 7.^bPossible range of scores: 0 to 42.^cPossible range of scores: 0 to 6.^dPossible range of scores: 0 to 64.^ePossible range of scores: 1 to 5.^fTotal group numbers: live-in partner (n = 53), no live-in partner (n = 40), no partner (n = 33).*Indicates mean difference between groups within a timepoint for Frequency of Sexual Behaviors and between timepoints for COVID-19 Related Stress is significant, $p < .001$; †Indicates mean difference between timepoints is significant, $p < .05$.

Anxiety

The three (group: live-in partner, no live-in partner, and single) by two (time: August–September 2020 and November 2021) mixed effects ANOVA revealed no significant interactions, $F(2, 115) = 1.89$, $p = .156$, partial $\eta^2 = .032$. There was no main effect of time, $F(1, 115) = 2.62$, $p = .108$, partial $\eta^2 = .022$, and no main effect of group, $F(2, 115) = 0.89$, $p = .915$, partial $\eta^2 = .002$, suggesting that groups reported similar levels of anxiety over time.

Stress

The three (group: live-in partner, no live-in partner, and single) by two (time: August–September 2020 and November 2021) mixed effects ANOVA revealed no significant interactions, $F(2, 115) = 0.52$, $p = .594$, partial $\eta^2 = .009$. There was no main effect of time, $F(1, 115) = 0.87$, $p = .769$, partial $\eta^2 = .001$, and no main effect of group, $F(2, 115) = 0.26$, $p = .770$, partial $\eta^2 = .005$, suggesting that there were no differences in stress between groups or over time.

COVID-19 related stress

As there was no indication of any group differences in stress, a paired samples t -test was

performed to evaluate change in COVID-19 related stress over time in the full sample. The paired samples t -test revealed a significant difference between time points, $t(117) = 4.74$, $p < .001$, $d = 0.44$, suggesting that there was a decrease in COVID-19 related stress (Table 2).

Frequency of dyadic sexual behaviors

The three (group: live-in partner, no live-in partner, and single) by two (time: August–September 2020 and November 2021) mixed effects ANOVA revealed a significant two way interaction, $F(2, 108) = 3.29$, $p = .041$, partial $\eta^2 = .057$. Post hoc tests were performed to analyze simple effects. Post hoc tests revealed that participants with a live-in partner, $p \leq .001$, $d = 0.40$, and single participants, $p = .022$, $d = 0.57$, both experienced decreases in dyadic sexual behaviors over time, while participants without a live-in partner did not (Table 2). Post-hoc tests also revealed significant group differences at August–September 2020, in which participants with a live-in partner engaged in more dyadic sexual activity than single participants, $p \leq .001$, $d = 1.00$. Significant group differences were seen in November 2021

(i.e., Time 2), where both participants with a live-in partner, $p \leq .001$, $d = 1.11$, and without a live-in partner, $p \leq .001$, $d = 1.13$, exhibited more frequent dyadic sexual behaviors than single participants.

Dyadic sexual desire

The three (group: live-in partner, no live-in partner, and single) by two (time: August–September 2020 and November 2021) mixed effects ANOVA revealed no significant interactions, $F(2, 115) = 0.48$, $p = .623$, partial $\eta^2 = .008$. There was no main effect of time, $F(1, 115) = 1.95$, $p = .166$, partial $\eta^2 = .017$, and no main effect of group, $F(2, 115) = 0.85$, $p = .431$, partial $\eta^2 = .015$, suggesting that regardless of time or live-in partner status, participants maintained similar levels of dyadic sexual desire (Table 2).

Relationship satisfaction

The two (group: live-in partner and no live-in partner) by two (time: August–September 2020 and November 2021) mixed effects ANOVA revealed no significant interactions, $F(1, 75) = 0.99$, $p = .322$, partial $\eta^2 = .013$. There was no main effect of time, $F(1, 75) = 0.42$, $p = .520$, partial $\eta^2 = .006$, and no main effect of group, $F(1, 75) = 2.18$, $p = .144$, partial $\eta^2 = .028$, suggesting that partnered participants with and without live-in partners reported similar relationship satisfaction over time. Table 2 displays the group means and standard deviations for relationship satisfaction in the two time points.

Discussion

The goal of the current study was to evaluate changes in COVID-19 related stress, relationship satisfaction, sexual desire, and frequency of sexual behaviors as pandemic measures loosened from August–September 2020 to November 2021, using an existing longitudinal study. For general mental health, participants with a live-in partner experienced an increase in self-reported depression over time compared to the other two groups. No differences were found in anxiety or general stress from the previous timepoint or between

groups. Over time from August–September 2020 to November 2021, concurrent with a reduction in COVID-19 related restrictions, participants reported a decrease in COVID-19 related stress, which was captured through questions evaluating aspects of health and finance. A potential explanation for these decreases may be the presence of high COVID-19 vaccine uptake in Canada (Government of Canada, 2022). Research done on an American population found decreased levels of mental distress after individuals had received one dose of a COVID-19 vaccine (Perez-Arce et al., 2021). Further, as COVID-19 vaccines have been shown to be effective at reducing the risk of infection, hospitalization, admission to intensive care units, and mortality (Zheng et al., 2022), increases in vaccination rates may directly lead to less cause for stress in terms of self or others' health. Thus, given the high levels of vaccination seen in our sample, and in Canada on a greater scale (Government of Canada, 2022), this may explain the observed reduction in COVID-19 related stress.

In our sample, single participants engaged in less frequent dyadic sexual behaviors over time than participants with partners. Further, both participants with live-in partners and single participants decreased in their frequency of dyadic sexual activity, while participants without a live-in partner experienced no significant changes, despite decreases in COVID-19 related stress. This was contrary to our hypotheses, given that we predicted that decreases in COVID-19 related stress would be associated with increased dyadic sexual behavior. Previous investigations in a larger Canadian sample earlier in the pandemic had showed an increasing trend in dyadic sexual behaviors for those without a live-in partner, and a somewhat decreasing trend for those with a live-in partner (Brotto et al., 2022). While the latter trend was continued in our sample, no further increases were observed for participants without a live-in partner. In our sample, participants with a live-in partner, while decreasing in dyadic sexual behavior frequency, also reported increased feelings of depression. Depression has been linked with negative impacts on sexual health (Field et al., 2016), specifically with reduced sexual function. Reduced sexual function could

manifest in decreasing frequency of sexual behaviors. This linkage may in part explain the continuing decrease in the frequency of dyadic sexual behaviors observed for individuals with a live-in partner.

Additionally, it is possible that despite decreases in COVID-19 related stress, return to in-person activities may introduce daily life challenges unrelated to COVID-19. While in our sample, no significant changes were observed for non-COVID-19 related stress and anxiety, there may be more specific concerns that are not captured by the general nature of these scales. For example, in one American study, almost 70% of participants indicated appearance-related stress or anxiety with the return to in-person activities and 30% stated they would be investing in their appearance as a direct coping strategy for their anxiety of returning to in-person activities (Silence et al., 2021). There may also be increased incidence of social anxiety developed during the COVID-19 lockdown (Loades et al., 2020). While the majority of research conducted on the development of social anxiety during the COVID-19 pandemic has focused on children and young adults, with the extreme social isolation imposed by some pandemic restrictions, similar phenomena may be occurring in adults. Findings of social challenges unrelated to COVID-19 may serve as a direct explanation especially for why single individuals experienced a significant decrease over time in frequency of dyadic sexual behaviors, potentially indicating social stressors as a barrier to seeking out new sexual partners.

Interestingly, in a married female Singaporean sample, trends opposite to what we observed in participants with a live-in partner occurred, in that the weekly frequency of marital sex increased with the lifting of lockdown measures (Tan, 2022). However, Tan (2022) also observed that the proportion of participants who were having no marital sex did not change. High levels of fatigue and moderate or low levels of stress were associated with lower sexual frequency and higher probability of no sexual activity in a week, while increased marital satisfaction was associated with higher sexual frequency and reduced probability of non-activity (Tan, 2022). The presence and influence of these moderating factors

highlight potential different trajectories of sexual activity as pandemic-related social restrictions come to an end, whereby some individuals with live-in partners retain low levels of dyadic sexual behaviors while others experience increases in sexual activity. Notably, low levels of stress were reported in our population, and participants with a live-in partner also experienced decreased dyadic sexual activity over time. Thus, the pattern observed by Tan (2022) of lower stress being associated with lower sexual frequency may be mirrored in our sample. Further investigations into potential moderators of this relationship in a Canadian sample is warranted.

While we initially predicted that dyadic desire in participants with a live-in partner would increase from August–September 2020 to November 2021, no significant changes were observed over time. Given that Fuchs et al. (2020) found that those who worked outside of the home during the pandemic experienced smaller decrements in desire than those who did not, this initial hypothesis had been generated in light of the decreasing COVID-19 pandemic restrictions on in-person activities. However, even as restrictions decreased and fewer employees were mandated to work remotely, many surveyed workers expressed a desire to continue working from home and more are working remotely now still than at the beginning of the pandemic (Ng et al., 2021). Thus, even though COVID-19 related restrictions may decrease, people may not necessarily be spending significantly more time outside of their home. Predictions have been made that hybrid models featuring a mix of in-person and virtual opportunities for work may increase in prevalence (Hanaei et al., 2022; Ng et al., 2021). Further research investigating the impacts of situations that increase or decrease partner availability, such as varying levels of virtual versus in-person involvements and live-in partner status, on dyadic sexual desire may reveal more information about the complexities of how desire can wax and wane in different conditions.

Another potential explanation for the lack of increases in dyadic sexual desire across all groups may be increasing rates of sexual dysfunction. Amongst our sample, under a third of

participants reported experiencing sexual difficulties since the beginning of the pandemic. Masoudi et al. (2022) found in their review of the literature that the presence of COVID-19 related restrictions were correlated with higher rates of sexual dysfunction and lowered frequency of sexual activity. Further, research done on erectile dysfunction in men found erectile dysfunction doubled in healthcare professionals working with COVID-19 patients when compared to non-healthcare professionals, ascribing the reason for this discrepancy to heavy workload and stressful environments (Pizzol et al., 2022). Development of sexual desire disorders in particular can negatively impact an individual's partnered desire levels. The increase in self-reported sexual problems by our sample may also point to increases in vaginal pain, which itself is linked to reduced sexual desire (Reissing et al., 2003). Given the potential for increased prevalence of sexual disorders, and their subsequent impact on sexual wellbeing, there is a need to address this through greater preventative services. Educating healthcare practitioners on the effects of the pandemic on sexual health, as well as leveraging telemedicine support to improve accessibility, are possible solutions (Pennanen-Iire et al., 2021).

In terms of relationship satisfaction, no changes were observed regardless of live-in partner status, in contrast to our prediction that relationship satisfaction would increase in those with a live-in partner. However, it is worth recognizing that participants' mean relationship satisfaction scores were in the high range and are comparable to Relationship Assessment Scale (RAS) scores in studies prior to the COVID-19 pandemic (Maroufizadeh et al., 2018; Renshaw et al., 2011). Further, although there were previous observations that higher COVID-19 related stress predicted lower relationship satisfaction in the early phases of the pandemic (Brotto et al., 2022), no significant impact of time was found here. In other words, even as COVID-19 stress decreased, it did not positively impact relationship satisfaction.

Limitations

There are some study limitations potentially affecting the generalizability of our findings.

There is no pre-COVID data for the sample, thus it is not possible to compare sexual behaviors during the time points where data was collected to pre-pandemic baselines. Participants were recruited from a preexisting sample that had been recruited predominantly through social media. Thus, those who do not frequently use social media are unlikely to be represented in our findings. Additionally, only the subset of participants who consented to being contacted for future studies were invited to participate in the study. Overall, the sample was also small, which increases difficulty of generalizability. The sample was highly educated, with 92.9% of participants having attended at least some college. The majority of participants were white, reducing the generalizability of findings to other ethnicities, as all other ethnicities represented less than 10% of the sample. Further, there were no participants from Prince Edward Island, New Brunswick, and Nunavut in our sample, while British Columbian participants made up a large proportion of the participants. Thus, our findings may be skewed to reflect the experiences of some provinces (namely British Columbia, with notable representation also from Ontario and Quebec) more than others. Our three participant groups (live-in partner, no live-in partner, and no partner) were constructed using participant reported relationship status during November 2021. We did not account for the fact that some individuals may have changed their relationship status from August to September 2020 to November 2021. In asking about dyadic sexual behaviors, a single reductionist question was used. Thus, we are limited in understanding the type of dyadic sexual behavior that participants engaged in.

Conclusions

The current study contributes to our growing understanding of how pandemic experiences continue to have impacts on sexual wellbeing, even as COVID-19 related stress decreases. Over time, as pandemic restrictions loosened and COVID-19 vaccination rates increased, decreased COVID-19 stress was observed in our Canadian sample. However, despite these reductions, levels of dyadic sexual desire, dyadic sexual behavior, and

relationship satisfaction did not increase. Notably, frequency of dyadic sexual behaviors continued to decrease for those with a live-in partner and single individuals. Return to in-person activities may re-introduce stressors that existed prior to the pandemic. Given the move to largely virtual activities over the COVID-19 pandemic, resumption of in-person activities may trigger social anxieties or fears, with people now being less accustomed to handling such stressors. These social changes and other stressors that may not have been captured in our COVID-19 stress items could explain the lack of observed improvements in the evaluated sexuality related measures. Further, these results suggest potential lasting effects of COVID-19 on sexual health and point to a need for increased support and resources for sexual wellbeing, especially for future pandemics.

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