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ORIGINAL ARTICLE

The disruptive impact of the COVID-19 pandemic on sexual behavior of a German-speaking population[☆]

L'impact de la pandémie de COVID-19 sur l'activité sexuelle et les pratiques sexuelles des célibataires et des personnes en couple dans une population germanophone

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KEYWORDS

COVID-19;
Pandemic;
Physical distancing
measures;
Relationship;
Contraception;
Sexual behavior

Summary

Objective. – The aim of this study was to investigate changes in sexual behavior during of the COVID-19 pandemic and physical distancing measures in single and partnered participants in Germany, Switzerland and Austria.

Material and methods. – Participants were assessed in a cross-sectional online survey. Amongst others, sociodemographic data, sociosexual attitudes as well as engagement in a range of sexual activities and practices prior to and during the pandemic were collected. Additionally, for subjects in a relationship, sexual attraction to the partner (feelings of affection during partnered sexual activities, and physical sexual attraction) and relationship satisfaction were measured.

Results. – Data of 1017 single and 1498 partnered participants were analyzed. Partnered participants masturbated significantly less during physical distancing measures compared to the period before, whereas single males masturbated more often. Single females masturbate less frequently but this difference was not statistically significant. For both subgroups, the frequency of most sexual activities significantly declined since the beginning of physical distancing measures with anal intercourse in partnered participants being the only exception that showed no significant decrease. In the group of participants in relationships, sociosexual variables and physical sexual attraction to one's partner showed a significant positive relationship to the number of new sexual practices added during physical distancing measures, while feelings of affection during partnered sexual activities and relationship satisfaction did not.

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Abbreviations: COVID-19, Coronavirus disease/infectious disease caused by SARS-CoV-2; SARS-CoV-2, Acute Respiratory Syndrome Coronavirus-2.

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MOTS CLÉS

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Conclusion. – Our data support previous findings showing potential disruptive effects on sexual routines of single and partnered participants by the COVID-19 pandemic and physical distancing measures. Further studies are needed to reveal causal factors and to study long-term effects on mental health and relationships.

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Résumé

Objectifs. – L'objectif de cette étude était d'analyser les variations dans les comportements sexuels des célibataires et des personnes en couple dans le contexte de la pandémie de COVID-19, en Allemagne, en Suisse et en Autriche.

Population et méthodes de recherche. – Les participants ont rempli un questionnaire en ligne de nature transversale. Ce questionnaire portait notamment sur le profil sociodémographique, la socio-sexualité ainsi que les activités sexuelles pratiquées avant et pendant la pandémie et ce pour tous les participants. Il mesure, par ailleurs, pour les participants en couple, les sentiments d'attachement et l'attraction physique pour leur partenaire et la satisfaction dans la relation.

Résultats. – L'étude analyse les données de 1017 célibataires et de 1498 personnes en couple. En comparaison avec la période précédente, les sujets en couple se sont significativement moins fréquemment masturbés pendant le confinement. Les hommes célibataires se sont, quant à eux, plus souvent masturbés. Pour les deux populations, la fréquence de la plupart des activités sexuelles a significativement décliné à partir du début du confinement, exception faite de la pénétration anale qui n'a pas enregistré de baisse prononcée chez les sujets en couple. Par ailleurs, chez ces derniers, l'étude souligne une forte corrélation entre les variables socio-sexuelles et l'attraction physique pour leur partenaire par rapport au nombre d'activités sexuelles nouvellement pratiquées pendant le confinement. Une telle corrélation n'existe toutefois pas avec les sentiments d'attachement et la satisfaction par rapport à la relation.

Conclusion. – Nos données confirment les résultats précédents d'effets potentiellement négatifs de la pandémie de COVID-19 et des mesures de distanciation physique sur les habitudes sexuelles des célibataires et des personnes en couple. D'autres études sont nécessaires pour identifier des facteurs de causalité et en étudier les effets à long terme sur la santé mentale et les relations amoureuses.

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Introduction

December 2019 saw the initial outbreak of the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) that leads to the coronavirus disease (COVID-19), which was subsequently been declared a pandemic by the World Health Organization in March of 2020 (WHO, 2020). Governments around the world implemented physical distancing measures and a range of restrictions – often referred to as “physical distancing measures” – in the hope of reducing infection rates. The German government announced partial physical distancing measures on March 22, 2020, which was in place until April 19, 2020, and was extended, with fewer restrictions, until May 3, 2020 (Müller et al., 2020). In this contact restriction period, public venues and systemically non-relevant shops were closed. Amongst other things, German citizens have been advised to practice physical distancing and to not meet more than one person from another household while keeping a physical distance of 1.5 meters.

Germany's and more generally most of Europe's population was now faced with an unfamiliar situation, given that there had not been comparable physical distancing measures in the continent's recent past. Data derived from other

situations with health-related restrictive measures, like the 2003 outbreak of severe acute respiratory syndrome (SARS) in China and Canada or the 2014 Ebola outbreak in Africa, show adverse psychological effects such as post-traumatic stress symptoms, confusion, and anger (Brooks et al., 2020). Following physical distancing restrictions during the COVID-19 pandemic implies an increased risk for social isolation and feelings of loneliness which are correlates of mental health burdens such as mood and anxiety disorders (Holmes et al., 2020). These types of mental health problems have been shown to be related to sexual outcomes with results generally indicating a negative relationship between depression or anxiety and sexual arousal and desire (Bancroft et al., 2003; Janssen et al., 2013; Lykins et al., 2006). In contrast to those studies providing evidence to assume negative effects of the pandemic on sexual and mental health other studies suggested activating effects on sexual function and reproductive activities. Some previous studies found links between hurricane advisories and increased birth rates in coastal areas (Rodgers et al., 2005). Other observations suggested an increase of sexual desire as a coping mechanism in the face of life-threatening events (Goldenberg et al., 2000).

In March and April 2020, during strict physical distancing measures, the German public discourse was dominated by narratives of an increase in sexual activity in couples and predictions of a “baby boom” following the COVID-19 pandemic (Döring and Walter, 2020). User data on pornography use (Pornhub Insights, 2020) and articles in media on other tech-based sexual practices (e.g. sex toy usage, sexting, and cybersex) (Döring and Walter, 2020) indicated a rise in the integration of digital solutions into sexual practices during physical distancing restrictions.

At the same time, research teams worldwide have gathered cross-sectional and prospective data to shed light on the question of the impact of physical distancing measures during the COVID-19 pandemic on sexual behavior based on scientific evidence. Changes in sexual behavior have been described by current studies collecting data during the first physical distancing measures in China (Li et al., 2020), the United Kingdom (Jacob et al., 2020), France (Landry et al., 2020), Italy (Mollaioli et al., 2021), Poland (Fuchs et al., 2020), Turkey (Yuksel and Ozgor, 2020) and by an internationally distributed online survey from the United States for English speaking participants (Lehmiller et al., 2020).

A significant decrease in sexual desire and the frequency of partnered sexual activity during physical distancing measures (vs. before the pandemic) was observed in a prospective study from Poland and by the international cross-sectional survey (Fuchs et al., 2020; Lehmiller et al., 2020). However, another prospective study from Turkey showed an increase in sexual desire and in the frequency of intercourse in females (Yuksel and Ozgor, 2020). Rates of masturbation declined in both male and female participants of the study from Lehmiller et al. (2020).

Moreover, Lehmiller et al. (2020) analyzed relevant factors associated with an extension of the sexual repertoire during the pandemic. In summary, those of younger age and lower socioeconomic status, who identified as non-White and lived alone, have been more likely to include new sexual practices in their sexual repertoire. The number of new techniques added to one’s sex life during the pandemic correlated to higher rates of quality of life and desire for sex, but also feelings of loneliness and stress during the pandemic.

A cross-sectional study from Italy was able to show (Mollaioli et al., 2021) that sexual activity (e.g. sexual intercourse) during the pandemic was linked positively to factors regarding mental, relational and sexual health. This observation demonstrates the role of dyadic sexual contacts in a broader biopsychosocial context. However, prospective data revealing the causal effects of social isolation and the disruption of sexual activities during the pandemic are still lacking. But a part of these observations might be supported by models suggesting the protective effect of social contacts on health (Holt-Lunstad et al., 2010) and human physical touch on the reduction of stress (Ditzen et al., 2007) and serves as the basis for concepts of sexual therapies (Beier and Loewit, 2013).

Overall, international data show a trend towards a disruptive effect on sexual behavior of COVID-19-related physical distancing restrictions. Results vary depending on study design and country, as well as on demographic and psychological factors. For singles, a change of sexual routines might partly be a consequence of following governmental

measures. Effects of isolation and a decline in social and physical contacts on mental health remain unclear. For couples factors responsible for a decline in sexual activities remain to be studied.

This study aimed to investigate exploratively if, and how, the sexual behavior of participants changed during physical distancing measures, with regard to reproductive aims, the frequency of partnered and autosexual activities and the integration of additional practices into their sex life. In particular, the objective was to find more specific differences between single and partnered participants. We chose three independent variables for which an association with changes in sexual behavior can be assumed based on previous investigations. First, sociosexuality has proven to be related to a variety of sexual and relationship outcomes, such as mating tendencies, sexual motivation and relationship interaction (Simpson et al., 2004). Furthermore, we chose to include a measure for sexual attraction in relationships which has been found to be strongly associated with sexual satisfaction and perceived quality of sexuality in close relationships (Von Irmer, 2011). Finally, we assessed relationship satisfaction since changes in this variable have been found to occur concurrently with changes in sexual satisfaction (Byers, 2005) and it depends on the extent of successful dyadic coping in relationships as a response to stressors (Falconier et al., 2015). Thus, changes in sexual behavior due to external stressors like the physical distancing measures are likely to be reflected in relationship satisfaction.

Material and methods

Study design

The CoVhabit study is a cross-sectional online survey that was conducted from April 9, 2020, until April 20, 2020. The survey was promoted on Facebook, a German online dating website (www.poppen.de), and the webpage of the German Association for Sexual Medicine, Sexual Therapy and Sexology (<https://www.dgsmtw.de/>, Deutsche Gesellschaft für Sexualmedizin, Sexualtherapie und Sexualwissenschaft [DGSMTW]). The survey was constructed with the online survey software “Unipark”, an academic program provided by Questback. Adults aged 18 years or older who were located in Germany, Austria or Switzerland at the time of the survey could participate after giving informed consent. Participation was anonymous and voluntary. Data collection and analyses were performed were in accordance with the ethical guidelines of the institutional ethical research committee.

Questionnaire

The unprecedented situation of the current pandemic causes a lack of previous data and research findings necessary to build hypotheses – and leads to the risk of bias during the selection of relevant variables. The involvement of stakeholders to improve the relevance and quality of research projects was recommended from research institutions of many countries (Institute of Medicine, 2009). Thus, for the development of this questionnaire, we initiated a semi-structured focus group discussion on our initially selected

study questions and variables with six stakeholders from different areas (journalism, humanities, social worker, public health, psychology and management consultancy) to include a broader perspective on relevant study questions which should be addressed by our research. Finally, the results of the focus group discussion were discussed with further researchers of the study group. The following variables were included in the analyses of this article.

Sociodemographic data

In the online survey, demographic data included gender (male, female, and diverse), age (assessed in six categories), sexual orientation, relationship status, change in employment-status during physical distancing measures, number of inhabitants in place of residence, number of persons living in the participants household and number of children the participants had to take of (cf. [Table 1](#)). In addition, for participants in relationships, it was assessed whether they lived together with their partner, in the same place of residence or in a long-distance relationship.

Contraception use

Contraceptive status and changes during the physical distancing measures were assessed by a single item asking whether participants continued to use contraception as before, continued not using contraception as before, started to use contraception or stopped using contraception. Furthermore, it was asked whether contraception was used for protection against sexually transmitted diseases, against COVID-19 or against pregnancies.

Sexual activities

All participants in couple and singles were queried on the frequency of solo (masturbation) and partnered sexual activities (kissing, hugging, touching of genitals, oral sex, vaginal intercourse and anal intercourse; cf. [Table 2](#) and [Table 3](#)) during the past 12 months before the pandemic and after implementation of strict social contact measure from never to multiple times a day (partnered participants were referring to their current partner).

Sexual practices

Participants were asked which sexual practices out of a list of 43 different sexual practices they had exercised both before and during the pandemic (e.g. "sexting", "using a sex toy", "tried a new sex position" or "pornography usage", 1 = sexual practices exercised; 0 = sexual practice not exercised). Practices can be categorized in with or without physical contact, with or without the use of technical devices according to [Lehmiller et al. \(2020\)](#).

Characteristics of personal attitude and relationship satisfaction

Sociosexuality was measured using the Revised Sociosexual Orientation Inventory (SOI-R; [Penke and Asendorpf, 2008](#)). The scale measures interindividual differences in tendencies towards uncommitted sex and relationships and is composed of three distinct subscales assessing sociosexual behavior, attitudes and desire. The behavior subscale consists of three items (e.g. Item 1: "With how many different partners have you had sex within the past 12 months?") on a five-point

Likert-scale with response options ranging from no partners to eight or more partners. Internal consistency for the subscale was good ($\alpha = 0.839$). The attitude subscale measures the evaluative disposition towards uncommitted sex by the use of items like "Sex without love is OK" (1 = strongly disagree; 5 = strongly agree) and also showed sufficient reliability ($\alpha = 0.853$). Finally, sociosexual desire reflects sexual desire that is specifically directed towards partners to whom an individual has no committed relationship by assessing the level of agreement to items like "How often do you have spontaneous fantasies about having sex with someone you have just met?" (1 = never; 2 = rarely, 3 = about once a month; 4 = about once a week; 5 = [almost] every day). Internal consistency for both sociosexual desire ($\alpha = 0.853$) as well as for the complete SOI-R ($\alpha = 0.881$) were sufficiently high.

In addition, partnered participants were asked to report relationship satisfaction based on the German version of the relationship assessment scale (ZIP; [Hassebrauck, 1991](#)). This scale consists of seven items on a four-point Likert-scale with higher scores indicating less satisfaction (for analytical purposes, the original scaling has been adapted so that higher scores reflect more relationship satisfaction). The items target different aspects of a romantic relationship, e.g., how satisfied a person is with his or her relationship, to what degree expectations and needs are met or to what extent the relationship is perceived as problematic. The scale showed very high reliability ($\alpha = 0.911$).

Furthermore, sexual attraction to one's partner was assessed using the German questionnaire of sexual experience in close relationships (FESP-K; [Von Irmer and Kemper, 2011](#)). Both physical sexual attraction and feelings of affection during sexual activities are assessed with seven items on a five-point Likert-scale (1 = does not apply at all; 5 = fully applies). Physical sexual attraction is conceptualized as the extent to which sexuality in close relationships is characterized by passion, openness and mutual experimentation whereas feelings of affection during partnered sexual activities points to emotional aspects of sexuality in a relationship like warmth, love and tenderness (von Irmer, 2011). Thus, these concepts reflect two of the three dimensions of sexuality in the conceptualization of [Beier and Loewit \(2013\)](#) with physical sexual attraction being comparable to the dimension of desire and feelings of affection during partnered sexual activities to the dimension of attachment, respectively. Examples of items for physical sexual attraction are "My partner likes to experiment a lot" and "My partner is very wild and passionate", whereas feelings of affection during partnered sexual activities was measured with items like "While having sex with my partner, I feel how much he/she appreciates me" and "Our sex life is romantic.". Internal consistency for both physical sexual attraction ($\alpha = 0.925$) and feelings of affection during partnered sexual activities ($\alpha = 0.930$) and reliability for the whole scale ($\alpha = 0.943$) were high.

Subgroups

Regarding relationship status, participants were grouped as "in a relationship" or "single", i.e. data of participants who were in a relationship with their current partner before and during the physical distancing measures were grouped

Table 1 Sample characteristics.

	Total sample (<i>n</i> = 2515) <i>n</i> (%)	Partnered (<i>n</i> = 1498) <i>n</i> (%)	Single (<i>n</i> = 1017) <i>n</i> (%)	Test statistic	<i>P</i>
Gender				$\chi^2 = 4.343$, <i>df</i> = 1	0.037*
Cis female	1191 (47.4)	735 (49.1)	456 (44.8)		
Cis male	1324 (52.6)	763 (50.9)	561 (55.2)		
Age (years)		<i>Mdn</i> = 31–40	<i>Mdn</i> = 31–40	$\chi^2 = 3.372$, <i>df</i> = 5	0.643
18–30	858 (34.1)	497 (33.2)	361 (35.5)		
31–40	579 (23.0)	341 (22.8)	238 (23.4)		
41–50	517 (20.6)	323 (21.6)	194 (19.1)		
51–60	459 (18.3)	278 (18.6)	181 (17.8)		
61–70	86 (3.4)	49 (3.3)	37 (3.6)		
>70	16 (0.6)	10 (0.7)	6 (0.6)		
Sexual orientation				$\chi^2 = 29.80$, <i>df</i> = 5	<0.001**
Exclusively opposite-sex	1359 (54.0)	782 (52.2)	577 (56.7)		
Mostly opposite-sex	595 (23.7)	383 (25.6)	212 (20.8)		
Equally both sex	331 (13.2)	220 (14.7)	111 (10.9)		
Mostly same-sex	61 (2.4)	33 (2.2)	28 (2.8)		
Exclusively same-sex	108 (4.3)	45 (3.0)	63 (6.2)		
Pansexual	61 (2.4)	35 (2.3)	26 (2.6)		
Number of inhabitants in place of residence	<i>Mdn</i> = 20,000–100,000	<i>Mdn</i> = 20,000–100,000	<i>Mdn</i> = 20,000–100,000	$\chi^2 = 17.58$, <i>df</i> = 5	0.004*
<5000	444 (17.7)	282 (18.8)	162 (15.9)		
5000–20,000	495 (19.7)	319 (21.3)	176 (17.3)		
20,000–100,000	563 (22.4)	340 (22.7)	223 (21.9)		
100,000–500,000	435 (17.3)	246 (16.4)	189 (18.6)		
500,000–1 Mio	218 (8.7)	116 (7.7)	102 (10.0)		
>1 Mio	360 (14.3)	195 (13.0)	165 (16.2)		
Change in employment and remote work				$\chi^2 = 3.11$, <i>df</i> = 4	0.54
No change (remote work)	257 (10.2)	148 (9.9)	109 (10.7)		
No change (no remote work)	945 (37.6)	562 (37.5)	383 (37.7)		
Change (partially remote work)	378 (15.0)	238 (15.9)	140 (13.8)		
Change (full time remote work)	614 (24.4)	367 (24.5)	247 (24.3)		
Lost job	321 (12.8)	183 (12.2)	138 (13.6)		
Child care				$\chi^2 = 176.01$, <i>df</i> = 1	<0.001**
No child	1898 (75.5)	990 (66.1)	908 (89.3)		
1 or more children	617 (24.5)	508 (33.9)	109 (10.7)		
Number of people in participants' households				$\chi^2 = 617.94$, <i>df</i> = 3	<0.001**
Living alone	768 (30.5)	181 (12.1)	587 (57.7)		
1 person	818 (32.5)	646 (43.1)	172 (16.9)		
2 persons	429 (17.0)	281 (18.8)	148 (14.6)		
3 or more persons	500 (19.9)	390 (25.8)	110 (10.8)		

as “in a relationship” and analyzed in this group. The same principle was applied for people who were not in a relationship, i.e., data of participants who were single before and during physical distancing measures were grouped and analyzed. Data of participants whose relationship status did change during the physical distancing measures were not analyzed. Furthermore, we analyzed changes in the frequencies of sexual activities separately for men and women in

both subgroups, i.e., women who have been in a relationship, single women, men who have been in a relationship as well as single men who have been single.

Statistical analyses

Statistical analyses were conducted in IBM SPSS Statistics 26 (Arbuckle, 2019). Sample characteristics were compared

Table 2 Changes in frequency of sexual activities in participants in a relationship ($n = 1498$) before and during physical distancing measures.

Sexual behavior in participants in relationships						
	Median before the pandemic	Median during the pandemic	Z	P	r	
Hugging	6	6	-7.659	<0.001 ^a	0.197	
Cis female	6	6	-4.914	<0.001 ^a	0.127	
Cis male	6	6	-5.576	<0.001 ^a	0.144	
Kissing	6	6	-10.285	<0.001 ^a	0.266	
Cis female	6	6	-7.190	<0.001 ^a	0.186	
Cis male	6	6	-7.373	<0.001 ^a	0.190	
Touching of genitals	6	5	-10.583	<0.001 ^a	0.273	
Cis female	6	6	-7.222	<0.001 ^a	0.186	
Cis male	5	5	-7.697	<0.001 ^a	0.199	
Oral sex	2	1	-6.698	<0.001 ^a	0.173	
Cis female	2	2	-4.724	<0.001 ^a	0.122	
Cis male	1	1	-4.761	<0.001 ^a	0.123	
Vaginal intercourse	5	2	-9.466	<0.001 ^a	0.244	
Cis female	5	5	-6.750	<0.001 ^a	0.174	
Cis male	2	1	-6.691	<0.001 ^a	0.172	
Anal intercourse	1	1	-0.333	0.74	—	
Cis female	1	1	-0.615	0.538	—	
Cis male	1	1	-0.955	0.339	—	

Sexual activities were reported on a 1–6 scale: 1: at least once a month or less; 2: once every 2 weeks; 3: about once a week; 4: several times per week; 5: every day; 6: several times a day

^a $P < 0.001$, due to multiple comparisons the alpha-level has been Bonferroni-adjusted ($\alpha = 0.0083$).

segregated by relationship status (partnered participants and those who were single) and gender (cis female and cis male). χ^2 -test were carried out to analyze statistical differences in the demographic data. For changes in the frequency of sexual activities (e.g., vaginal intercourse) as well as in the frequency of masturbatory behavior we ran Wilcoxon signed-rank tests for each subgroup comparing responses before pandemic measures with those for the time with physical distancing measures. To predict the probability of adding new sexual practices while physical distancing measures were implemented, we used multiple logistic regression analysis with three continuous predictors (sociosexuality, relationship satisfaction, and sexual attraction to one's partner) and gender as a categorical predictor.

Results

Sample

In total, $n = 2774$ participants completed the online survey without any missing data for the variables relevant for this study. Due to the small numbers, the groups of trans ($n = 70$) and diverse ($n = 31$) identified participants' data and data of asexual participants ($n = 12$) were excluded from analyses. Participants' whose relationship status changed during physical distancing measures were also excluded: 49 participants were single before physical distancing measures and partnered during physical distancing measures, while 97 were partnered before and single during physical distancing measures. Finally, $n = 2515$ participants were included in this study. Two thousands and four hundred and

thirty-three (96.7%) participants resided in Germany, 14 (0.6%) in Switzerland, and 8 (0.3%) in Austria. Median age was $Mdn = 31$ –40 years. Out of all included participants, $n = 1498$ reported being in a relationship before physical distancing measures and at the time of assessment. Sample characteristics and statistical differences in response frequencies using χ -tests are reported in Table 1. In all, 68.7% of the participants in a relationship lived together with a partner, 16.6% lived in a different household but in the same place of residence and 14.8% had a long-distance relationship. In all, 73.5% of partnered participants agreed mostly or absolutely with governmental pandemic measures and 87.4% followed these mostly or absolutely in their private lives. In all, 72.3% of the singles agreed mostly or absolutely with governmental pandemic measures and 86.9% followed these mostly or absolutely in their private lives.

Reproductive aims and use of contraception

Regarding partnered participants, 26.5% did not use contraceptives, while 71.3% did use contraceptives before and during physical distancing measures. During physical distancing measures, 0.9% of participants in a relationship did stop the use of contraceptives, while 1.3% started the use of contraceptives. Out of the participants who were not in a relationship, 74.6% used contraceptives and 23.4% did not use contraceptives before and during physical distancing measures. In all, 1.1% of singles stopped and 0.9% started the use of contraceptives during physical distancing measures.

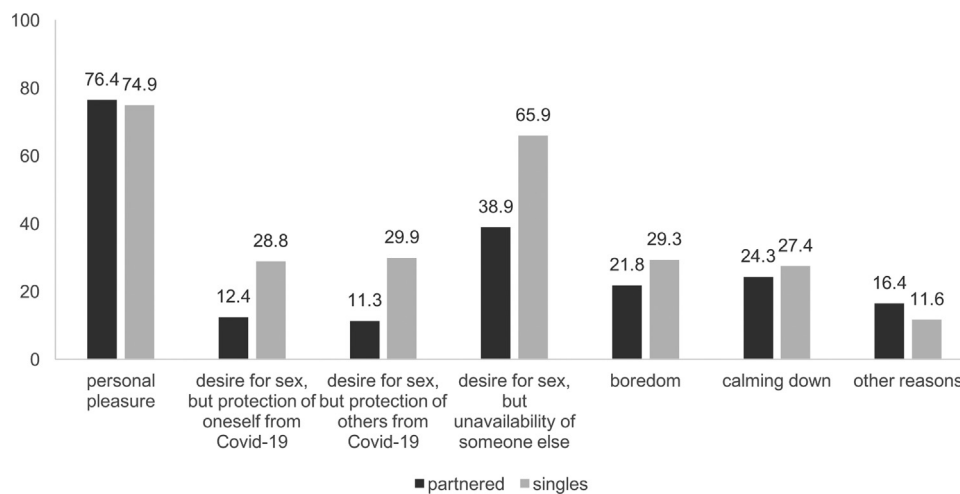


Figure 1 Reasons for masturbatory behavior of partnered ($n=1498$) and single ($n=1017$) participants in percent during physical distancing measures. Multiple reasons could be selected, therefore percentages add up to more than 100.

Masturbatory behavior

Wilcoxon signed-rank tests revealed that for participants in a relationship the frequency of masturbatory behavior was significantly lower during physical distancing measures, compared to the period before ($Z = -7574$; $P < 0.001$; $r = 0.19$). When analyzing separately male and female participants in a relationship, we found that a stronger decrease for women ($Z = -7719$, $P < 0.001$, $r = 0.28$) than for men ($Z = -2101$, $P = 0.036$, $r = 0.076$). On the other hand, singles over showed an statistically non-significant increase in the frequency of masturbation during the physical distancing measures compared to the time before ($Z = -1872$; $P = 0.061$; $r = 0.06$). Male single participants masturbated significantly more since the beginning of physical distancing measures ($Z = -4719$, $P < 0.001$, $r = 0.199$), whereas female single participants reported a decreased frequency which was not statistically significant ($Z = -1570$, $P = 0.116$, $r = 0.073$). Reasons for contraceptive usage are reported in Fig. 1.

Frequency of partnered sexual activities before and during the pandemic

Wilcoxon signed-rank tests were used to analyze changes in the frequency of specific partnered sexual activities. Most sexual activities occurred less frequently during the physical distancing measures compared to the time before. For singles and participants in a relationship of both genders post-test ranks for hugging, kissing, touching of genitals, oral sex and vaginal intercourse were statistically significantly lower than the pre-test ranks, i.e., that there was a general decline in sexual activity for our population sample with weak to moderate effects for participants in a relationship and moderate to strong effects for singles. (cf. Table 3).

Additional sexual practices

In all, 70.6% of the total sample reported no additional sexual practice since the beginning of the COVID-19-related contact restrictions (71.2% of singles vs. 70.2% of partnered participants). In all, 19.5% of all participants reported that

they had tried one additional sexual practice (19.8% of singles vs. 19.4% of partnered participants). In all, 9.9% of the whole sample (9.0% of singles vs. 10.4% of partnered participants) reported more than one additional sexual practice during the COVID-19-related measures.

Associations between additional sexual practices, sociosexuality, partner attraction and relationship satisfaction

For participants in a relationship, correlation coefficients between relationship satisfaction, sociosexual behavior, sociosexual attitudes, sociosexual desire, physical sexual attraction to the partner, feelings of affection during partnered sexual activities to the partner and difference in variety of sexual practices are reported in Table 4.

Logistic regression analysis for adding new sexual practices

Logistic regression analysis was used to predict the probability of adding new sexual practices during the implementation of physical distancing measures. We first transformed the dependent variable of new sexual practices added during physical distancing measures into a dichotomous outcome (i.e., 0 = no sexual practices added, 1 = sexual practices added). While adjusting for gender, all three subscales of sociosexuality, two subscales of attraction to one's partner (i.e., physical sexual attraction and feelings of affection during partnered sexual activity) and relationship satisfaction served as continuous predictors. The regression model was significant ($\chi^2(7) = 14.887$, $P = 0.037$), whereas physical sexual attraction was the only significant predictor in the model ($\beta = 0.337$, $SE \beta = 0.138$, $Wald(1) = 5.310$, $P = 0.021$). Thus, there was no significant association between all facets of sociosexuality, relationship satisfaction and feelings of affection during partnered sexual activity with the binary outcome variable. Nevertheless, for each one-unit increase in physical sexual attraction to one's partner the probability of adding new sexual

Table 3 Changes in frequency of sexual activities in participants who were single ($n = 1017$) before and during physical distancing measures.

Sexual behavior in single participants						
	Median before the pandemic	Median during the pandemic	Z	P	r	
Hugging	6	1	-20.398	<0.001 ^a	0.639	
Cis female	6	1	-14.227	<0.001 ^a	0.446	
Cis male	5	1	-14.673	<0.001 ^a	0.46	
Kissing	1	1	-12.403	<0.001 ^a	0.39	
Cis female	1	1	-7.989	<0.001 ^a	0.25	
Cis male	1	1	-9.544	<0.001 ^a	0.299	
Touching of genitals	1	1	-10.508	<0.001 ^a	0.329	
Cis female	1	1	-5.728	<0.001 ^a	0.179	
Cis male	1	1	-9.036	<0.001 ^a	0.283	
Oral sex	1	1	-8.873	<0.001 ^a	0.278	
Cis female	1	1	-4.301	<0.001 ^a	0.134	
Cis male	1	1	-7.948	<0.001 ^a	0.249	
Vaginal intercourse	1	1	-8.308	<0.001 ^a	0.261	
Cis female	1	1	-5.147	<0.001 ^a	0.161	
Cis male	1	1	-6.677	<0.001 ^a	0.209	
Anal intercourse	1	1	-5.063	<0.001 ^a	0.159	
Cis female	1	1	-2.602	0.009	-	
Cis male	1	1	-4.359	<0.001 ^a	0.137	

Sexual activities were reported on a 1–6 scale: 1: at least once a month or less; 2: once every 2 weeks; 3: about once a week; 4: several times per week; 5: every day; 6: several times a day

^a $P < 0.001$, due to multiple comparisons the alpha-level has been Bonferroni-adjusted ($\alpha = 0.0083$).

Table 4 Bivariate correlation between relationship satisfaction, sociosexuality, affective and physical sexual attraction towards partner and number of additional sexual practices during the pandemic for participants who have been in a relationship and did not change their relationship status ($n = 1498$).

	1	2	3	4	5	6	7
1. Relationship satisfaction	1.00	-0.079 ^a	-0.101 ^a	-0.252 ^a	0.529 ^a	0.647 ^a	-0.003
2. Sociosexual behavior	-0.079 ^a	1.00	0.585 ^a	0.481 ^a	-0.026	-0.117 ^a	0.107 ^a
3. Sociosexual attitudes	-0.101 ^a	0.585 ^a	1.00	0.550 ^a	-0.071 ^a	-0.172 ^a	0.077 ^a
4. Sociosexual desire	-0.252 ^a	0.481 ^a	0.550 ^a	1.00	-0.229 ^a	-0.269 ^a	0.110 ^a
5. Physical sexual attraction	0.529 ^a	-0.026 ^a	-0.071 ^a	-0.229 ^a	1.00	0.619 ^a	0.095 ^a
6. Feelings of affection during partnered sexual activities	0.647 ^a	-0.117 ^a	-0.172 ^a	-0.269 ^a	0.619 ^a	1.00	0.032
7. Number of additional practices	-0.003	0.107 ^a	0.077 ^a	0.110 ^a	0.095 ^a	0.032	1.00

Note: because of violation of normal distribution of the relationship satisfaction values (participants in general reported high relationship satisfaction. $M = 3.3$) Spearman Rho (ρ) correlation coefficients were used.

^a $P < 0.01$.

practices increases by 37.3%. Nearly the same results were found when adjusting for age (cf. Table 5).

As can be seen in Table 6, our model does not predict the outcome of adding new sexual practices during physical distancing measures correctly. Overall, the model did show poor goodness-of-fit and thereby a neglectable proportion of variance is explained (Nagelkerke $R^2 = 0.026$).

Discussion

The coronavirus pandemic is an unprecedented global health crisis of vast extent. In addition, the measures necessary

to limit the spread of the virus might have far-reaching effects on the social and economic order. Previous studies have shown the disruptive effects on sexual routines during the physical distancing measures. In our cross-sectional online survey, we aimed to assess the sexual behavior of participants before and during the COVID-19 pandemic, with a focus on the analyses of differences between partnered and single participants. In both analyzed groups, most participants agreed with governmental measures and followed these in their private lives.

The majority of our study population did not change contraceptive use after the beginning of pandemic related restrictions. Partnered participants masturbated

Table 5 Logistic regression analysis of participants who were in a relationship ($n = 1498$) for adding new sexual practices during physical distancing measures.

Predictor	e^{β}			e^{β}		
	OR	95% CI	P	OR age-adjusted	95% CI	P
Gender	1.275	0.782–2.079	0.330	1.238	0.741–2.071	0.415
Relationship satisfaction	0.966	0.599–1.559	0.888	0.967	0.599–1.599	0.890
Sociosexual behavior	1.076	0.858–1.350	0.525	1.065	0.843–1.346	0.599
Sociosexual attitudes	0.869	0.694–1.088	0.221	0.874	0.696–1.097	0.247
Sociosexual desire	1.175	0.928–1.488	0.180	1.171	0.924–1.484	0.191
Physical sexual attraction	1.373	1.049–1.798	0.021 ^a	1.377	1.051–1.805	0.020 ^a
Feelings of affection during partnered sexual activity	1.070	0.766–1.494	0.693	1.070	0.766–1.494	0.692

Note: "female" served as the reference group for gender as a categorical predictor.

^a $P < 0.05$.

Table 6 Observed and predicted frequencies for adding new sexual practices during physical distancing measures by logistic regression analysis with the cut-off of 0.50.

Observed	Predicted		% correct
	No practices added	Practices added	
No practices added	1401	0	100.00
Practices added	97	0	0.00
Overall % correct			93.5

significantly less during physical distancing measures compared with the period before. Participants without relationships showed a trend towards higher masturbation frequencies during physical distancing measures without reaching significance. Frequencies of all sexual activities including genital and non-genital physical contact to another person significantly decreased in both groups, with the exception of anal intercourse in partnered participants (which was only rarely practiced in this group, even before physical distancing measures). In general, the effects were more pronounced in participants without a relationship – as can be seen by stronger effect sizes for all kinds of sexual activities (cf. Table 3). The integration of additional sexual practices by couples was linked to sociosexual characteristics and physical sexual attraction to their partner, but not to their reported relationship satisfaction or feelings of affection for their partner during partnered sexual activities.

Only one percent of participants in each of both groups stopped the use of contraceptives after the implementation of physical distancing measures. This might indicate that the participants included in our analysis – independent of their relationship status – did not intend to become pregnant during physical distancing measures. According to our findings, cross-sectional data from China report no changes in condom use (Li et al., 2020). Longitudinal data from Turkey show a decrease in the desire to get pregnant amongst married women (Yuksel and Ozgor, 2020). However, in the Turkish study, despite a decrease in sexual desire, the use of contraceptives declined significantly, and in the Chinese study, 10% of participants reported a shortage of contraception.

Thus, shortage of medication should be also considered as a reason for increased birth rates following a crisis.

The decline in partnered sexual activities is in line with findings from other countries (Fuchs et al., 2020; Lehmillier et al., 2020). The separate analyses of participants in a relationship indicate that the repercussions on people's sexual lives may not be fully explained by physical distancing measures to limit the spread of the virus (68.7% living in the same household/were not separated from their partner). One explanation for this decline might be mood-related effects on sexual behavior and sexual functioning due to uncertainty and fear, as previously described (Bancroft et al., 2003). An association between mood and sexual activity was also reported by Mollaioli et al. (2021) in a study population showing higher rates of symptoms of depression and anxiety in sexually inactive subjects in Italy. But as longitudinal data are missing it remains unclear if mood affects sexual activity or sexual inactivity has a negative effect on mood.

Partnered participants reported significantly lower frequencies of masturbation during physical distancing measures compared with the period before, with a stronger effect in females. Single females reported a low frequency of masturbation which was not significant. Similar trends have been reported by other study samples independent of relationship status (Lehmillier et al., 2020). A lack of sufficient privacy due to the continuous presence of partners, children or parents, which might be more prevalent among participants with partners in our study sample, might have contributed to this result. The reverse trend towards an increase of masturbation rates of single males analyzed in this study and living alone more frequently might be

explained by an absence of these potential obstacles. Moreover, mental states like stress or loneliness which have been linked to the performance of new sexual practices during the pandemic (Lehmiller et al., 2020) as well as might be more prevalent in singles. The reverse trend of masturbation frequency in singles and associated factors (e.g. stronger impact of distress on sexual desire in females) remain to be studied in future research.

Lehmiller et al. (2020) could show that the introduction of new sexual practices correlated positively with quality of sex life during the pandemic. Potential contributing factors to this change of sexual routines could be found both on intrapersonal and interpersonal level. Accordingly, on an intrapersonal level, we assessed sociosexuality, whereas relationship satisfaction and sexual attraction to one's partner served as interpersonal variables. Sociosexuality in general and sociosexual desire specifically show the strongest link to adding new sexual practices, whereas more dyadic constructs regarding the satisfaction with one's relationship did not show any statistically significant associations. These findings are in line with the results reported by Lehmiller et al. (2020) who could show that "desire for sex" was significantly associated with adopting new sexual practices, whereas "desire for partner" did not show a significant association.

The lack of association with relationship satisfaction and feelings of affection during partnered sexual activities provides further insights in the meaning of expanding the sexual repertoire during the pandemic. In the study from (Lehmiller et al., 2020) participants with higher burdens (feelings of stress and loneliness) were more likely to add new practices. New additions were subsequently interpreted as an adaption to fulfil psychological needs (Lehmiller et al., 2020). Relationship satisfaction has been shown to be linked to the ability of couples to perform stress reducing dyadic coping mechanisms (Falconier et al., 2015). Moreover, relationship satisfaction was even identified as protective factor to reduce mortality risks (Robles et al., 2014). Thus, for couples with higher rates of satisfaction with their relationship this adaption mechanism might be less urgent as they can find relief from negative mood states and stress through dyadic stress reducing behaviors. Furthermore, the lack of association to feelings of affection during partnered sexual activities and the strong correlation to relationship satisfaction ($r=0.647$) indicates they tend to seek sexual pleasure and emotional stabilization on the attachment dimension of sexuality (Beier and Loewit, 2013). After adjusting for gender and age in the multivariate analysis only physical sexual attraction increased the probability of adding new sexual practices significantly.

The main limitation of our study is the online-based recruitment procedure and the retrospective data acquisition on the frequency of sexual contacts and sexual practices. Firstly, the online-based data collection in a non-representative sample does not allow for the generalization of this sample's findings on the total population of Germany. Non-representative studies on sexual behavior might be biased by attracting participants with sex positive attitudes. Secondly, tech-based tools for data collection might have created a bias in behavioral data by attracting participants who are in favor of using technical devices also in sexual activities (e.g. sex toys) and might be more open to

integrating additional sextech-solutions in times of enforced physical distancing measures. Thirdly, the time spans for the retrospective data acquisition and the time during physical distancing measures differed and might have caused a recall-bias effect. Fourthly, the multiple logistic regression analysis shows poor goodness-of-fit and did not predict the probability of adding new sexual practices. Adjusting for further sociodemographic variables (e.g. level of education and socioeconomic status) did not impact the results or the model's goodness-of-fit significantly. Therefore, we assume that other factors that have not been assessed in our study may account for the proportion of variance not explained by our model. The required explorative study design of studies in the first phase of the pandemic is limited to identifying and selecting relevant variables and building hypotheses based on previous research findings.

Despite the short period of strict physical distancing measures in Germany, this study was able to collect data on the sexual behavior of a relatively large study sample. With respect to all limitations, our analysis shows a decrease in partnered sexual activities in our study population. The finding that this affected also participants in relationships adds important and relevant information to the implications of the COVID-19 pandemic on sexual behavior.

Particularly for participants in a relationship living in the same household this observation cannot be explained by following the governmental measures and needs to be further investigated. For both groups, the disruptive effects of the COVID-19 pandemic and physical distancing measures on sexual, social and emotional well-being, will be needed to be studied further. In order to better understand and also address these concerns in clinical settings, further studies are needed to investigate the associated and causal factors of sexual health during the pandemic.

Conclusion

To our knowledge, this is the first cross-sectional study focusing on changes in sexual behavior during the COVID-19 outbreak in German-speaking countries. Our results show that the frequency of a range of sexual activities declined significantly for single and partnered participants in this study. For participants in relationships an expansion of the sexual repertoire could not be detected in couples with higher rates of relationship satisfaction and feelings of affection during sexual activities. Given that sexual health is an important aspect of overall health and well-being, a significant disruption of sexual routines during the COVID-19 pandemic should be addressed in interdisciplinary research teams and in multiple clinical settings. Further studies are needed to investigate the long-term effects COVID-19 pandemic and physical distancing measures on relationships and sexual health in order to identify further clinical implications.

Disclosure of interest

The authors declare that they have no competing interest.

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