



Changes in Penile-Vaginal Intercourse Frequency and Sexual Repertoire from 2009 to 2018: Findings from the National Survey of Sexual Health and Behavior

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Abstract

Solo and partnered sexual behaviors are relevant to health, well-being, and relationships. Recent research shows that sexual frequency has declined in the U.S. and in other countries; however, measurement has been imprecise. We used data from 14- to 49-year-old participants in the 2009 and 2018 waves of the National Survey of Sexual Health and Behavior (NSSHB), a confidential U.S. nationally representative survey that is conducted online. We aimed to: (1) assess changes in frequency of past-year penile-vaginal intercourse and (2) examine combinations of past-year sexual behaviors for each of the two waves. We hypothesized that we would observe lower frequency of penile-vaginal intercourse (PVI) from 2009 to 2018 and that we would observe greater engagement in sexual repertoires involving non-coital partnered behaviors (e.g., partnered masturbation, oral sex) in 2018 as compared to 2009. Participants were 4155 individuals from the 2009 NSSHB (Adolescents: 406 females, 414 males; Adults: 1591 women, 1744 men) and 4547 individuals from the 2018 NSSHB (Adolescents: 416 females, 411 males; Adults: 2007 women, 1713 men). Compared to adult participants in the 2009 NSSHB, adults in the 2018 NSSHB were significantly more likely to report no PVI in the prior year (28% in 2018 vs. 24% in 2009). A similar difference in proportions reporting no PVI in the prior year was observed among 14–17-year-old adolescents (89% in 2018 vs. 79% in 2009). Additionally, for both adolescents and adults, we observed decreases in all modes of partnered sex queried and, for adolescents, decreases in solo masturbation.

Keywords Sexual frequency · Sexual repertoire · National Survey of Sexual Health and Relationships · Penile-vaginal intercourse frequency · Masturbation

Introduction

Solo and partnered sexual behavior contribute to mental and physical health, sexual and gender identity development, reproduction, cognitive function, happiness, sexual pleasure

and well-being, interpersonal relationships, and quality of life (e.g., Kaestle & Allen, 2011; Levin, 2007; Lindau et al., 2007; Mitchell et al., 2013; Schmiedeberg et al., 2017; Sprott & Benoit Hadcock, 2018; World Health Organization, 2006). Also, people who are more satisfied in their romantic/sexual relationships and/or who are healthier and lack sleep difficulties tend to be more sexually active (e.g., Field et al., 2013; Hess et al., 2009; Lindau & Gavriloiva, 2010; McNulty et al., 2016).

Declines in Sexual Frequency

Recently, studies from the USA, the UK, Australia, Germany, and Japan have observed declines over time in partnered sexual activity. Researchers have expressed concern about such declines, given the consequences on human fertility and relationship happiness as well as what potential declines in partnered sexual frequency may reflect about

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the influences of social media platforms, environmental influences on people's hormones, and overall changes to human connection and intimacy (e.g., Twenge et al., 2017; Wellings et al., 2019). Despite the consistency of these cross-national findings, multiple interpretations for these shifts have been proposed, including the idea that the decline in frequency may be associated with changes in sexual repertoire—increased quality of sex in the context of decreased frequency (e.g., Herbenick et al., 2010b; Richters et al., 2006). For example, using data from US adults ages 18 and older in General Social Survey (GSS) waves conducted between 1989 and 2014, Twenge et al. (2017) found that sexual frequency had declined over time—particularly among midlife cohorts and individuals with school-aged children. Strengths of the GSS include its robust sample size, methodology, and ability to support comparisons across decades; however, these strengths are tempered by the broad coverage of the GSS and thus the little space allocated to sexual behavior assessment. The GSS item used for the Twenge et al. (2017) analysis asks, “About how often did you have sex during the last 12 months?” even though how people interpret questions about having “sex” can vary considerably based on age, gender, sexual identity, and the intersections of these (Byers et al., 2009; Hille et al., 2020; McBride et al., 2017; Sanders & Reinisch, 1999; Schick et al., 2016).

Wellings et al. (2019)—using three waves of data from the UK's National Surveys of Sexual Attitudes and Lifestyles (Natsal) completed in 1991, 2001, and 2012—found that frequency of sex among 16–44 year olds had declined, more so among married participants and those in the 35–44 age group. The Natsal analysis used an item that asked about frequency of sex in the prior four weeks, clarifying to participants that “this means vaginal intercourse, oral sex, anal sex.” In Germany, researchers compared data from two waves of a representative sample of women and men ages 18–99 and found that past-year sexual activity had declined from 2005 to 2016, though this was largely attributed to declining proportions of people cohabitating with a partner. In the German study, past-year sexual activity was measured with the item, “Were you intimate with someone in the past 12 months? Yes or no?” (Beutel et al., 2018; Burghardt et al., 2020). Further, small but significant declines in sexual frequency were described between the 2001/2002 and 2012/2013 waves of the Australia Studies of Health and Relationships (ASHR) among individuals ages 16–59, but so were expanded overall sexual repertoires (that is, more people reporting engaging in masturbation and sex toy use, among other non-coital sexual behaviors) (de Visser et al., 2014).

Other research has examined population-level sexual behavior trends by examining the proportion of the population reporting no partnered sex in a given year (termed

“sexually inactive” people). Using 1987–2015 data from 18- to 39-year-old adult participants in the National Fertility Survey of Japan, Ghaznavi et al. (2019) found increases in the proportion of young adults reporting never having had “sexual intercourse with someone of the opposite sex” (the authors note that the term used in the survey—*seikosho*—is typically used to refer to vaginal intercourse). Ueda et al. (2020) used data from 10 rounds of the GSS to demonstrate increases in the proportions of 18–24-year-old US men reporting no partnered sex in the prior year as well as greater proportions of 25–34-year-old US women and men reporting no partnered sex in the prior year. Taken together, these studies from multiple countries demonstrate some level of decline in partnered sexual activities, at least among some age groups. Each of these studies has used population-based probability sampling (considered the gold standard in survey research; Catania et al., 2015), yet the measurement of sexual activity and/or frequency differs across studies and has at times been imprecise. Although these methodological and measurement differences hinder direct comparisons across countries, the consistency of findings supports a true secular decline in partnered sexual behaviors.

Sexual Repertoire

One aspect of sexual frequency that is understudied at the population level relates to a person's overall sexual repertoire. Assessing sexual repertoire expands understandings of how people have sex, beyond just engagement in “sex,” “intimacy,” or intercourse in the prior month or year. Studies in Australia (Richters et al., 2006), France (Messiah et al., 1995), and the USA (Herbenick et al., 2010b) have examined the composition of behaviors at sexual events for individuals and report that certain sexual behaviors are correlated within sexual events. As examples, oral sex and penile-vaginal intercourse (PVI) may be correlated (Herbenick et al., 2010b) as are giving and receiving oral sex (Messiah et al., 1995). The present research extends ideas about sexual repertoire by considering the diversity of people's sexual behaviors over the course of a year and to what extent such sexual behaviors may cluster among groups of people. Because the NSSHB is US nationally representative, spans a decade as of this writing, and includes a detailed assessment of past year sexual behaviors (e.g., solo and partnered masturbation, giving and receiving oral sex, PVI, anal intercourse), it is an ideal dataset to use to examine questions about potential changes in specific sexual behaviors over time.

Study Aims

Using data from participants in the 2009 and 2018 waves of the National Survey of Sexual Health and Behavior (NSSHB), separately for adolescents (14–17 years) and

adults (18–49 years), we aimed to: (1) assess changes in frequency of past-year PVI and (2) examine combinations of past-year sexual behaviors across the two waves. We hypothesized that we would observe lower frequency of PVI from 2009 to 2018. We also hypothesized that we would observe decreases in past-year PVI but increases in non-coital partnered behaviors (such as oral sex and anal sex) in 2018 as compared to 2009.

Method

Participants

The methods for the 2009 and 2018 NSSHB survey waves have been described in detail elsewhere (e.g., Fortenberry et al., 2010; Fu et al., 2019; Herbenick et al., 2010a; Reece et al., 2010). The NSSHB is a US nationally representative probability survey of adolescents and adults in the USA that was initiated in 2009, with six subsequent data collection waves occurring between 2012 and 2018 (Beckemeyer et al., 2019; Carter et al., 2019; Guerra-Reyes et al., 2018; Hensel et al., 2015; Herbenick et al., 2019a, 2019b).

The NSSHB uses internet-based surveys administered by Ipsos (formerly GfK and Knowledge Networks) through their KnowledgePanel®. KnowledgePanel® members are recruited using address-based sampling via the US Postal Service's Delivery Sequence File, with recruitment occurring through an initial invitation letter, a reminder postcard, follow-up letter, and telephone calls when a matched landline telephone number is available. That is, KnowledgePanel® is established through probability-based sampling of US households and not through convenience methods (e.g., people cannot volunteer for the panel, and it is not an opt-in panel). Households without internet connection are provided with a web-enabled device and internet access upon enrollment. Further weighting adjustments, using the latest Current Population Survey (CPS) distribution as a benchmark, are then applied to account for minor differential attrition rates among recruited panel members. Ipsos then used a probability proportional to size procedure to identify a sampling frame for each wave of the NSSHB.

All sampled adults received an invitational message from Ipsos with a link to an IRB-approved study information sheet. Those who consented to participate could then proceed to the online survey. Adolescents ages 14–17 were invited to participate only if their parent/guardian first consented to their invitation to participate. As incentives, KnowledgePanel® members who complete surveys can earn points to accumulate toward cash rewards or merchandise.

Once data collection was complete, Ipsos created post-stratification weights to maximize generalizations to the US population. The post-stratification weights were generated

using an iterative proportional fitting (raking) procedure to ensure alignment with respect to all study benchmark distributions (gender, age, race/ethnicity, Census region, household income, home ownership status, metropolitan area, and internet access) based on the latest CPS.

Measures

Demographic and Other Key Variables

Demographic variables such as age, gender, race/ethnicity, marital status, annual household income, education, and adult employment status were collected as part of the research panel's recruitment and retention efforts. The 2009 and 2018 measures were identical.

Penile-Vaginal Intercourse Frequency

Participants were asked, "Thinking about the past year, about how often have you engaged in penile-vaginal intercourse?" Response options included: not at all, a few times in the past year, once a month, a few times per month, once a week, 2–3 times per week, and almost every day. Similar to measures used in prior studies (Laumann et al., 1994; Twenge et al., 2017) frequency of PVI in the past year is reported using a score ranging from 0 (not at all) to 6 (almost every day).

Sexual Repertoire

Participants were asked, "How recently have you..." (1) masturbated alone; (2) masturbated with a partner; (3) given oral sex to someone; (4) had someone give you oral sex; (5) had penile-vaginal intercourse; (6) had someone put their penis in your anus; or (7) (males only) put your penis in someone's anus. Response options were: done in the past 30 days, done in the past 90 days, done in the past 6 months, done in the past year, done more than a year ago, and never done this.

Statistical Analysis

For Hypothesis 1—that we would observe a lower frequency of penile-vaginal intercourse from 2009 to 2018—linear regression was used to analyze the associations between survey year and PVI frequency. Similar to Twenge et al. (2017), we examined PVI frequency in two ways: (1) categorically from 0 to 6 (corresponding to the response options described above in Measures) and (2) with numerical estimates calculated by calculating an annual frequency based on the response categories (not at all = 0, a few times in the past year = 3, once a month = 12, a few times a month = 36,

2–3 times/week = 130, almost every day or every day = 365). For adults, the covariates were age, race/ethnicity, income, marital status, education, and employment. For adolescents, the model was adjusted for age and race/ethnicity.

For Hypothesis 2—that we would observe decreases in past-year PVI but increases in non-coital partnered sexual behaviors (such as oral sex and anal sex) in 2018 as compared to 2009—we did the following: First, sexual repertoire categories were dichotomized to participants that reported having engaged in a particular behavior “more than a year ago or never” and “at least once in the past year.” Having engaged in receptive or insertive anal sex was re-categorized as “anal intercourse.” Descriptive statistics were calculated for sexual repertoire categories in each of the 2009 and 2018 waves. Then, separately for adults and adolescents, Chi-squared tests were performed to examine whether there were different trends between the 2009 and 2018 waves for each sexual repertoire category (e.g., solo masturbation, partnered masturbation, etc.). Because they require different statistical weights in the dataset, all analyses were done separately for adults (18–49 year olds) and adolescents (14–17 year olds).

To identify the latent subgroups engaging in similar patterns of behaviors in the population, Latent Class Analysis (LCA) was performed for both adolescents and adults in each of the 2009 and 2018 waves. LCA loadings are the conditional probability that someone in a particular class would have engaged in a certain sexual behavior at least once in the last year. The items with higher loadings for a specific class are considered to be part of that class. Afterwards, linear regressions were done to examine the associations between class, survey year and PVI frequency. All analyses were done using SAS for Windows 9.4 (SAS Institute, Cary, NC, USA).

Results

Participants

A total of 1647 adolescents ages 14–17 and 7055 adults ages 18–49 were included from both waves of data. A total of 820 adolescents and 3335 adults (3070 weighted) were from the 2009 NSSHB, while 827 adolescents and 3720 adults (3719 weighted) were from the 2018 NSSHB. Additional demographic characteristics are shown in Table 1.

Past Year Frequency of Penile-Vaginal Intercourse

Hypothesis 1 was supported. Compared to adult participants in the 2009 NSSHB, those in the 2018 NSSHB were significantly more likely to report no PVI in the prior year (28% in 2018 vs. 24% in 2009). A similar difference in proportions

reporting no PVI was observed in the adolescent sample (89% in 2018 vs. 79% in 2009).

Among adult participants, those who reported no PVI in the prior year were significantly more likely to be in the 18–2-year-old age category, Black/non-Hispanic, never married, have a lower household income (< \$50,000/year), and less likely to have a college degree (Table 2). We also examined associations between past year PVI and other sexual behaviors. Additionally, those who reported no PVI in the prior year were also significantly less likely to report having engaged in any of the other sexual behaviors we examined.

Among adolescents, those who reported no PVI in the prior year were significantly more likely to be 14–15 (compared to 16–17). As with adults, those who reported no PVI in the prior year were also significantly less likely to report having engaged in any of the other sexual behaviors we examined. There were no statistically significant differences in PVI frequency categories and adolescent gender, race/ethnicity, or household income.

Estimated Frequency of Past Year Penile-Vaginal Intercourse

After controlling for age and race/ethnicity, adolescents in the 2009 NSSHB were estimated to have PVI 14.37 times in the past year which was significantly more than the 4.32 PVI events estimated to occur among adolescents in the 2018 NSSHB (Table 3). Among adults ages 18–49, those in the 2009 had PVI an estimated 63.2 times which was significantly more times than adults in the 2018 NSSHB who had PVI an estimated 47.0 times. These differences remained significant after adjustment for age, race/ethnicity, income, marital status, and education.

Past Year Sexual Repertoire

Hypothesis 2 was partially supported; for both adolescents and adults, we observed decreases in reports of past year PVI. However, contrary to our hypothesis we did not observe increases in any of the non-coital partnered sexual behaviors assessed (i.e., partnered masturbation, giving oral sex, receiving oral sex, anal intercourse). In fact, all modes of partnered sex were reported less frequently in the past year in the 2018 NSSHB than in 2009.

Among 14–17-year-olds, significantly fewer 2018 NSSHB participants reported having engaged in every past year sexual behavior as compared to 2009 NSSHB participants—that is, in 2018 significantly fewer adolescents reported having engaged in solo masturbation, partnered masturbation, giving oral sex, receiving oral sex, PVI, and anal intercourse (Table 4).

Table 1 Characteristics of the unweighted and weighted sample, overall and by frequency of penile vaginal intercourse, $n = 1647$ Americans age 14–17, 2009 and 2018

Characteristic	Unweighted overall $N = 1647$ $N (%)$	Weighted overall $N = 1646$ $N (%)$	No penile vaginal intercourse $N = 1370$ $N (%)$	Penile vaginal intercourse < once/week $N = 155$ $N (%)$	Penile vaginal intercourse at least once/week $N = 74$ $N (%)$	p -value*
Sex						.903
Female	822 (49.9)	813 (49.4)	680 (49.6)	78 (50.5)	35 (47.3)	
Male	825 (50.1)	833 (50.6)	690 (50.4)	77 (49.5)	39 (52.7)	
Age group						< .0001
14–15	797 (48.4)	779 (47.3)	706 (51.6)	39 (25.0)	12 (15.7)	
16–17	850 (51.6)	867 (52.7)	664 (48.5)	116 (75.0)	62 (84.3)	
Race/ethnicity						.089
White, non-Hispanic	1158 (70.4)	947 (57.6)	802 (58.6)	82 (52.7)	39 (53.6)	
Black, non-Hispanic	139 (8.5)	226 (13.8)	184 (13.5)	24 (15.5)	6 (8.2)	
Other or 2+ races, non-Hispanic	151 (9.2)	135 (8.2)	105 (7.7)	14 (8.9)	13 (17.0)	
Hispanic	196 (11.9)	335 (20.4)	276 (20.2)	36 (22.9)	16 (21.1)	
Missing	$N = 3$	$N = 3$	$N = 3$	$N = 0$	$N = 0$	
Household income						.133
< \$25 k	204 (12.4)	214 (13.0)	170 (12.4)	25 (16.3)	14 (19.5)	
\$25–49 k	291 (17.7)	331 (20.1)	272 (19.9)	38 (24.4)	14 (18.8)	
\$50–74 k	376 (22.8)	305 (18.6)	264 (19.3)	26 (16.7)	9 (11.6)	
\$75–124 k	479 (29.1)	449 (27.3)	372 (27.2)	45 (28.9)	20 (27.3)	
\$125 k+	297 (18.0)	346 (21.0)	292 (21.3)	21.2 (13.7)	17 (22.9)	
Year						< .0001
2009	820 (49.8)	820 (49.8)	642 (46.9)	92 (59.4)	58 (78.7)	
2018	827 (50.2)	826 (50.2)	728 (53.1)	63 (40.6)	16 (21.3)	
Sexual repertoire categories (At least once in the past year)						
Masturbate alone	777 (48.1)	773 (47.8)	580 (42.6)	115.3 (75.3)	55.8 (75.7)	< .0001
Masturbate with partner	150 (9.3)	152 (9.4)	52 (3.8)	59 (38.1)	32 (44.4)	< .0001
Gave oral sex	214 (13.2)	201 (12.4)	49 (3.6)	83 (54.5)	60 (81.7)	< .0001
Received oral sex	243 (15.0)	248 (15.3)	59 (4.4)	104 (67.6)	68 (93.3)	< .0001
Penile-vaginal intercourse	248 (15.3)	255 (15.8)	6 (0.5)	155 (100.0)	74 (100.0)	< .0001
Anal intercourse	38 (2.3)	50 (3.1)	3 (0.2)	20 (13.0)	22 (29.8)	< .0001

Among 18–49 year-old adults, significantly fewer 2018 NSSHB participants reported having engaged in every partnered sexual behavior assessed (partnered masturbation, gave oral, received oral, PVI, anal intercourse) as compared to the 2009 NSSHB participants (Table 4). However, there were no statistically significant differences in regard to participants' reports of prior year solo masturbation for 2009 versus 2018.

Latent Class Analyses: Sexual Repertoire

For latent class analyses, we selected four classes as additional classes were redundant (Table 5). Latent Class 1 was characterized by solo masturbation only for both adolescents and adults. Latent Class 2 was characterized by no sexual

behaviors at all for adolescents, and solo masturbation and PVI for adults. Latent Class 3 was characterized by engagement in all modes of sexual behavior. Latent Class 4 was characterized by inclusion of oral genital behaviors but exclusion of partnered masturbation and anal intercourse.

Overall, among adolescents we observed a significant change in participants' distribution across the classes from 2009 to 2018 (Fig. 1). That is, membership in the Class 1 (solo masturbation), Class 3 (all sexual behaviors queried), and Class 4 decreased in frequency, whereas membership in the Class 2 (no sexual behaviors) increased in frequency from 2009 to 2018. When examining class distributions by gender, the same trend was observed for both adolescent women and adolescent men, with decreases in each of the

Table 2 Characteristics of the unweighted and weighted sample, overall and by frequency of penile vaginal intercourse, $n = 7055$ Americans age 18–49, 2009 and 2018

Characteristic	Unweighted overall $N = 7055$ N (%)	Weighted overall $N = 6789$ N (%)	No penile vaginal intercourse $N = 1715$ N (%)	Penile vaginal intercourse < once/week $N = 2359$ N (%)	Penile vaginal intercourse at least once/week $N = 2388$ N (%)	p -value*
Sex						.116
Female	3598 (51.0)	3478 (51.2)	844 (49.2)	1213 (51.4)	1254 (52.5)	
Male	3457 (49.0)	3311 (48.8)	870 (50.8)	1146 (48.6)	1134 (47.5)	
Age group						< .0001
18–24	915 (13.0)	1087 (16.0)	467 (27.2)	254 (10.8)	307 (12.9)	
25–29	1360 (19.3)	1547 (22.8)	317 (18.5)	521 (22.1)	622 (26.1)	
30–39	2331 (33.0)	2018 (29.7)	403 (23.5)	766 (32.5)	770 (32.2)	
40–49	2449 (34.7)	2138 (31.5)	528 (30.8)	818 (35.7)	689 (28.8)	
Race/ethnicity						< .0001
White, non-Hispanic	4517 (64.0)	4136 (60.9)	950 (55.4)	1504 (63.8)	1524 (63.8)	
Black, non-Hispanic	1118 (15.9)	806 (11.9)	246 (14.3)	272 (11.5)	241 (10.1)	
Other or 2+ races, non-Hispanic	523 (7.4)	565 (8.3)	163 (9.5)	201 (8.5)	152 (6.4)	
Hispanic	897 (12.7)	1283 (18.9)	356 (20.7)	381 (16.2)	471 (19.7)	
Marital status						< .0001
Married or living with partner	3993 (56.6)	3890 (57.3)	375 (21.8)	1559 (66.1)	1777 (74.4)	
Separated/divorced	590 (8.4)	515 (7.6)	160 (9.3)	189 (8.0)	147 (6.1)	
Widowed	30 (0.4)	34 (0.5)	12 (0.7)	8 (0.4)	14 (0.6)	
Never married	2442 (34.6)	2350 (34.6)	1169 (68.2)	602 (25.5)	450 (18.9)	
Household income						< .0001
< \$25 k	1267 (18.0)	987 (14.5)	378 (22.0)	271 (11.5)	287 (12.0)	
\$25–49 k	1618 (22.9)	1587 (23.4)	464 (27.0)	492 (20.9)	540 (22.6)	
\$50–74 k	1443 (20.5)	1363 (20.1)	302 (17.6)	485 (20.6)	509 (21.3)	
\$75–124 k	1813 (25.7)	1731 (25.5)	350 (20.4)	646 (27.4)	668 (28.0)	
\$125 k+	914 (13.0)	1122 (16.5)	222 (12.9)	465 (19.7)	384 (16.1)	
Education						< .0001
Less than high school	592 (8.4)	705 (10.4)	205 (11.9)	200 (8.5)	247 (10.3)	
High school	1637 (23.2)	1844 (27.1)	507 (29.6)	585 (24.8)	649 (27.2)	
Some college	2081 (29.5)	2060 (30.3)	557 (32.5)	689 (29.2)	731 (30.6)	
Bachelor's degree or higher	2745 (38.9)	2181 (32.1)	446 (26.0)	885 (37.5)	762 (31.9)	
Employment status						< .0001
Currently employed	5445 (77.2)	5123 (75.5)	1159 (67.6)	1876 (79.6)	1840 (77.1)	
Currently unemployed	1610 (22.8)	1666 (24.5)	556 (32.4)	482 (20.5)	547.7 (22.9)	
Year						< .0001
2009	3335 (47.3)	3070 (45.2)	691 (40.3)	972 (41.2)	1254 (52.5)	
2018	3720 (52.7)	3719 (54.8)	1024 (59.7)	1386 (58.8)	1134 (47.5)	
Sexual repertoire categories (at least once in the past year)						
Masturbate alone	4752 (74.4)	4716 (72.6)	1115 (65.8)	1836 (79.0)	1683 (71.2)	< .0001
Masturbate with partner	2417 (37.8)	2439 (37.5)	263 (15.4)	897 (38.6)	1230 (52.2)	< .0001
Gave oral sex	4074 (63.4)	4090 (62.7)	319 (18.7)	1690 (72.0)	2018 (85.3)	< .0001
Received oral sex	4174 (65.0)	4206 (64.4)	327 (19.1)	1737 (74.3)	2076 (87.6)	< .0001
Penile-vaginal intercourse	4774 (74.6)	4810 (74.0)	26 (1.5)	2359 (100.0)	2388 (100.0)	< .0001
Anal intercourse	1183 (18.4)	1224 (18.8)	138 (8.1)	404 (17.2)	665 (28.1)	< .0001

* p -values are for chi-square tests

Table 3 Unadjusted and adjusted linear regression for the associations between survey year (2009 vs. 2018) and penile vaginal intercourse frequency, presented for adolescents (14–17) and adults (18–49)

	Mean (SD)	Median (IQR)	Beta (95%CI)	Adjusted beta ^c (95% CI)
Age 14–17				
PVI frequency Categories ^a				
Year				
2009	0.58 (1.42)	0 (0–0)	1	1
2018	0.22 (0.84)	0 (0–0)	–0.36 (–0.47, –0.25)	–0.37 (–0.48, –0.25)
PVI frequency (Number/year estimate) ^b				
Year				
2009	14.37 (55.51)	0 (0–0)	1	1
2018	4.32 (30.11)	0 (0–0)	–10.05 (–14.42, –5.69)	–10.54 (–14.90, –6.19)
Age 18–49				
PVI Frequency Categories ^a				
Year				
2009	2.81 (2.03)	3 (1–5)	1	1
2018	2.36 (1.95)	3 (0–4)	–0.45 (–0.54, –0.35)	–0.48 (–0.58, –0.40)
PVI Frequency (Number/year estimate) ^b				
Year				
2009	63.2 (87.58)	36 (3–130)	1	1
2018	47.0 (70.52)	36 (0–52)	–16.18 (–20.03, –12.34)	–15.83 (–19.68, –11.98)

^a Penile vaginal intercourse frequency reported across 7 categories, coded 0–6: 0=“not at all,” 1=“a few times in the past year,” 2=“once a month,” 3=“a few times a month,” 4=“once a week,” 5=“2–3 times per week,” 6= “almost every day” or “every day”

^b Penile vaginal intercourse frequency number estimates calculated by assigning a number value to each of the above categories: “not at all”=0, “a few times in the past year”=3, “once a month”=12, “a few times a month”=36, “once a week”=52, “2–3 times per week”=130, and “almost every day” or “every day”=365

^c Covariates for 14–17-year-olds are age and race/ethnicity. Covariates for 18–49-year-olds are age, race/ethnicity, income, marital status, education, and employment status

three classes marked by solo and/or partnered sexual activities and increases in membership in Class 2 in 2018. Specifically, 28.8% of adolescent men ages 14–17 were categorized in Class 2 (no sexual behaviors) in 2009 compared to 44.2% in 2018. Among adolescent women, 49.5% were categorized in Class 2 in 2009 compared to 74.0% in 2018.

For adults, the distribution of classes between 2009 and 2018 was significantly different, where Class 3 decreased its frequency, while the other classes increased their frequency from 2009 to 2018. When looking at these trends by gender, in Class 1 (solo masturbation only), men had a greater increase from 2009 to 2018 than did women, while for Class 4, women increased in membership 2018 and males decreased from 2009 to 2018.

As can be seen in Table 6, in examining associations between survey year and class with PVI frequency categories, for adolescents there are significant differences by year, class, and the interaction between year and class. This means that classes have different trends in regard to their frequency of PVI. Class 1 adolescents (solo masturbation) increased their frequency of PVI in 2018, while the Class 2, 3, and 4 adolescents decreased their PVI frequency from 2009 to 2018. The decreases in PVI frequency for those categorized in Classes 3 and 4 were statistically significant.

For adults, there were also significant differences observed by year and by class. However, the interaction between year and class was not significant, as each of the four classes decreased in PVI frequency from 2009 to 2018 (unadjusted and adjusted). When looking at PVI frequency as an estimated number of times over the year, the trend is the same as when looking at it as categories.

Discussion

The present study used data from two waves of US nationally representative survey data to examine changes in sexual frequency and sexual repertoire between 2009 and 2018. Our research adds to the literature by using detailed measures of sexual behaviors beyond oral, vaginal, and anal intercourse; we did this in order to examine whether an explanation for declines in coital frequency might be explained by increases in non-coital behaviors. However, in addition to finding decreased PVI frequency in 2018 as compared to 2009, we found significant decreases across all partnered sexual behaviors assessed and, for adolescents, decreases in the proportion of adolescents reporting solo masturbation in the prior year as well. Overall, our findings are consistent with studies from multiple

Table 4 Sexual repertoire in the prior year, for each of the 2009 and 2018 waves of the National Survey of Sexual Health and Relationships

Sexual behavior		2009		2018		Chi-square
		More than a year ago or never	At least once in the past year	More than a year ago or never	At least once in the past year	
<i>Adolescents (ages 14–17)</i>						
Masturbated alone	<i>n</i>	355	453	490	320	< .001
	%	44.0	56.0	60.5	39.5	
Masturbated with a partner	<i>n</i>	707	98	757	54	< .001
	%	87.8	12.2	93.3	6.7	
Gave oral sex	<i>n</i>	672	139	745	62	< .001
	%	82.8	17.2	92.3	7.7	
Received oral sex	<i>n</i>	643	168	726	79	< .001
	%	79.3	20.8	90.1	9.9	
Penile-vaginal intercourse	<i>n</i>	642	165	722	90	< .001
	%	79.5	20.5	89.0	11.1	
Anal intercourse	<i>n</i>	773	36	802	14	.001
	%	95.6	4.4	98.3	1.7	
<i>Adults (ages 18–49)</i>						
Masturbated alone	<i>n</i>	807	2144	975	2573	.898
	%	27.4	72.7	27.5	72.5	
Masturbated with a partner	<i>n</i>	1708	1238	2356	1201	< .001
	%	58.0	42.0	66.2	33.8	
Gave oral sex	<i>n</i>	1029	1939	1408	2151	< .001
	%	34.7	65.3	39.6	60.4	
Received oral sex	<i>n</i>	977	1990	1345	2216	< .001
	%	32.9	67.1	37.8	62.2	
Penile-vaginal intercourse	<i>n</i>	691	2254	998	2556	< .001
	%	23.5	76.5	28.1	71.9	
Anal intercourse	<i>n</i>	2353	588	2948	636	.020
	%	80.0	20.0	82.3	17.8	

countries that have documented declines in sexual frequency. Because our sample was limited to individuals ages 14–49, we were unable to examine sexual behavior trends among people aged 50 and older. However, our findings align with studies that have found greater proportions of young people reporting no partnered sexual behaviors in the prior year (e.g., Burghardt et al., 2020; Ghaznavi et al., 2019; Ueda & Mercer, 2019; Ueda et al., 2020).

Other than Natsal and ASHR, most population-representative studies examining sexual frequency trends have not included those under age 18 and thus less has been known at the population level about sexual trends among younger adolescents. Our study extends the literature by including adolescents as young as 14 years old in our analytic sample (the youngest participants in Natsal and ASHR were 16 years old). Findings from our research also align with the US Youth Risk Behavior Survey (YRBS) which has demonstrated declining rates of high school students reporting having ever had sex

over a similar period of time (e.g., 46% in 2009 vs. 38% in 2019) (Centers for Disease Control & Prevention, 2020a). The lower rates of adolescents' reports of solo masturbation and PVI in 2018 are striking and deserve further study. These differences aren't trivial: for example, the proportion of adolescents reporting neither solo nor partnered sexual behaviors (Latent Class 2) increased from 28.8% of young men and 49.5% of young women in 2009 to 43.3% of young men and 74.0% of young women in 2018.

A number of potentially convergent social and cultural changes may contribute to these substantial shifts in young people's sexual behaviors. Widespread internet connectivity and emerging new technologies have added a new medium for providing sexual experiences outside of physical sex with a partner (e.g., sexting, easy access to sexually explicit media) (Doring et al., 2017; Twenge et al., 2017; Wright, 2013; Wright et al., 2013). Alcohol use has decreased among adolescents (Miech et al., 2019), and many young people have been engaged in conversations about sexual consent

Table 5 Sexual repertoire: Latent class analysis loadings

Behavior	Latent class			
	1	2	3	4
<i>Adolescents (ages 14–17)</i>				
Masturbated alone	1.000	0.040	0.970	0.758
Masturbated with partner	0.038	0.000	0.815	0.325
Gave oral sex	0.002	0.001	0.901	0.600
Received oral sex	0.000	0.004	1.000	0.771
Penile vaginal intercourse	0.035	0.021	0.945	0.681
Anal intercourse	0.000	0.000	0.540	0.037
<i>Adults (ages 18–49)</i>				
Masturbated alone	0.561	0.741	0.961	0.642
Masturbated with partner	0.000	0.463	0.866	0.213
Gave oral sex	0.000	0.305	0.950	0.846
Received oral sex	0.007	0.243	0.981	0.877
Penile vaginal intercourse	0.220	0.662	0.908	0.961
Anal intercourse	0.000	0.108	0.449	0.119

LCA loadings are the conditional probability that someone in a particular class would respond “yes” (at least one in the last year) to a certain item. The items with higher loadings for a specific class are considered to be part of that Class. For example, the probability that someone in Class 1 indicated having engaged in solo masturbation is 0.561

In other words, 56% of the adults in Class 1 masturbated alone in the prior year

Bolded entries reflect the sexual behaviors that characterize each class

(such as through the #MeToo movement led by Tarana Burke, the Obama/Biden administration’s It’s On Us campaign, and recent high profile rape cases) (e.g., Armstrong & Mahone, 2017; PettyJohn et al., 2019). Also, more contemporary young people identify with non-heterosexual identities—including asexual identities—and more young people identify in gender expansive ways (Newport, 2018; Watson et al., 2020). It is also possible that secular trends reflect a tendency to have over-reported sexual behavior in earlier years, with more accurate reporting now as people become more comfortable with online presentations of themselves. These are among the many potential influences on adolescent sexual development and expression; subsequent research might examine how each of these may be contributing to changing patterns of sexual frequency and repertoire at the population level. Greater investment in understanding adolescent sexual development beyond risk is warranted, including how adolescents form, sustain, and interpret intimate relationships.

In terms of young adults, some research suggests that increasing use of computer games and social media may be implicated in young adults’ declining sexual activity (Lei & South, 2021). A recent analysis of 18–23-year-olds in 2007–2017 waves of the Transition to Adulthood Supplement of the Panel Study of Income Dynamics found that increased use of computer games, decreased alcohol use, decreased earnings, and declines in romantic relationship formation explained 76% of the decline in sexually active young adults

in their sample (Lei & South, 2021). The median age at first marriage in the USA has also increased (US Census, 2020). It is worth noting that many published reports of adult sexual behavior (including ours) begin by describing the potential positive contributions of sex to health and quality of life. Media coverage of declining sexual activity tends to be similarly imbued with a sense that—in spite of risks that include unintended or mistimed pregnancy, sexually transmitted infections, and/or sad or lonely feelings connected to sex—partnered sex is generally pleasurable, joyful, connecting, and/or beneficial and thus declines in partnered sex among adults may be concerning (e.g., Feder, 2020; Julian, 2018). The age-old question on how much sex is too much and how little sex is not enough comes to mind. Given the impacts of the COVID-19 pandemic on physical and mental health, sexual behavior, relationships, and (for youth) in-person school and extracurricular activities, ongoing population-level research on sexual development and behaviors will be important (Finnerty et al., 2021; Rosenberg et al., 2021).

Positive aspects of adolescent partnered sex are less often highlighted. For example, in the section of the 2019 YRBS report that shows sexual behavior trends over time, the row that shows declining percentages of high school students who have “ever had sex” also features a green symbol (similar to the US traffic light system) which the legend describes as moving “in right direction” (Centers for Disease Control & Prevention, 2020b). The line between adolescence and

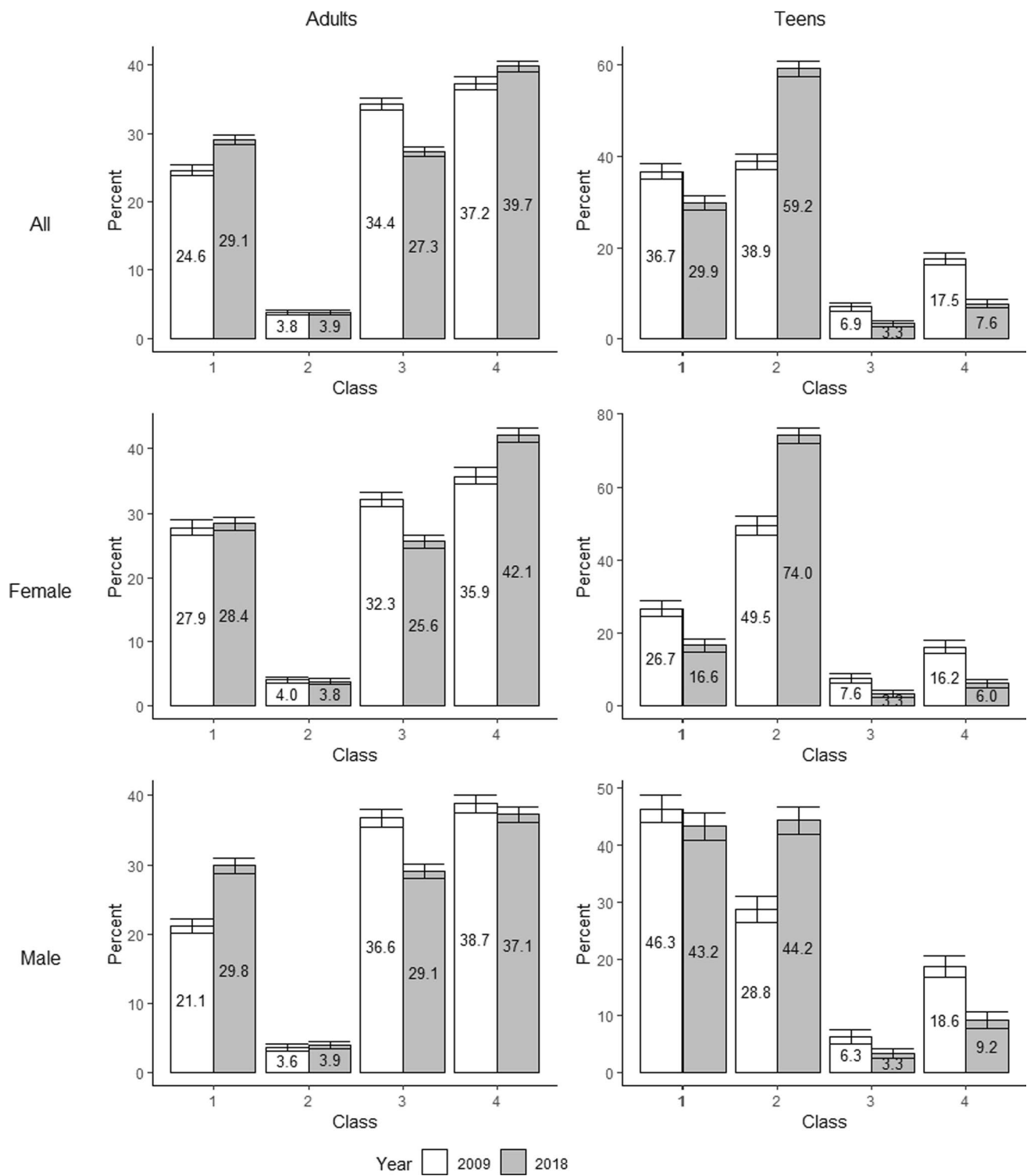


Fig. 1 Frequencies of LCA Class membership for adolescent and adult participants in the 2009 and 2018 National Survey of Sexual Health and Relationships waves, presented by gender. For each analy-

sis (adults, adolescents, adults by gender, adolescents by gender), class membership was significantly different from 2009 to 2018

adulthood has always been tenuous—perhaps particularly so when it comes to sexual behavior—but we must continue to interrogate how declining adolescent sexual activity is in

the “right direction” yet declining adult sexual activity warrants concern. Solo and partnered adolescent sexual exploration are developmentally normative, offer opportunities for

Table 6 Unadjusted and adjusted linear regression for the associations between survey year (2009 vs. 2018), class and penile vaginal intercourse frequency

			Year 2009		Year 2008		Type III test <i>p</i> -value			
			Est Mean	SE	Est Mean	SE	Sig	Year	Class	Year*Class
<i>PVI frequency categories</i>										
Age 14–17	Unadjusted	Class 1	0.05	0.05	0.12	0.05		<.001	<.001	<.001
		Class 2	0.03	0.05	0.02	0.04				
		Class 3	3.53	0.11	2.58	0.18	*			
		Class 4	1.90	0.07	1.38	0.10	*			
	Adjusted	Class 1	0.05	0.05	0.12	0.05		<.001	<.001	<.001
		Class 2	0.04	0.05	0.03	0.04				
		Class 3	3.50	0.11	2.56	0.18	*			
		Class 4	1.87	0.07	1.35	0.10	*			
<i>PVI frequency (number/year estimate)</i>										
Age 14–17	Unadjusted	Class 1	0.20	2.22	5.05	2.45		<.001	<.001	<.001
		Class 2	0.13	2.17	0.11	1.75				
		Class 3	119.41	5.17	34.72	8.35	*			
		Class 4	36.54	3.36	23.72	4.86	*			
	Adjusted	Class 1	−0.11	2.25	4.77	2.46		<.001	<.001	<.001
		Class 2	0.35	2.17	−0.41	1.79				
		Class 3	118.47	5.20	34.35	8.36	*			
		Class 4	35.47	3.42	22.82	4.89	*			
<i>PVI frequency categories (0–6)</i>										
Age 18–49	Unadjusted	Class 1	0.83	0.06	0.60	0.05	*	<.001	<.001	.550
		Class 2	1.50	0.15	1.21	0.13				
		Class 3	3.60	0.05	3.22	0.05	*			
		Class 4	3.51	0.05	3.16	0.04	*			
	Adjusted	Class 1	1.10	0.06	0.83	0.05	*	<.001	<.001	.690
		Class 2	1.58	0.14	1.22	0.13				
		Class 3	3.49	0.05	3.10	0.05	*			
		Class 4	3.36	0.05	3.01	0.04	*			
<i>PVI frequency (number/year estimate)</i>										
Age 18–49	Unadjusted	Class 1	14.30	2.75	9.42	2.29		<.001	<.001	.054
		Class 2	33.30	6.87	22.89	6.24				
		Class 3	86.73	2.33	71.87	2.35	*			
		Class 4	76.94	2.22	59.63	1.96	*			
	Adjusted	Class 1	18.30	2.78	12.42	2.37		<.001	<.001	.205
		Class 2	32.76	6.77	23.17	6.16				
		Class 3	82.78	2.31	69.45	2.36	*			
		Class 4	72.29	2.21	56.83	2.01	*			

learning and joy, and are supportive of adult sexual development (Hensel et al., 2011; Robbins et al., 2011; Tolman & McClelland, 2011). Our findings have implications for those in policy roles, who might consider other helpful metrics of understanding changes in adolescent sexual experience—as an example, tracking the proportion of adolescent sex that is wanted, consensual, and even pleasurable may be illuminating.

Findings from our study also extend the existing literature by including solo masturbation among participants' sexual behaviors. For both adults and adolescents, we found a latent class that was marked by engaging in solo masturbation. This highlights the important role of masturbation in people's sexual expression; however, we note that the proportion of adolescents in the solitary masturbation Latent Class 1 decreased in 2018 compared to 2009, while the proportion reporting

neither solo nor partnered sex increased. The 2009/2019 NSSHB waves did not ask participants how they feel about their sexual lives or whether they would like to have more sex or less sex than they are having; however, we note that Ueda and Mercer (2019) found that most Natsal participants who reported no prior year partnered sex but who did have prior partnered sexual experience were not dissatisfied with their sexual lives. Subsequent research should include more questions about people's own subjective assessments of their sexual lives and feelings about their solo and partnered sexual behaviors.

Similarly, we need to understand more about how people's subjective feelings about the sex they've experienced may shape their subsequent choices about sex. At the population level, the 2009 NSSHB demonstrated that anal intercourse had nearly doubled in lifetime prevalence since the National Health and Social Life Survey of the early 1990s. However, anal sex remained infrequent overall in any given year (though much more frequent among gay and bisexual men) (Dodge et al., 2016; Herbenick et al., 2010a). Anal sex has generally been rated as unappealing among US adults (Herbenick et al., 2017), and several qualitative studies examining anal intercourse between women and men found that—although anal sex behaviors were pleasurable to some—anal sex was often marked by pressure, coercion, lack of communication, fear, and pain among women (e.g., Fahs & Gonzalez, 2014; Fahs et al., 2015; Herbenick et al., 2015, 2019a, 2019b; Jozkowski et al., 2014). Given these experiences, it is perhaps not surprising to have observed a decrease in anal intercourse between the 2009 and 2018 NSSHB, but that does not explain other decreases across all partnered sexual behaviors queried.

Recent research suggests that some sexual behaviors sometimes described as aggressive or as “rough sex” may have grown in prevalence in the USA, including choking during sex (which is technically a form of strangulation) (Herbenick et al., 2020; Herbenick et al., 2021a). Like anal sex behaviors, choking/strangulation is often wanted, asked for, and/or perceived as pleasurable (Herbenick et al., 2021a, 2021b). However, being choked/strangled has also been identified by many women as an example of something a partner has done during sex that made them feel scared (Herbenick et al., 2019a, 2019b), which is not surprising given that choking/strangulation is a common feature of sexual assault, intimate partner violence, and (in rare cases) is lethal even as part of consensual sex (e.g., McQuown et al., 2016; Roma et al., 2013; Sandler, 2018). Subsequent research might examine the extent to which partnered sex may be declining, at least for some subset of the population, as a result of experiencing unpleasant or frightening experiences during otherwise consensual sex (e.g., being hit, punched, slapped, or choked without consent, or as a form of sexual compliance).

Strengths and Limitations

Our study was subject to several strengths and limitations. Among our strengths, we used data from the 2009 and 2018 waves of the NSSHB, a US nationally representative probability survey. The NSSHB is unique in that it includes items related to both sexual frequency and repertoire as well as a detailed assessment of solo and partnered sexual behaviors, which allowed for an examination of specific behavioral trends over two time periods. Other US national surveys, such as the GSS, YRBS, National Survey of Family Growth, and the National Longitudinal Study of Adolescent to Adult Health, are more limited in the scope of sexual behavior items assessed (Centers for Disease Control & Prevention, 2020a, 2020b; Harris et al., 2009; NORC at the University of Chicago, 2016). Both the 2009 and 2018 NSSHB waves were conducted through online, confidential surveys which has been shown to facilitate the reporting of sensitive behaviors. Among our limitations is that—in terms of frequency of sex—we were limited to comparisons of PVI (i.e., frequency of other sexual behaviors had not been assessed in both waves). Also, neither wave included an oversample of individuals who identify as lesbian, gay, bisexual, or asexual and thus—being a general population survey—findings largely reflect majority groups (e.g., heterosexual identified people). This becomes particularly apparent in examining the LCA classes, for which PVI loaded heavily on three of the four adult classes and two of the four adolescent classes. This is likely a fair representation of sex between males and females, given prior research showing the prevalence of PVI in many combinations of sex between women and men, and other research describing the intercourse imperative (Herbenick et al., 2010b; Richters et al., 2006). However, it does mean that these LCA classes do not reflect the rich diversity of all US adolescents and adults. Subsequent research might investigate similar constellations of intimate and/or sexual behaviors among dedicated samples of LGBTQ+ individuals and/or among general population samples with sufficiently sized oversamples of LGBTQ+ individuals.

Similarly, although the 2009/2018 NSSHB waves included a broad range of sexual behaviors for comparison, we would have liked to have been able to compare additional behaviors across waves but did not have additional items common among the two waves (e.g., kissing, cuddling, sex toy use, sexting, reading erotica, and/or watching pornography). As the NSSHB is focused on sexuality, we also did not have measures of more general behaviors (e.g., media use, substance use, mental health, physical health, perceived racism, political stress, etc.) that could have shed light on potential changes in sexual behaviors from 2009 to 2018. Finally, although our findings may help clinicians contextualize questions or concerns their clients have about how often people have sex, it is left to the client–clinician relationship, and

to people themselves, to examine contexts of pleasure and satisfaction.

Conclusions

The present study found a decrease in PVI frequency between the 2009 and 2018 NSSHB waves; we also found significant differences in past year sexual repertoire for both adults and adolescents, including decreases in partnered masturbation, giving and receiving oral sex, PVI, and anal intercourse. Additionally, we observed a significant decrease in the proportion of adolescents reporting solo masturbation in the prior year between 2009 and 2018. These findings have implications for sexual health researchers, clinicians, and educators.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10508-021-02125-2>.

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Authors' Contributions Herbenick and Fortenberry contributed to the development of the 2009 NSSHB survey; Herbenick and Fu contributed to the development of the 2018 NSSHB survey. Rosenberg and Golzarri-Arroyo analyzed the data. All authors contributed to manuscript preparation, review, and approval.

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Declarations

Ethical approval The Institutional Review Board at Indiana University reviewed and approved study protocols and questionnaires used in the NSSHB (Protocols 0,812,000,042, 1,408,833,205, and 1,906,506,253).

Conflict of interest Authors declare that they have no conflict of interest.

Data Availability If accepted for publication, a limited data set may be archived at Indiana University.

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