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Gap between Consecutive Sexual Partnerships and Sexually Transmitted Infections Among STI Clinic Patients in St Petersburg, Russia

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Abstract

We conducted a cross-sectional study to determine whether the time between two consecutive sexual partnerships (gap) is associated with sexually transmitted infections (STIs) in Russia. A self-administered questionnaire was administered to STI clinic patients in St. Petersburg and participant's STI data at the time of enrollment in the study was collected from medical charts. The length of the gap between partnerships was divided into four categories: overlapping (0 or negative gap), short gaps (1–90 days), mid-length gaps (91–365 days), and long gaps (366 days or more). Among the 659 respondents, 22.6% had overlapping partnerships, and 13.7, 4.2, and 59.5% had short, mid-length and long gaps, respectively. Short gaps (OR 2.34; 95% CI 1.38–3.95), but not overlapping relationships, were independently associated with STIs when contrasted against long term gaps. HIV prevention programs for Russian STI clinic patients should therefore focus also on prolonging the gap between consecutive, monogamous sexual partnerships.

Keywords

Gap between sexual partnerships; Consecutive sexual relationships; Serial monogamous relationships; Partner concurrency; STI; Russia

Introduction

The likelihood that someone will transmit or acquire a sexually transmitted infection (STI) depends on the biologic characteristic of the infectious agent (eg., the duration of

infectiousness) and the physical and behavioral characteristics (eg., concurrent partnerships) of the individual exposed to infection [1]. Mathematical models and empirical studies have demonstrated that sexual concurrency (i.e., having more than one partner at a time) is a risk factor for STIs [2-4]. Although concurrent sexual partnerships are recognized as one of the most important risk factors for STIs, such as HIV [2, 3, 5], the length of time between two consecutive sexual partnerships for monogamous individuals (referred to as the “gap”) is also an important STI/HIV risk. Specifically, the transmission of STIs is possible even for mutually monogamous individuals if the gap occurs during an STI’s infectious period, that is, if a new relationship begins while the relevant STI is still infectious [6, 7]. A recent mathematical modeling study conducted in the United Kingdom, found that short gaps coupled with short to medium relationship durations played a more important role in the transmission of gonorrhea than other gap-partnership combinations [6]. The study concluded that interventions targeting individuals with multiple partnerships separated by short gaps would reduce STI prevalence more effectively than interventions targeting groups with a high number of sexual partnerships separated by longer gap.

However, few empirical studies have investigated the association between relationship gaps and STIs. One study examined the gap reported by women (aged between 15 and 44 years) from a representative sample in the United States who participated in the 1995 wave of the National Survey of Family Growth [7]. They found that 47% of serially monogamous, sexually active women reported a gap of less than 6 months. Furthermore, women with a history of STI diagnoses reported significantly shorter gaps than did women without a history of STI diagnoses [7]. Another study, a random digit dialing survey conducted between 2003 and 2004 showed that the median gap for 18 to 39 years old Seattle residents was 187.4 days, which was within the infectious period of the participant’s self-reported STIs [8]. Both studies concluded that interventions to reduce sexual risk behaviors need to address serial monogamous relationships separated by short gaps [7, 8]. However, both of these studies were descriptive, and neither used inferential analysis techniques to examine whether short gaps could independently predict STI risk.

In the present study, we measured the frequency of different types of gaps and further examined the association between gaps and STIs after controlling for potential confounders. We used data collected from two STI clinics in St. Petersburg, Russia between 2006 and 2008.

Methods

Participants and Procedures

We recruited 805 individuals (aged 18 years and older) who attended one of two STI clinics in St. Petersburg, Russia, to participate in a cross-sectional study between July 2006 and February 2008. Written informed consent was obtained for each participant. The study was approved by the Human Investigations Committees at Yale University and the Biomedical Center in St. Petersburg, Russia. Of the 805 participants, six reported no sexual activity in the past year, and 42 reported having one sexual partner in his/her life. In addition, we could not measure relationship gaps for 98 participants. These individuals were excluded from the analysis. A self-administered questionnaire was used to collect information including demographic characteristics, medical information, sexual activity, and drug-use habits. In the section on sexual partners, the participants provided the demographic characteristics and sexual activities of the partner(s) with whom they had sexual contact within 1 year prior to data collection. These data included the dates of the respondents’ first and last sexual contact with up to three of their most recent sexual partner(s). Thus, the number of sexual partners in the past year was determined according to the following criteria: three or more partners when none of the dates of sexual contact were coded as “100” (not applicable); two partners

when the dates of sexual contact with one partner were coded as “100”; one partner when dates of sexual contact with two partners were coded as “100”; and no partner when the dates of sexual contact with all three partners were coded as “100”.

We restricted our analysis to the most recent gap between sexual relationships that the participants reported. We defined the gap as the time interval between the participant’s first sexual intercourse with his/her most recent partner and the last sexual intercourse with his/her second most recent partner. A gap of zero or less than zero was considered as an overlapping relationship. We did not collect information about sexual contact more than 1 year before the interview, so we treated participants who reported only one partner in the past year as having a long gap (366 days or more). Gaps of 1–90 days and 91–365 days were treated as short and mid-length gaps, respectively. These cutoff points were chosen because studies that investigate the number of sexual relationships in Russia typically use 3–6 months recall periods [9–11].

We used two criteria to define the presence of STIs to maximize the validity of our measurements [12]. The first criterion was the report of any of the following STIs in the last year: syphilis, *Neisseria gonorrhoeae*, *Chlamydia trachomatis*, and *Trichomonas vaginalis*. The second criterion was a diagnosis of one of these four STIs on the participant’s medical chart at the time he/she enrolled in this study. STIs were diagnosed according to standard clinical procedures in Russia. These four STIs were chosen because they have infectious periods that are more likely to represent recent sexual risk behaviors than are viral STIs. Furthermore, they are routinely tested in STI clinics and are commonly associated with the sexual risk of HIV transmission [13, 14].

The engagement in unprotected sex was defined as a participant having at least one episode of vaginal or anal intercourse with his/her most recent partner without a condom during the 30 days prior to the interview. For the question, “how many sexual partners have you had in your life”, the participants chose among the following responses: 1, 2–5, 6–10, 11–20, 21–50, 51–100 or more than 100. Lifetime number of sexual partners was dichotomized as <11 vs. ≥11 because this cutoff was the closest point to the median.

Data Analysis

An overall Chi-square test was used to assess whether participants with different gaps had different frequencies for each characteristic. When a Chi-square test was not appropriate, as in the case of small expected frequencies, Fisher’s exact test was used to evaluate the significance levels across the gap measures. If the overall Chi-square test was significant ($P < 0.05$), the COMPROP macro in SAS [15], which is based on the Tukey-type multiple comparison technique discussed by Zar [16], was used to assess whether each characteristic differed for participants who reported different gaps.

We created three dummy variables for the gap and used the long gap as the reference group. Logistic regression models were then created to determine if the gaps were associated with STIs. The following steps were used to build the final model for a multivariate analysis. First, we conducted a series of bivariate logistic regression analyses to identify the variables to include in the initial model building process. Variables with a P -value below 0.25 in the bivariate analyses, except for the number of sexual partners in the past year, were included in this process. The number of sexual partners in the past year was not included in the initial model because of its high correlation with the relationship gaps. Second, we used a manual backward selection procedure to sequentially eliminate the covariates that did not remain significant. Although stepwise exclusion and inclusion procedures might be less efficient than formal model fit comparisons, this methodology was adopted because it is widely used and easier to explain. Finally, to verify the robustness of the results, we compared the model

fit indices and conducted a stratified analysis to examine whether inclusion of the number of sexual partners in the past year changed our results. SAS software (version 9.1, SAS Institute Inc., Cary, NC) was used for the analysis.

Results

Of the 659 participants whose most recent gap status could be determined, 149 (22.6%) had an overlapping relationship; and 90 (13.7%), 28 (4.2%), and 392 (59.5%) had a short, mid-length and long gap, respectively. As shown in Table 1, gender distribution, having ever injected drugs, and rates of homosexual intercourse and unprotected sex were similar among the participants with different gaps. Compared to the long gap group, the short gap group had a higher percentage of people aged 25 years or younger (67.8 vs. 42.3%, q -statistic = 6.2, $P < 0.05$), were less likely to be married (15.6 vs. 63.0%, q -statistic = 12.3, $P < 0.05$), less likely to be employed (65.6 vs. 84.7%, q -statistic = 5.5, $P < 0.05$), had a lower percentage of university degrees (38.2 vs. 54.6%, q -statistic = 4.0, $P < 0.05$), were more likely to drink alcohol weekly (47.7 vs. 31.4%, q -statistic = 4.0, $P < 0.05$), and gave more reports of 11 or more lifetime sexual partners (62.3 vs. 41.0%, q -statistic = 4.8, $P < 0.05$). In addition, the participants in the short gap group were less likely to be married than were those with an overlapping relationship (15.6 vs. 35.6%, q -statistic = 4.9, $P < 0.05$).

The percentages of STIs among the participants with overlapping relationships or short, mid-length, or long gaps were 35.0, 47.7, 40.7 and 23.0%, respectively (Fig. 1). Compared to participants with long relationship gaps, the percentage of STIs was significantly higher among participants with overlapping relationships (q -statistic = 3.8, $P < 0.05$) and short relationship gaps (q -statistic = 6.2, $P < 0.05$). There was no statistically significant difference between the STI prevalence of participants with medium relationship gaps and other gap lengths (Fig. 1).

The significant independent co-variables in the final model of the multivariate analysis were gender (OR 2.67; 95% CI 1.76–4.06, $P < 0.0001$), marital status (OR 0.63; 95% CI 0.43–0.93, $P = 0.02$) and having ever injected drugs (OR 2.36; 95% CI 1.09–5.11, $P = 0.03$). The adjusted associations between gaps and STIs were 1.48 (95% CI 0.95–2.29, $P = 0.08$), 2.34 (95% CI 1.38–3.95, $P = 0.002$) and 1.89 (95% CI 0.82–4.38, $P = 0.14$) for the participants with an overlapping relationship, those with a short, and those with a mid-length gap, respectively, compared to those with a long-length gap (Table 2).

Table 2 does not include the number of sexual partners in the past year in the multivariate model to avoid colinearity due to the strong correlation between this variable and gap length (Spearman correlation coefficient = -0.91 , $P < 0.0001$). To verify the robustness of the results, we compared the model fit indices (Table 3). By comparing the Akaike information criterion (AIC, a model fit indicator), we found that the final multivariate model in Table 2 (AIC = 727.0) was a better fit than the model that replaced the three dummy variables for the gap with the number of sexual partners (AIC = 799.7). The likelihood ratio Chi-square test also indicated that the multivariate model was the best fit.

We also conducted a stratified analysis in a subsample, which consisted of the participants who had two or more sexual partners in the past year (classified into two strata: either two sexual partners or three or more sexual partners in the past year). We found that among the participants with two sexual partners in the past year, those with a short gap were significantly more likely to report a STI than were those with a concurrent partnership (OR, 2.97; 95% CI 1.07–8.23, $P = 0.04$). No significant association was observed between gap and STIs among the participants with three or more sexual partners in the past year.

Discussion

Our study found that participants with short relationship gaps, rather than those with overlapping relationships or mid-length gaps had a higher chance of having STIs than did those with long gaps. These findings provide new evidence that short gaps between sexual partnerships play an important role in the transmission of STIs. To our knowledge, this is the first empirical study to directly link short gaps and STIs and to control for potential confounders, such as gender, employment status, marital status, condom use and the number of lifetime sexual partners. Our findings are consistent with the results of the previously mentioned descriptive gap study, which did not control for potential confounders [7]. The present study's findings may seem counterintuitive, but we might explain them with a scenario in which people with short partnership gaps have more frequent sexual intercourse with their STI-infected partner than do individuals with overlapping relationships, provided that both groups have similar rates of condom use, which was the case in our study. It is plausible that compared to individuals engaged in serial monogamy, those with overlapping relationships may have less sexual intercourse with an infected partner (eg., a casual partner) since he/she must share his/her usual number of sexual intercourses between multiple partners. However, we did not measure frequencies of sexual intercourse with each partner, and thus we cannot verify this conjecture. It is also worth noting, that condom use rates did not change the association between short gaps and STIs and did not significantly differ between the gap sub-groups. This finding indicates that the association between short gaps and STIs is not due to individuals with short partnership gaps forgoing the use of condoms. An alternative scenario that could explain the results would be if individuals who engage in serial monogamy have a greater sexual drive than those engaged in concurrent sexual partnerships. This study did not collect data that allowed for an accurate confirmation of this assumption. However, two possible markers for sexual drive: age of sexual debut and overall frequency of sexual intercourse, did not significantly differ between participants with concurrent partnerships and those with short gaps, suggesting that the available data did not support this scenario.

We cannot fully disentangle the effects of short gaps and multiple sexual partnerships in the past year on STIs due to the high correlation between these two factors and due to our relatively small sample size. However the results of the subsample analysis that was conducted among the participants who had two sexual partners in the past year provide some evidence that short gaps may have an independent effect on STIs (i.e., independent of the number of sexual partners in the past year). Our results confirm the findings from previous studies that demonstrated the high STI/HIV transmission risk among individuals who report multiple, non-overlapping sexual partnerships. These studies emphasized that efforts to reduce people's number of sexual partners must target both serial monogamous relationships and concurrent partnerships [17]. Our study's finding is significant given that the proportion of the participants in the short gap group was not negligible (nearly 14%).

Although our study found that the short gap group had distinct characteristics that differentiated them from the participants who reported a long gap or an overlapping relationship, we could not detect any statistically significant difference between the short gap and mid-length gap groups. This result may be due to the small number of participants with mid-length gaps in the sample. Future research might explore the reasons why a substantially low number of participants had mid-length gaps and examine whether particular characteristics put them at risk for STIs.

Our findings have implications for STI prevention. Further research should identify the patterns of multiple, non-overlapping sexual relationships and the variations in gap length among high-risk STI sub-groups. Furthermore, STI prevention and control strategies should

include messages that are relevant to the specific subgroups [8, 18]. Education and counseling for monogamous individuals with short gaps should focus on prolonging the period between consecutive partners and encouraging consistent condom use during the first several months of a new relationship.

The study has several limitations. First, the measurement of gaps may be subject to information bias because some participants do not accurately recall the dates of their first and last sexual contact with each of their partners. However, by restricting our analysis to the most recent gap, we aimed to reduce recall bias. Second, the sample size for participants with a mid-length gap was relatively small, which may have limited the statistical power to test for effects among this subgroup. Third, the percentage of STIs is likely to be underestimated because of undetected asymptomatic infections. However, such an underestimation is likely to dilute the observed associations and thus would not have changed our conclusions. Fourth, this study was cross-sectional and therefore longitudinal studies should further explore the causality of the associations. Finally, a 3-month and 12-month cut-off point for the gap may have affected the results. However, our choice of cut-off points was based on the infectious periods of the STIs and on the sample size in the present study. Thus, the cut-off points were the most appropriate and informative for the current analysis.

In conclusion, our study demonstrated that short gaps between relationships, rather than concurrent partnerships were associated with STIs when contrasted against long term gaps for this sample of STI clinic patients. We recommend that future studies identify the variations in gap length among high-risk STI sub-groups. Interventions to reduce sexual risk behaviors in Russia may need to focus on prolonging the period between consecutive monogamous partnerships and on promoting male or female condom use for the first 3 months after a sexual relationship commences in addition to reducing the number of sexual partnerships.

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Fig. 1.
The percentage of STIs in the past year by length of gap between relationships in St. Petersburg, Russia, 2006–2008 ($N = 634$)

Characteristics of the study participants by the length of gap between relationships, St. Petersburg, Russia, 2006–2008 ($N = 659$)

Table 1

Characteristic	Overlapping ($n = 149$) (%)	1–90 Days ($n = 90$) (%)	91–365 Days ($n = 28$) (%)	366 Days or more ($n = 392$) (%)	Overall Chi-square (df), P -value or Fisher's exact test
Age (25 years or less)	53.7	67.8	74.1	42.3	27.7 (3), <0.0001
Male	73.2	74.4	64.3	63.5	7.1 (3), 0.07
Currently married	35.6	15.6	21.4	63.0	90.3 (3), <0.0001
Currently employed	79.1	65.6	78.6	84.7	17.4 (3), 0.0006
Education (completed university)	48.3	38.2	39.3	54.6	9.7 (3), 0.02
Weekly alcohol consumption	47.2	47.7	38.5	31.4	15.7 (3), 0.001
Ever injected drugs	6.8	4.4	3.6	4.4	0.007, 0.71 ^a
Age at time of first sexual intercourse (<16 years) ^b	35.8	28.9	14.3	21.9	13.1 (3), 0.004
Ever traded sex	2.0	6.7	3.6	1.0	0.0003, 0.01 ^a
Homosexual intercourse	9.5	11.1	3.6	5.4	5.8 (3), 0.12
Had unprotected sex in the past month	80.0	73.6	73.9	83.0	4.2 (3), 0.38
Had sexual intercourse twice a week or more ^b	47	33.3	60.7	44.9	7.9 (3), 0.05
Lifetime number of sexual partners (11 or more)	70.0	62.3	57.7	41.0	36.5 (3), <0.0001

^a Fisher's exact test was used to evaluate the significance level (table probability, P -value)

^b The overall Chi-square test was significant; however, there was no significant difference between the participants with a gap of 1–90 days and the other gap groups

Association between the length of gap between relationships and sexually transmitted infections in St. Petersburg, Russia, 2006–2008 ($N = 634$)

Table 2

Characteristic	Crude OR (95% CI)	Adjusted OR (95% CI) ^a
Age (25 years or less)	1.52 (1.10–2.10) *	–
Male	2.47 (1.69–3.60) ***	2.67 (1.76–4.06) ***
Currently married	0.54 (0.39–0.75) **	0.63 (0.43–0.93) *
Currently employed	0.63 (0.43–0.93) *	–
Education (completed university)	0.71 (0.52–0.98) *	–
Weekly alcohol consumption	1.51 (1.09–2.09) *	–
Ever injected drugs	2.11 (1.05–4.21) *	2.36 (1.09–5.11) *
Age at time of first sexual intercourse (< 16 years)	0.99 (0.69–1.42)	–
Ever traded sex	0.71 (0.23–2.19)	–
Homosexual intercourse	0.83 (0.45–1.54)	–
Had unprotected sex in the past month	0.89 (0.58–1.37)	–
Lifetime number of sexual partners (11 or more)	1.30 (0.92–1.83)	–
Gap		
366 days or more	Reference	Reference
91–365 days	2.30 (1.03–5.14) *	1.89 (0.82–4.38)
1–90 days	3.05 (1.87–4.96) ***	2.34 (1.38–3.95) **
Overlapping	1.80 (1.18–2.73) **	1.48 (0.95–2.29)

^a Adjusted for significant co-variables

* P -value < 0.05,

** P -value < 0.01,

*** P -value < 0.001

Table 3

Comparison of model fit statistics

Model fit indices	Model 1 ^a	Model 2 ^b	Model 3 ^c
Akaike's information criterion (AIC)	725.6	727.0	799.7
-2 log-likelihood-ratio statistic	709.6	713.0	789.7
Difference of -2 log-likelihood-ratio compared to Model 1	-	3.4	80.1
Degree of freedom	-	1	3
<i>P</i> -value	-	<i>P</i> > 0.05	<i>P</i> < 0.001

^a Includes 3 dummy variables for gap, gender, marital status, having ever injected drugs, and number of sexual partners in the past year

^b Includes all variables in Model 1 except number of sexual partners in the past year

^c Includes all variables in Model 1 except 3 dummy variables for gap