


Effect of multi-level social risk factors on developmental trajectories of sexual risk behaviors among Bahamian middle-to-late adolescents

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ABSTRACT

Background: Few studies have examined how multi-level social factors interact and affect developmental patterns of sexual risk among middle-to-late adolescents who are at risk of experiencing sexual risk behaviors. We examined developmental trajectories of sexual risk behaviors of boys and girls in middle-to-late adolescence and the effects of exposure to three social risk factors (poor parental monitoring, peer risk, and neighborhood risk).

Methods: We followed 2,332 Bahamian adolescents every six months from Grades 10–12. We used group-based trajectory modeling to identify distinct trajectories of sexual risk behaviors for boys and girls.

Results: We identified three trajectories each for boys and girls. Peer risk and neighborhood risk predicted a high sexual-risk trajectory for boys, and peer risk (alone or combined with other risk factors) had the greatest impact on the membership of moderate-to-high-risk trajectory for girls. Parental monitoring had a relatively small effect on adolescents' sexual risk behavior.

Conclusion: Our results underscore the importance of early identification of adolescents with sexual risk behavior and development of targeted prevention interventions to improve adolescent health outcomes.

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Sexual risk behaviors; social risk factors; middle-to-late adolescence; adolescents; developmental trajectories; group-based trajectory modeling

Adolescents typically explore sexuality as their physical, cognitive, and emotional development progresses through this period of rapid change (Kar et al., 2015). Many experience their first sexual intercourse during middle-to-late adolescence (Connolly et al., 2014; National Center for Health Statistics, 2017). Also, throughout adolescence, risk-taking behavior increases (Braams et al., 2015). When compared across ages, adolescents

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have the highest incidence of sexually transmitted infection (STI) (Zheng et al., 2022), which is linked with increased sexual risk behaviors (Rusley et al., 2022). Confidentiality concerns make adolescents less likely to access sexual health services (Shannon & Klausner, 2018). It is important to understand patterns of sexual risk behaviors and identify high-risk subgroups of adolescents to prevent negative health consequences such as unintended pregnancy, STIs, and HIV infection.

Gender differences in sexual risk behaviors

Multiple studies of adolescents have revealed gender differences in developmental trajectories for risk behavior to understand different patterns in the course of their behaviors over age. Boys are often reported to engage in more sexual risk behaviors than girls (Ali et al., 2021; Rossi et al., 2017), with low knowledge levels exacerbating these behaviors (Czaderny, 2024). However, another trajectory study found that more girls, than boys, experienced an increase in sexual risk behaviors during middle adolescence (Huang et al., 2012). Moreover, girls' sexual decision-making was more affected by partners (Clark et al., 2018; Romero-Estudillo et al., 2014) and conventional gender norms than boys (Lefkowitz et al., 2014; Yu et al., 2021). These gender differences underscore the need for examining distinct trajectories of sexual behaviors among boys and girls and exploring the interacting risk factors contributing to these trajectories.

Effect of multi-level social factors on adolescent sexual risk behaviors

The socioecological model posits that complex interactions of intrapersonal, interpersonal, and environmental factors influence individuals' behaviors (McLeroy et al., 1988). Aligned with the model, a systematic review reported that adolescent risk behaviors were influenced by interpersonal factors, such as peers and family, and environmental factors, such as neighborhood (Bozzini et al., 2021). A sense of belonging to peer groups is important among adolescents (Tomova et al., 2021), and peer norms strongly influence sexual risk behaviors (Peçi, 2017); however, effects differ by gender. In one study, peers had more effect on boys than girls, possibly because of more permissive standards for boys (Widman et al., 2016). Another meta-analysis reported the opposite: perceptions of peers' engagement in sexual risk behaviors had a stronger effect on girls' behavior (Van de Bongardt et al., 2015).

Parental monitoring is another interpersonal factor affecting adolescent risk behaviors (Dittus et al., 2015). Higher levels of parental monitoring correlated with protective sexual behaviors such as increased condom use and fewer sex partners during their lifetime (Debele et al., 2022; Dittus et al., 2023). Specifically, a longitudinal study showed that adolescents who thought that their parents had a good knowledge of their activities delayed sexual initiation (Ethier et al., 2016). Further, mothers tended to monitor daughters more than sons, and mothers' monitoring was significantly associated with girls' decreased sexual behavior (Villarreal & Nelson, 2018), emphasizing the need for further exploration of peer and parental effects on the sexual trajectories of adolescents.

Beyond close social networks, adolescents' environment plays a vital role as well. A meta-analysis reported that positive neighborhood support was associated with greater condom use and delayed sexual initiation, whereas unsafe neighborhoods and lax

community norms were associated with early sexual initiation (Decker et al., 2018). Adolescent boys who faced a deteriorated neighborhood and accepted community norms toward sexual risk behaviors were more likely to initiate sex early (Orihuela et al., 2020; Settheekul et al., 2019). A risk trajectory study found that a combination of multi-level risk factors predicted risk behaviors, including sexual risk behaviors, in early-to-middle adolescence (Wang et al., 2014). However, to our knowledge, there is a lack of sexual risk trajectory studies specifically focusing on middle-to-late adolescents, despite risky behaviors peaking during high school years. Identifying factors associated with high-risk trajectories is important for designing effective strategies that mitigate future risks and negative health consequences among youth.

Current study and research questions

The Caribbean has one of the world's highest STI rates, with the HIV prevalence second only to sub-Saharan Africa (UNAIDS, 2023). In The Bahamas in 2018, the HIV prevalence was 1.74% (UNAIDS, 2019). Although young people aged 15–34 years represent less than 20% of The Bahamian population, they account for nearly 60% of HIV cases in the country (Deveaux et al., 2011). One study of four Caribbean countries found that 41% of adolescents (aged 11–18 years) had initiated sex. Among those, the majority reported sexual risk behaviors: approximately 60% of sexually active adolescents initiated sex at age 14 or earlier and had multiple sex partners, 42% had unprotected sex, and 32% engaged in two or more sexual risk behaviors (Pengpid & Peltzer, 2020).

Using comprehensive longitudinal data from a large HIV intervention trial among high school students in The Bahamas, this study attempted to address the following questions: (1) Do boys and girls have distinct developmental trajectories of sexual risk behaviors in middle-to-late adolescence? and (2) How do multi-level social risk factors (i.e. parental monitoring, peer risk, and neighborhood risk) interact and affect those trajectories? A unique contribution of this analysis is to quantify the impact of individual risk factors (such as peer, parent, and neighborhood risk) and various combinations of these risk factors on high-risk trajectories, using probability estimates.

Methods

Study site and participants

Data were collected as part of a randomized controlled trial of a school-based HIV prevention program in The Bahamas, named The Bahamian Focus on Older Youth (BFOOY) (Stanton et al., 2015). The trial enrolled Grade-10 students in 2008/2009 from all eight public high schools in New Providence. Students' classrooms were randomly assigned to one of four arms: Bahamian standard health classes, BFOOY alone, BFOOY with a single-session parental intervention, and BFOOY with a control variation of parental intervention for career-planning. Data were collected over 24 months at five time points: baseline before the program implementation and four follow-ups at 6, 12, 18, and 24 months for program outcome evaluation. Of the 2,564 students enrolled at baseline, 83.9% responded at 6 months, 78.7% at 12 months, 77.7% at 18 months, and 78.2% at 24 months. A total of 2,332 students (91.0%; 1,339 girls, 993 boys) completed the

baseline and at least one follow-up survey and were included in the analyses. The mean age of the participants at the baseline was 14.2 years (standard deviation 2.7 years). The vast majority of students were of African descent (98%). Ethical approval was given by the Wayne State University School of Medicine Institutional Review Board and the Institutional Review Board of the Bahamian Princess Margaret Hospital, Public Hospitals Authority. All research activities were conducted in accordance with the Declaration of Helsinki.

Data collection procedures

Participants completed the Bahamian Youth Health Risk Behavioral Inventory in their classrooms in the presence of study staff and without their teacher present (Stanton et al., 1995). The instrument was adapted from the Youth Health Risk Behavioral Inventory to be culturally appropriate for Bahamian youth via extensive ethnographic research including participant observation and interviews and multiple rounds of pilot testing (Deveaux et al., 2007; Kaljee et al., 2016; Wang et al., 2014). The instrument collected information on demographics, knowledge of HIV transmission knowledge, healthy sex practices and condom use, substance use, sexual behaviors, and risk perceptions and behavioral intentions. Written parental consent and youth assent were collected. The instrument took approximately 45 minutes to complete.

Measures

Adolescent sexual risk behaviors

The risk behavior section included eight binary items related to sexual risk behaviors (Kaljee et al., 2016). The eight sexual risk behaviors were: having ever had sex, having sex within the last six months, having multiple sex partners, having anal sex within the last six months, not using a condom in the last sexual encounter, lifetime inconsistent condom use, drinking alcohol before sex, and having a partner four or more years older (Supplement Table 1). One point was given for each risk behavior reported. The present analyses focused on the responses to sexual risk behaviors in determining participants' membership in risk-trajectory groups. The resulting composite sexual risk score had a range from 0 to 8; higher scores indicated participation in more sexual risk behaviors.

Peer risk

For peer risk, 10 items, using a 3-point Likert scale (1 = none to 3 = most), assessed the proportion of the participant's friends who engaged in risk behaviors, including sexual risk, alcohol consumption, and drug use (Smith & Brown, 2018). Adolescents answered questions such as 'How many of your close friends have sex?' and 'How many of your friends drink alcohol?' (Supplement Table 2). The average of the 10 items yielded a score ranging from 1 to 3. The internal consistency of the scale was 0.79. Peer risk was dichotomized; scores in the upper quartile were considered 'high-risk peers'.

Parental monitoring

A validated 8-item, 5-point Likert scale (1 = never to 5 = always) assessed adolescents' perceptions of their parents' monitoring efforts (Small & Kerns, 1993). Statements

included ‘My parents/guardian know where I am after school’ and ‘When I go out, my parents/guardian tell me what time to return’ (Supplement Table 3). The average of the 8 items yielded a score ranging from 1 (low parental monitoring) to 5 (high parental monitoring). Cronbach’s alpha for the internal consistency of the scale was 0.85. Parental monitoring was also dichotomized; scores in the lower quartile were considered ‘poor parental monitoring.’

Neighborhood risk

Neighborhood risk was measured via an 8-item, 3-point Likert scale (1 = never to 3 = very often), assessing the adolescent’s perception of the frequency of risks in their neighborhood. Questions included ‘How often have you seen your neighbors use marijuana?’ and ‘How often have you seen physical fighting in your neighborhood?’ (Supplement Table 4). The average of the 8 items yielded a score ranging from 1 to 3. The internal consistency of the measurement was 0.84. The measure of neighborhood risk was dichotomized; scores in the upper quartile were considered ‘high-risk neighborhoods.’

Analysis

First, the proportions of boys’ and girls’ risk behaviors were calculated at each time point; generalized linear mixed models (GLIMMIX) took into account the dependence among the repeated measures and the clustering effect of school and/or classroom.

We used group-based trajectory modeling (Nagin, 2005) to identify distinct trajectory patterns of sexual risk behaviors for boys and girls. We conducted separate trajectory analyses for boys and girls because of differences in their patterns of sexual engagement (Huang et al., 2012; Rossi et al., 2021). The dependent variables were the sexual risk behavior scores at baseline and the 6-, 12-, 18-, and 24-month follow-ups. Developmental trajectories of sexual risk behaviors, assuming 2–5 groups, were estimated by a zero-inflated Poisson (ZIP) model to accommodate the considerable number of zeros. We first estimated a growth model with linear terms, and in two additional steps, we added quadratic and cubic terms. Missing data were handled using the maximum likelihood estimation (MLE) approach (Nagin, 2005). The Bayesian Information Criterion (BIC) was used to evaluate goodness of model fit. We chose the best models according to the BIC value and interpretability of the trajectories (e.g. distinct patterns of sexual risk behavior) (Hsu & Jones, 2012; Jones & Nagin, 2007; Nagin, 2005). Age, gender, intervention group assignment, and baseline delinquent and substance use behaviors were controlled in the group-based trajectory models, as these factors are associated with adolescent sexual behaviors (Liu et al., 2015; Ritchwood et al., 2015). The final step examined the impact of the three social risk factors (i.e. high-risk peers, poor parental monitoring, high-risk neighborhood) on the probability of group membership for boys and girls. Each social risk factor was considered alone and in combination with the other risk factors (a total of eight models). Specifically, we used a matrix format to analyze individual risk factors or combinations. Each row corresponds to a specific combination of peer influence, parental monitoring, and neighborhood risk, indicated by ‘1’ for presence and ‘0’ for absence. This method allowed us to systematically assess how various combinations of these factors affect the development of sexual risk behaviors in adolescents.

All statistical analyses were performed using SAS 9.4 statistical software (SAS Institute Inc., Cary, NC, USA).

Results

The percentage of adolescents who engaged in sexual risk behaviors increased on average over 24 months in both genders. When examined by gender, boys engaged more in sexual risk behaviors than girls at baseline. However, girls' sexual risk behaviors increased more rapidly on average over time. Drinking before sex had a sixfold increase among girls (1.2% to 7.4%, $p < 0.001$) and a twofold increase among boys (7% to 15.4%, $p < 0.001$) Further, girls with no condom use during their last encounter and inconsistent condom use significantly increased (18.4% to 23.6%, $p = 0.007$; 25.6% to 38.6%, $p < 0.001$), whereas both behaviors did not change significantly among boys (26.7% to 23.1%, $p = 0.653$; 34.0% to 30.7%, $p = 0.712$) (Table 1).

Sexual risk trajectories also differed by gender. For boys, the analysis distinguished three trajectories: 'low-risk' (31.2%), 'moderate-risk, increasing' (35.1%), and 'high-risk' (33.7%). The proportions of correct group membership assignments were 0.94, 0.88, and 0.92. Girls had different trajectories: 'no-risk' (47.0%), 'low-risk, increasing' (28.3%), and 'moderate-to-high-risk' (24.7%). The BIC values were the lowest with four-group trajectory models for both boys and girls (Table 2). However, we chose the

Table 1. Percentage of adolescents involved in sexual risk behaviors from Grades 10–12

Risk Behavior	Baseline	6 Months	12 Months	18 Months	24 Months	<i>t</i>	<i>p</i>
Adolescent boys (<i>n</i> = 993)							
1. Ever had sex	40.5%	51.4%	58.1%	58.7%	61.7%	10.52	<.001
2. Had sex in the last 6 months	31.8%	38.9%	44.2%	45.3%	49.8%	8.69	<.001
3. Had multiple sex partners	17.5%	20.8%	23.0%	23.8%	26.2%	5.01	<.001
4. Had anal sex in the last 6 months	3.6%	3.3%	4.8%	5.0%	5.0%	2.03	0.04
5. Did not use a condom during last encounter	26.7%	17.0%	23.1%	20.3%	23.1%	-0.45	0.65
6. Inconsistent condom use, lifetime	34.0%	27.8%	29.5%	30.7%	30.7%	-0.37	0.71
7. Drank alcohol before having sex	7.0%	8.4%	11.4%	11.3%	15.4%	6.5	<.001
8. Had sex with an older partner	4.5%	7.0%	8.1%	8.2%	7.8%	3.05	0.002
Adolescent girls (<i>n</i> = 1,339)							
1. Ever had sex	14.3%	24.9%	34.2%	38.4%	46.7%	20.39	<.001
2. Had sex in the last 6 months	12.1%	21.5%	29.5%	31.9%	37.8%	16.81	<.001
3. Had multiple sex partners	2.4%	4.1%	5.1%	5.6%	5.8%	4.50	<.001
4. Had anal sex in the last 6 months	2.6%	2.7%	2.8%	2.2%	3.0%	0.27	0.79
5. Did not use a condom during last encounter	18.4%	16.6%	20.5%	23.4%	23.6%	2.69	0.01
6. Inconsistent condom use, lifetime	25.6%	26.1%	35.6%	35.6%	38.6%	4.47	<.001
7. Drank alcohol before having sex	1.2%	4.0%	5.8%	5.3%	7.4%	7.45	<.001
8. Had sex with an older partner	4.0%	7.4%	9.1%	10.1%	10.9%	6.89	<.001

Note. GLIMMIX model was used to examine the time trend of sexual risk engagement.

Table 2. BIC values for the boys' and girls' sexual risk trajectories

Number of Trajectory Groups	BIC Value for Boys' Trajectory Models	BIC Value for Girls' Trajectory Models
2	-7094.31	-6865.50
3	-6851.81	-6511.82
4	-6782.63	-6417.02
5	-6792.99	-6444.18

three-group trajectory models because the four-group models included a very small trajectory group, comprising only 5-7% of participants. The percentages of correct group membership assignments were 93.7%, 88.3%, and 91.5% for boys, and 90.2%, 89.6%, and 91.3% for girls.

Trajectories of sexual risk behaviors for boys and associated risk factors

Figure 1(a) depicts the boys' three trajectories. On average, boys in the low-risk group displayed a low level of sexual risk behavior score with minimal increase over 24 months. Those in the moderate-risk, increasing group displayed the largest increase in the risk score: from an average of 0.6 to an average of 2.4. Finally, those in the high-risk group displayed the highest risk score, but with a slight increase, from an average of 3.4 at baseline to an average of 3.9 at 24 months.

Figure 2(a) displays the impact of social risk factors on group membership for boys. Boys with high-risk peers or a high-risk neighborhood had a higher probability of

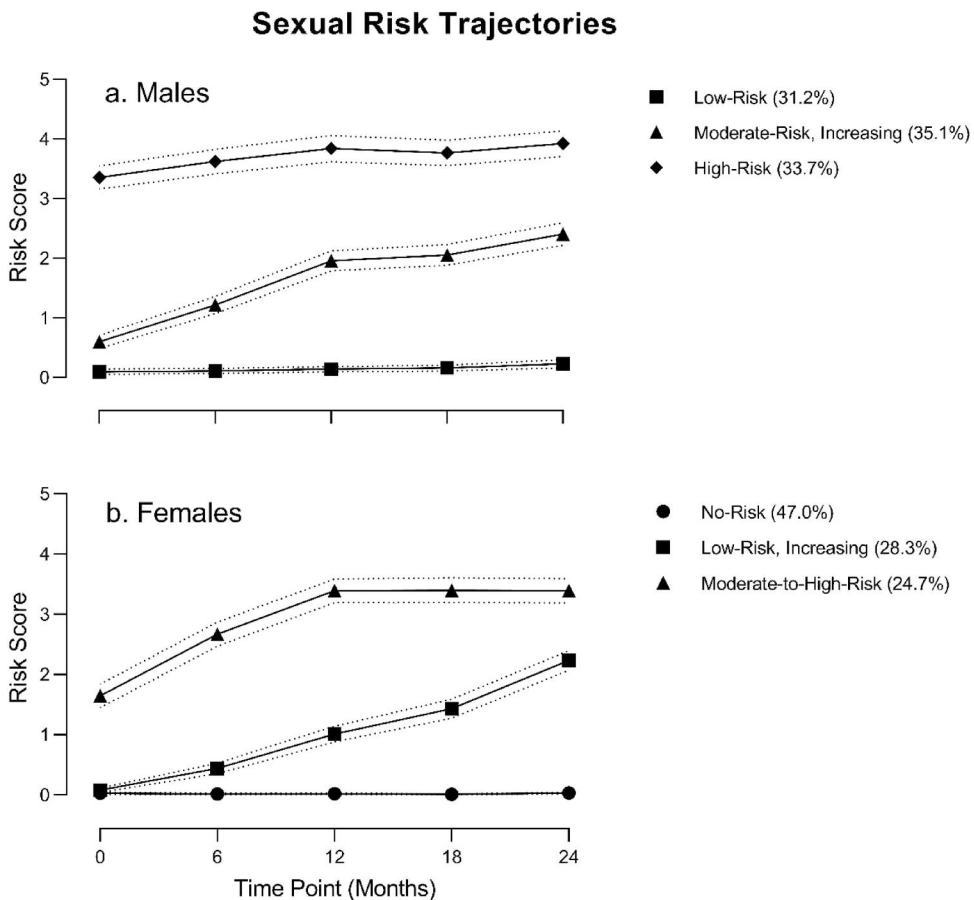


Figure 1. The Sexual Risk Trajectories for Males (a) and Females (b) across 24 Months. Figure 1a shows three distinct sexual risk trajectories for boys, which are low-risk, moderate-risk and increasing, and high-risk trajectories. Figure 1b shows three distinct trajectories for girls, which are no-risk, low-risk and increasing, and moderate-to-high-risk trajectories.

Impact of Social Factors on Group Membership

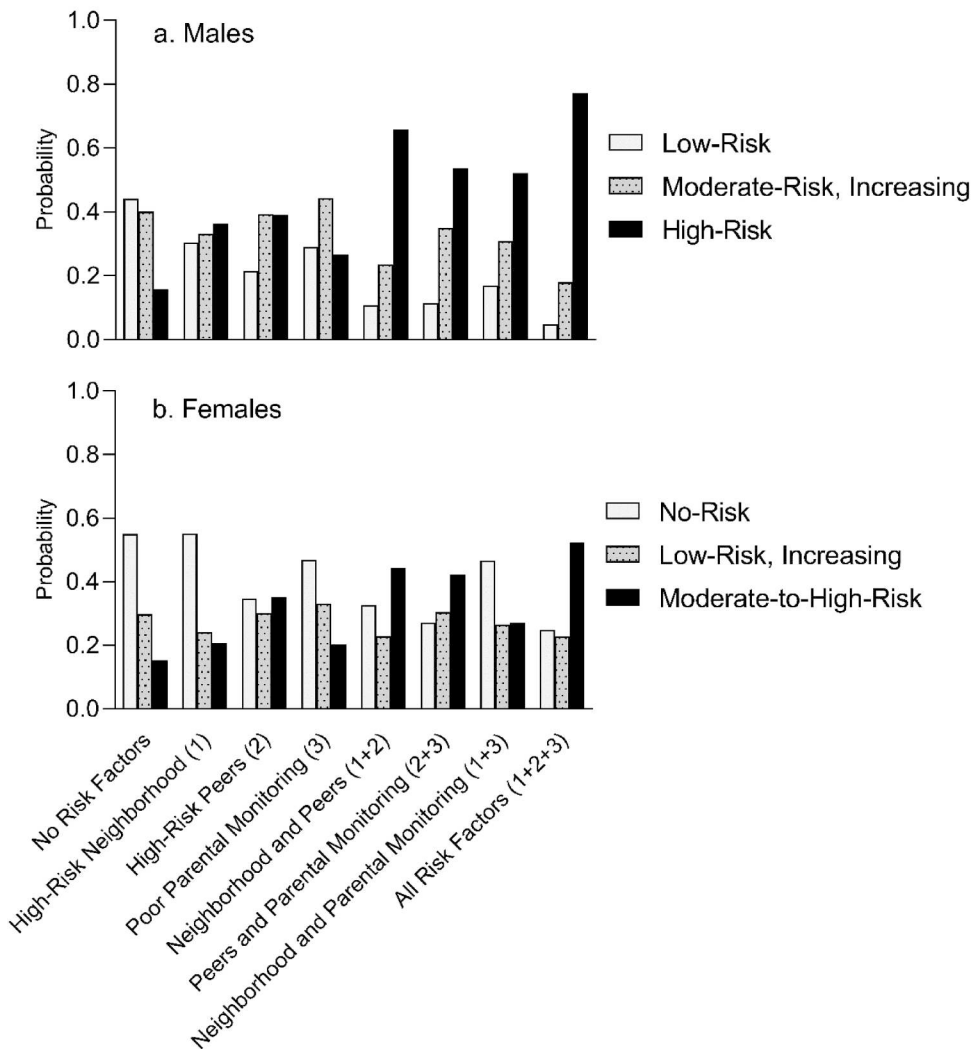


Figure 2. Probability of Group Membership Based on Experience with Risk Factor Combinations for Males (a) and Females (b). Figure 2 shows the impact of social risk factors on three distinct trajectories for boys and girls. Having high-risk peers, poor parental monitoring, and high-risk neighborhoods had the greatest probability of following the high-risk trajectory for boys and the moderate-to-high-risk trajectory for girls. For boys, those with high-risk peers or neighborhoods or with both risk factors increased the probability of following the high-risk trajectory. For girls, high-risk peers had the highest impact on membership in the moderate-to-high-risk group.

being in the high-risk group (0.39 and 0.36, respectively), and having two risk factors increased this probability even further (high-risk neighborhood and high-risk peers, 0.66; high-risk peers and poor parental monitoring, 0.54; high-risk neighborhood and poor parental monitoring, 0.52). Those who experienced all three risk factors had the greatest probability (0.77) of being in the high-risk group. This means that if all male students were exposed to three risk factors, 77% would likely follow the high-risk trajectory.

Trajectories of sexual risk behaviors for girls and associated risk factors

Figure 1(b) depicts the girls' three trajectories. Girls in the no-risk group, on average, displayed near zero sexual risk behavior score over 24 months. Those in the low-risk, increasing group displayed a steady increase, from an average of 0.1 at baseline to an average of 2.2 at 24 months. Finally, girls in the moderate-to-high-risk group displayed the highest score; the trajectory increased from an average of 1.7 at baseline to an average of 3.4 at 12 months through 24 months.

Figure 2(b) displays the impact of social risk factors on group membership for girls. In the absence of other risk factors, high-risk peers had the highest impact on membership in the moderate-to-high-risk group (probability of group membership = 0.35), and combining high-risk peers with the other risk factors increased that probability further (high-risk peers and high-risk neighborhood, 0.44; high-risk peers and poor parental monitoring, 0.42; all three risk factors, 0.52). This means that if all female students were exposed to three risk factors, 52% would likely follow the moderate-to-high-risk trajectory.

Discussion

Using longitudinal data from Bahamian high school students, we examined the sexual risk trajectories of middle-to-late adolescents, marked with a high incidence of risk behavior experimentation. We identified three distinct trajectories for boys and girls. Some trajectories showed consistently high risk scores or rapid increases in risk engagement. Previous studies have explored the impacts of peers, parental monitoring, and neighborhood risk on adolescent risk behaviors; this study contributes by examining how the combinations of these multi-level social risk factors affect adolescents' membership in high-risk trajectories and gender differences.

Gender differences in sexual risk engagement were evident in our study. On average, boys consistently engaged in sexual risk behaviors more than girls. Also, more boys followed the high-risk trajectory than girls followed the moderate-to-high-risk group. Previous literature also indicates that boys tend to engage in more risk behaviors than girls (Ali et al., 2021; Muhammad et al., 2021). Our data indicate that a third of boys in our study exhibited high sexual risk even before entering middle adolescence and maintained the behavior throughout late adolescence. These findings emphasize the necessity of intensive interventions among boys, starting in early adolescence, for sexual health promotion and HIV prevention.

Our study also revealed distinct trajectory patterns. Boys in the moderate-risk, increasing group showed tempered growth in the sexual risk score, and girls in the low-risk, increasing group exhibited a more noticeable increase. When examined by specific behaviors, the increasing rate of girls who initiated sex and had sex in the last six months was twice faster than boys, which may be a consequence of girls' initiating sexual activity later than boys (Kushal et al., 2022). The gender disparity in the increasing rate was even larger in drinking before sex. A sexual trajectory study from middle adolescence to young adulthood found that problematic alcohol use was significant only in girls (Rossi et al., 2021), suggesting special attention to drinking and its impact on sexual risk behavior during sexual health education for adolescent girls.

Our study further highlighted the importance of multi-level social factors in adolescents' sexual risk engagement. Although it is not surprising that simultaneous exposure to all risk factors substantially escalated the sexual risk score, the effects of individual factors or combinations of the factors differed by gender. For girls, peer influence was pronounced, with high-risk peers having the greatest impact on moderate-to-high sexual risks. Studies about youths' peer norms reported that girls, more than boys, believed that their friends were engaged in sexual risk behaviors (Van De Bongardt et al., 2017) and girls with such perceptions were more likely to practice the risk behaviors than boys. An experimental study revealed that peer effects disappeared when adolescents believed they were surrounded by less risk-oriented peers (Moriizumi & Usui, 2020), suggesting that modifying misperception of sexual risk peer norms should be an essential part when designing a sexual health program for adolescent girls.

Parental monitoring had a relatively smaller effect on sexual risk behavior. When compared on individual risk factors, both boys and girls with poor parental monitoring were the least likely to be in the high-risk group or moderate-to-high group. These patterns in boys and girls may be due to their developmental stage seeking more autonomy or less engaged parenting style in the Caribbean, yielding a weaker impact on their child's risk behaviors than parents in other regions (Ruprah et al., 2017). The interaction effect of poor parental monitoring and high-risk neighborhoods also differed by gender. Boys with both of those factors had a higher probability of following the high-risk trajectory than boys with only one of the factors. However, girls' probability of following the moderate-to-high-risk trajectory did not differ by whether they were exposed to one of those factors or both factors. Previous studies report inconsistent findings about the relation between parental monitoring and neighborhoods (Orihuela et al., 2020; Udell et al., 2017), and our study suggests that gender could have contributed to the inconsistency. Therefore, the potential relation between poor parental monitoring and high-risk neighborhoods warrants further investigation.

The results of this study have important implications for development of interventions to prevent and reduce adolescents' sexual risk behaviors. First, tailored interventions for gender-specific needs and risks are crucial, given the different patterns of boys and girls. Early identification of adolescents with high sexual risks, particularly boys, is vital in preventing patterns that persist into adulthood. Second, interventions that address multi-level social risks are likely to be more effective. For instance, strategies to have a healthy peer norm and cope with negative peer influences might reduce adolescents' high sexual risks. Interventions should also include parents to help them communicate effectively with their kids and protect them from other social risks.

Strength and limitations

This study is based on a large, longitudinal study of adolescents in a developmental period of rapid risk-taking in the context of a geographically high HIV prevalence. Compared with other studies, which often examine at most three sexual risk behaviors, the measure in our study is more comprehensive and reflects a range of sexual risks that are likely to occur in this adolescent population. We did not assess drug use before sex due to its anticipated low prevalence, especially among females, with only 7.0% of males and 1.4% of females using marijuana in the past six months (Kaljee et al., 2016).

This study has several potential limitations. Although certain sexual behaviors may vary in their impact on health outcomes, we assigned equal weight to each item due to a lack of guidance on differential weighting for a composite risk score. The strategy for creating risk behavior composite scores with equal weighting is supported by previous literature (Bornovalova et al., 2008; Wright et al., 2018). Additionally, our samples included about two-thirds of students in all eight public senior high schools in New Providence, the most densely populated island of The Bahamas, with about 75% of the population (Census Office, 2023), but the study findings may not be applicable to adolescents in remote family islands. Lastly, our group-based trajectory analysis was adjusted for age, sex, and intervention assignment. Ethnicity and socioeconomic status were not included because nearly all students were of African descent and came from low-income families attending government schools.

Conclusion

We identified three district developmental trajectories of sexual risk behaviors for middle-to-late adolescent boys and three for girls using group-based trajectory modeling. Adolescents exposed to all three risk factors were most likely to follow a high-risk trajectory. High-risk peers and a high-risk neighborhood predicted boys' high-risk trajectory, whereas high-risk peers (alone or combined with other risk factors) had the greatest impact on girls' high risks. Poor parental monitoring had a relatively small effect on high sexual risks although its effect differed by gender. Our results underscore the importance of early identification of high-risk adolescents and risk factors that predispose adolescents to high-risk trajectories. Tailored interventions should address gender-specific factors: focusing on peer influence for girls and addressing peer influence and neighborhood contexts for boys can effectively reduce these risks and improve health outcomes among adolescents.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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Institutional review board statement

This study was approved by the Wayne State University School of Medicine Institutional Review Board (064008B3F) and the Institutional Review Board of the Bahamian Princess Margaret Hospital, Public Hospitals Authority.

Consent to participate

Informed consent was obtained from participants.

Data availability statement

The data are available from the corresponding author upon reasonable request.

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