Modeling the community-level effects of male incarceration on the sexual partnerships of men and women

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ABSTRACT

Men who have been incarcerated experience substantial changes in their sexual behavior after release from jail and prison, and high rates of incarceration may change sexual relationship patterns at a community level. Few studies, however, address how rates of incarceration affect community patterns of sexual behavior, and the implications of those patterns for HIV and STD risk. We describe a "proof of principle" computational model that tests whether rates of male incarceration could, in part, explain observed population-level differences in patterns of sexual behavior between communities with high rates of incarceration and those without. This validated agent-based model of sexual partnership among 20—25 year old heterosexual urban residents in the United States uses an algorithm that incarcerates male agents and then releases them back into the agent community. The results from these model experiments suggest that at rates of incarceration similar to those observed for urban African American men, incarceration can cause an increase in the number of partners at the community level. The results suggest that reducing incarceration and creating a more open criminal justice system that supports the maintenance of inmates' relationships to reduce instability of partnerships for men who are incarcerated may have important sexual health and public health implications. Incarceration is one of many social forces that affect sexual decision-making, and incarceration rates may have substantial effects on community-level HIV and STD risks.

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1. Introduction

Population and individual level studies show associations between rates of incarceration and higher rates of STDs and/or HIV; these studies also find a relationship between population rates of incarceration or individual history of incarceration and increased risk factors associated with HIV and STD acquisition and transmission, including higher rates of concurrent sexual partnerships and a greater number of sexual partners (Adimora et al., 2007; Epperson et al., 2010; Johnson and Raphael, 2005; M. R. Khan et al., 2009; Knittel et al., 2013; J. C. Thomas, Levandowski et al., 2007). Although incarceration among women is increasing, because men are incarcerated at a rate many times higher than that of women (954 per 100,000 U.S. residents compared to 68 per 100,000 U.S. residents, respectively, in 2009), most analyses focus on sexual risks to men that result from incarceration and the effects on women of having an incarcerated partner (Carson and Golinelli, 2013; Epperson et al., 2011; West, 2010). Qualitative and quantitative analyses emphasize increased rates of partnership dissolution due to physical and emotional distance, as well as a desire for an increased number of sexual partners to "make up for lost time"

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(Bergman, 2008; Braman, 2004; Maria R. Khan et al., 2011a; J. C. Thomas et al., 2007). The literature also suggests that whether female partners of incarcerated men "go on about [their lives]" while their partners are away or maintain their relationships through visits and calls, these women may rely on other relationships, including new sexual partners, for emotional and financial support (Braman, 2004; Comfort, 2008; J. C. Thomas et al., 2007, p. 94).

Clear et al. (2003) define "coercive mobility" as the disruption of social networks, community structure, and social norms that occurs as a result of high community rates of incarceration, and results in an increase, rather than a decrease, in crime rates with high rates of incarceration. Thomas (2006) extrapolated that this may also translate into a shift in social norms governing sexuality that facilitates HIV and/or STD transmission. These authors hypothesize a threshold effect, wherein low levels of incarceration are associated with less crime and maintain sexual norms that limit disease spread, but once incarceration rates reach a threshold, crime increases and risky partnerships increase, leading to increased disease transmission.

Discussion of incarceration in the United States must include the context of racial disparities in criminal justice involvement. The complex historic interaction between racialized fears of and responses to crime, increasing economic disparity, the influx of crack cocaine into already struggling urban neighborhoods, and political responses to the drug "epidemic" fueled a "prison boom" starting in the 1980s which resulted in disproportionate incarceration of young African American men, particularly poor men with little education (Kent and Jacobs, 2005; Stolzenberg, D'Alessio and Eitle, 2004; Western, 2006). Persistent disparities in economic disadvantage, differential policing, and conscious and unconscious bias in the criminal justice system have reinforced these differential rates of incarceration even as the absolute number of men incarcerated in the US has plateaued in recent years (Carson and Golinelli, 2013; Ousey and Lee, 2008; Rodriguez, 2011; Walker et al., 1996).

Conceptual models postulating the relationships between criminal justice involvement and sexual decision-making appropriately situate it in relation to other social forces that shape sexual relationships and community-level risk for HIV and other STDs (Adimora and Schoenbach, 2005; J. C. Thomas, 2006; J. C. Thomas and Thomas, 1999). Individuals are constrained by geography and biography, and sexual and social networks form through introductions that take place in the contexts of work and school, still remarkably segregated in most of the United States due to decades of discriminatory lending policies and federal and state housing policy (Frey and Meyers, 2005; Laumann et al., 1994; Massey, 1990). Economic policy, concentrated unemployment and disadvantage, sex differences in mortality and migration, and residential segregation all contribute to the racial disparities in the prevalence of incarceration, and also decrease the relative availability of desirable male partners compared with female partners (Geronimus et al., 1996; Massey, 1990). Green et al. (2012) also empirically demonstrate a frequently postulated association between low sex ratios (where men are underrepresented) and increased risk for unprotected sex and having multiple sex partners.

These studies together provide compelling evidence for a relationship between male incarceration, sexual behavior, and sexual decision-making, and they provide theoretical underpinnings for an examination of the effects of incarceration at a community level. The shortcomings of observational, often cross-sectional, studies limit our understanding of these effects, however, in a context in which experimental design would be unethical. Computational approaches provide a closed system in which to test hypotheses, and, as such, can suggest important avenues for policy and research. Agent-based modeling (ABM) is a promising method for understanding potential mechanisms through which high rates of incarceration shape sexual networks in communities because it allows for heterogeneity between individuals in the model. In addition, ABM requires an explicit description of the assumptions used in the modeling process. ABM offers the opportunity to experiment with rates of incarceration and sexual partnership preferences in a transparent way that would be impossible in a study of an actual network of sexual partnerships.

Previous work using ABM to examine patterns of sexual partnership focused on preferences and decision-making strategies involved in spousal selection as well as implications of patterns of sexual partnership (and particularly non-monogamy) on HIV transmission (Alam et al., 2008; French and Kus, 2008; Simao and Todd, 2003). These earlier models emphasized decision-making around first marriage and non-monogamy in male partners, but were not applicable to a context in which individuals have more than one partner over the course of their lives, and where both men and women are relatively likely to engage in non-monogamous partnerships at some point in their lives. These limitations prompted the development of a model of sexual partnership in the United States that would reproduce patterns of partnerships demonstrated in nationally representative data sets, and would provide a model world in which to test hypotheses about sexual decision-making (Knittel et al., 2011).

We present here an extension of that model, a "proof of principle" model testing whether men's incarceration may provide an explanation for some important proportion of the observed population-level differences in sexual decision-making and sexual networks between communities with high rates of incarceration and those with relatively low rates of incarceration, separate from sexual behavior that occurs inside criminal justice institutions. We also test whether incarceration might interact with other social forces, such as the sex ratio and the availability of high quality partners.

2. Methods

2.1. Model description

This study builds on an agent-based model of sexual partnerships over a 5-year period, implemented in Repast J, adding parameters and analyses to address the question of male incarceration. Full details on the parameters, design, and evaluation of the core model have been described previously (Knittel et al., 2011). In brief, when the model is run without incarceration, individuals (called "agents") are assigned measures indicating how desirable they are to other agents ("quality"), the level of quality they look for in a partner ("aspiration"), how long they need to date another agent before engaging in a sexual relationship, how long they will go without a partner before decreasing their aspirations, and the number of partners they believe they should have in a year. As the model runs, agents meet and decide whether to form a partnership. At each time-step, existing couples can choose to remain in a non-sexual partnership, become sexual partners, or break up. The flow of this portion of the model is illustrated in Fig. 1. Parameter values for this portion of the model were chosen from a combination of empirical data, previous parameter values described in the literature, and theoretical considerations (Knittel et al., 2011). Where no data or theory were available to guide the selection of parameter values, a range of values were tried until the model was calibrated to produce qualitatively reasonable results based on available partnership data. It was ultimately parameterized to approximate sexual decision-making processes among 20–25 year-old urban residents in the United States, and the values that produced these distributions are used here.