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Are skin color and body mass index associated with social network structure? Findings from a male sex market study

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Abstract

There is a growing burden of HIV and sex-related diseases in South Asia and India. Sociological research illustrates that key axes of social stratification, such as race and ethnicity, affect social network structure which, in turn, impacts sexual health and wellbeing. Research on networks has increasingly begun to examine the ways in which networks drive or harness sexual behaviors, but has largely neglected the influence of culture and cultural markers in this continuum. Furthermore, much of the existing scholarship has been conducted in the U.S. or in Western contexts. As part of an exploratory effort, we examined how skin color and body mass index (BMI) affected networks among 206 men who have with men (MSM) frequenting sex markets in Hyderabad, India. A novel phone-based network generation method of respondent-driven sampling was used for recruitment. In assessing how skin color and BMI drive these structures, we also compared how these factors contribute to networks relative to two more commonly referenced markers of social difference among Indians, caste and religion. Our findings suggest that skin color and BMI contribute significantly more to network structure than do caste and religion. These findings tentatively illuminate the importance of individual-level heterogeneity in bodily attributes, factors which are

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seldom considered in conventional approaches to researching how social stratification and health inequalities are animated during the formation of networks.

Keywords

social networks; men who have sex with men; India; skin color; BMI

Social Networks, Ordering and Status

Social networks represent intricate meaning structures within which social interactions occur and behaviors are normalized (Lin 1999, Friedman and Aral 2001, Fujimoto, Wang et al. 2015). Applied and theoretical research has consistently demonstrated that the structure of networks is primarily driven by processes of social stratification (Grusky 2018, Smith, McPherson, Smith-Lovin 2014, Tumin 1985). Social stratification codifies the socioeconomic categories which rank and group individuals, while determining and allocating resources, services, and prestige (Kerbo 2006). In the United States, race and ethnicity, representing dense, amalgamated social categories, are principal dimensions of social stratification shown to pattern the structure of social networks (Moody 2001, Wimmer and Lewis 2010).

In India, contrasting to the United States and much of the West, factors that are chiefly ascriptive, such as caste and religion, typically represent the most salient categories of social stratification (Berreman 1972, Ambedkar, 2016). *Varna*, the Sanskrit word for caste, originally referred to “color” (Gergen 1967), with upper castes in India collectively designated as *Arya Varna*, or “Aryan color,” and lower castes termed *Dasa Varna*, connoting “slave color” (Macdonell 1914, Bailey 1963). Traditionally, there have been four *varna* in India: *brahmins*, or priests; *kshatriyas* or warriors; *vaishyas*, or merchants; and *sudras*, or manual workers and craftsmen (Bailey, 1963). In Buddhist texts, *brahmins* have been referred to as white *varna* and others as black *varna* (Gergen 1967). Imbued with these hierarchical groupings, the caste system served to create strict rules for social interaction and marriage, institutionalizing a system wherein lighter skinned *brahmins* most readily generated and amassed power and the resultant social and economic resources and opportunities. Like caste systems, religion plays a key role in shaping social networks in India (Berreman 1972, Vanneman, Noon, Sen, Desai, & Shariff, 2006), which has a diverse landscape of religions, including Hindus (80.5% of the population), Muslims (13.4%), Christians (2.3%), and Sikhs (1.9%) (*Religion, Census of India 2001*).

One means of better understanding these complex macro-level systems and the resultant social interactions and behavioral dynamics is by considering the role of social homophily, the pattern of an individual being regularly connected to similar individuals via social network structures (McPherson, Smith-Lovin, & Cook, 2001). To date, however, very little research has examined association social networks, behaviors and health in India, or whether they may be structured differently than in the US and Western world, where much of the extant scholarship on networks has been conducted (Perkins, Subramanian, Christakis, 2015).

India's population of men who have sex with men (MSM) constitutes a valuable group for characterizing the influence of social networks on behaviors. UNAIDS estimates that there were more than 2.1 million people (CI:1,700,000 – 2,600,000) in India living with HIV in 2016 (India: HIV and AIDS Estimates, 2016), with a substantial portion of this disease burden falling on the country's sizeable population of gay and MSM populations: Largely "hidden," there are an estimated 2.35 million MSM in India, with an HIV prevalence predicted to be between 7% and 16.5% (Thomas, Mimiaga et al. 2009, National AIDS Control Organisation 2012b), up to 15 times the general population's prevalence (United Nations Development Programme 2012).

Despite globalization and evolving views on heteronormativity, same-sex relations remain highly stigmatized in much of India (Asthana & Oostvogels, 2001; Kole, 2007), where non-heterosexual relationships were, up until a landmark decision from the Supreme Court of India in 2018, punishable by law (Shrivastava, Misra, Mohan, Unnikrishnan, & Bachani, 2017). Negative views of non-heteronormativity have generally been shown to be prominent across populations at all caste and economic levels in India (Kole, 2007; Vanita, 2013). These dynamics have contributed to a base of literature demonstrating high rates of internalized stigma and depression among MSM in India, trends shown to be significantly associated with HIV status, in this subgroup (Logie, Newman, Chakrapani, & Shunmugam, 2012).

Sex markets represent one common and stark manifestation of social homophily (Uecker and Regnerus 2010, Mauk, Perry et al. 2013). Importantly, sex markets follow boundary specifications based upon particular geographical areas (Laumann, Gagnon, Michaels et al. 1989). Networks within bathhouses and cruising venues (Choi, Han et al. 2002)—spaces men who have sex with men (MSM) may frequent to meet and engage prospective sexual partners—have provided rich data on health behaviors, attitudes, and exposures of participants, as well as targets for interventions. For example, in a sample of MSM from four U.S. cities, party drug usage and unprotected anal sex were shown to be more common among those visiting sex venues, and MSM attending both public cruising areas *and* bathhouses were more likely than those attending only public cruising areas to report risky sex in public settings (Binson, Woods et al. 2001). Further, in a study in Portugal (Gama, Abecasis et al. 2017), more than one-third of respondents indicated visiting cruising venues to meet sexual partners, with significantly more of these individuals reporting HIV seropositivity in contrast to those whom did not attend cruising venues.

Skin Color and Body Mass Index as Status Markers

The study of anthropometric features, such as skin color and body mass index (BMI) (Ayyar and Khandare 2013), represent another underdeveloped frontier in the investigation of high-risk network structure. In South Asia, lighter skin is socioculturally privileged, with dark skin often stigmatized and serving as a *de facto* marker of lower socioeconomic class or caste (Shrestha 2013). Among South Asians, darker skin has been found to negatively predict self-esteem and self-rated physical health (Bhagwat and Brunswick 2012, Ismail, Loya et al. 2015). This research complements scholarship in the U.S. on Blacks, where darker skin, a "visible marker," has been demonstrated to be negatively associated with

multiple measures of mental and physical health (Sweet, McDade et al. 2007, Monk 2015). Research conducted among Latinx has shown similar associations (Chavez-Dueñas, Adames et al. 2014).

The conflation of race and skin color, along with essentialist discourses related to race and ethnicity, often obscure the substantial variation in skin color not only across, but also *within*, ethno-racial categories (Hunter 2007). In fact, studies illustrate that educational and health inequalities between light and dark-skinned Black Americans rival, or may even exceed, inequalities between Black and White Americans at the population-level (Monk 2014, 2015, 2018). Further, research in the U.S. finds that Blacks, Asians, and Latinx with lighter skin tones earn higher salaries, are more educated, live in safer, more prosperous neighborhoods, and marry individuals with higher social status, compared to darker-skinned individuals of the same race/ethnicity (Keith and Herring 1991, Espino and Franz 2002, Rondilla 2007). Notably, there is also evidence in these dyads of homophily and social closure being expressed (Bodenhorn 2015). “Colorism” has particular theoretical primacy in India, given the deep embeddedness of skin color within the caste system and its relation to India’s ongoing identity politics (see above). These elements may be doubly paramount for MSM in India, given the legacy of disenfranchisement of non-heteronormative individuals in the country (Vanita 2016, Chowdhury 2017).

Like skin color, prior research has acutely observed BMI’s dense association with poor mental and physical health outcomes (Anandacoomarasamy, Caterson et al. 2009, Zhao, Ford et al. 2009) and also socioeconomic inequality, particularly with respect to the labor and marital markets (Cawley 2004, Puhl and Latner 2008). Consequently, BMI represents a form of social stratification which may be meaningfully related to social network structure. While existing research shows that BMI may be positively associated with stratification in the U.S. (Ailshire and House 2011, Botoseneanu and Liang 2011), differing cross-cultural perspectives on health and body image may lead to BMI being operationalized differently outside of the U.S.. Moreover, associations between BMI and sexual activity may be more pronounced in the social and sexual networks of MSM.

Along these lines, considerable nuance has been demonstrated in studies assessing linkages between network structure and sexual behavior and health. In one cross-sectional web-based survey conducted in the US, 431 single young MSM between the ages of 18 and 24 years who sought romantic partners online were asked to respond to questions regarding their BMI, body image, and sexual behavior (Meanley, Hickok et al. 2014). Here, participants reporting a BMI $\leq$27 were shown to have lower odds of engaging in unprotected receptive anal intercourse (Meanley, Hickok et al. 2014). Other research has shown that MSM possessing an underweight body image may have *lower* overall odds of having unprotected anal intercourse than those who reporting an average body weight image (Allensworth-Davies, Welles et al. 2008).

As in much of the West, and increasingly in developing countries, India is wrestling with accelerating obesity rates. A recent review found obesity prevalence in the country ranging from 11.8% in Jharkhand (east India) to 31.3% in Chandigarh (north India), and higher rates in urban vs. rural areas (Shrivastava et al., 2016). Expanding scholarship in this space may

help contextualize the situational salience of body weight, showing how measures of body weight and composition could enable a better understanding of social network formation and critical public health targets such as risky sexual behaviors. In India, fundamental differences in nutrition, and larger BMIs suggesting higher socioeconomic status, may modify differences in sex partner selection (Subramanian, Perkins et al. 2010). Presently, however, it is unclear to what extent BMI may be associated with network structure in India.

Skin color and BMI, as readily observable physical attributes, likely play a role in structuring interpersonal relationships and associated networks, given existing evidence that these markers act as cues signaling relative attractiveness and other desirable social traits, such as perceived intelligence (as in the case of a "halo" effect) (Moore, Filippou, & Perrett, 2011). These markers may be conceptualized as forms of *bodily capital* (Monk 2015), which operate as *symbolic capital* (e.g., honor and status) that may, in turn, facilitate the acquisition of *social capital* (e.g. advantageous network positions, social connections, etc.).

As part of an exploratory effort, we conducted a pilot study to explore whether skin color and BMI were associated with social networks among MSM in India. Since skin color and weight (BMI) are more readily discernible than caste or religion, we hypothesize that skin color and BMI are more likely to shape the social network structure of MSM. Moreover, in applying a heuristic approach to ascertaining the relationship between bodily characteristics and social structuring, we ultimately rely on the positional—as opposed to relational—features of a social network by describing the patterns of relations defining an actor's position in a system of actors (Burt 1980). Given the overwhelming focus in this field on individuals in the US and West, the present provisional investigation may enable a broader, globally-oriented theory of how the body can operate as a meaningful factor in social network organization. Moreover, a more nuanced understanding of these dynamics carries important implications for interventions aimed at mitigating sexual health risks.

Methods and Materials

Study Setting

The study was conducted between January 2011 and December 2011, in Hyderabad, the fast-growing capital of the former South Indian state of Andhra Pradesh, which has a population of just under 7 million residents (Census of India 2011). Andhra Pradesh has the 18th highest per capita income in India at 142,054 (US$2,100) (Andhra Pradesh, Socio Economic Survey 2017-18), wrestling with pronounced rates of poverty, unemployment, malnutrition, and communicable and environmentally-borne diseases (Deininger & Liu, 2013; Dhanaraj, 2016).

A recent census in Hyderabad estimated that Hindus comprised approximately two-thirds of the population, and Muslims comprised roughly 30% (*Report: Population By Religious Community, Government of India*). (Data on the numerical distribution of citizens in Andhra Pradesh by caste type were unavailable at the time of this writing.) Of note, prior to the creation of the South Indian state of Telangana, Andhra Pradesh had the highest adult HIV prevalence in India (0.90%), roughly three times the national average (National AIDS Control Organisation 2012b). According to the most recent data, there are roughly 500,000

(424,000-596,000) people in Andhra Pradesh living with HIV, accounting for 20% of all HIV infections in India (National AIDS Control Organisation 2012a).

Participants, Sampling, and Inclusion Criteria

In concert with two local partner organizations, 20 “cruising” venues where MSM are known to socialize were identified; anecdotal evidence suggested that paid and unpaid sex were highly common in these venues. These social venues included public sites, such as railway stations, theaters, small restaurants, and parks. To enhance the scope and precision of recruitment efforts, the most common days of the week and the times of the day for MSM to gather in each respective venue were identified. Each venue was estimated to have anywhere from 30 to 200 MSM within the specific time period. For logistical reasons, other venues with a smaller number of MSM (<30) were excluded. To protect the sensitive nature of the identity and activities of the MSM frequenting these venues, no further details on the venues are provided.

The study used Time Location Cluster Sampling (TLCS) (Diaz, Ayala et al. 2001). The sampling frame included 3-hour periods at the 20 venues in which participants could be recruited. Every month of the study period, 15 venues were randomly selected, without replacement, from the sampling frame, and one of the 3-hour periods associated with the venue was also randomly selected. Members of the collaborating community-based organization (CBO) approached MSM at the venue and screened them for eligibility. To reduce the chance of self-section bias and to reduce the likelihood of duplication of participants (Khazaal et al., 2014), individuals who approached the team for enrollment or who were previously enrolled (as verified by cellphone number), were deemed ineligible and excluded from the study. The study was reviewed and approved by the appropriate Institutional Review Boards in the U.S. and India. Informed consent was obtained from the study participants prior to study enrollment.

Peer health educators working for an MSM-focused CBO funded by NACO recruited participants from these venues. Inclusion criteria for study participants included: 1) male; 2) a least 18 years of age; 3) a visitor to one of the 20 aforementioned cruising venues; 4) reported anal or oral intercourse with another man within the past 12 months; and 5) owned, and in possession of, at least one activated cellphone at the time of recruitment.

Data Collection

Individuals who met the inclusion criteria were subsequently interviewed at the CBO office. To generate respondents’ networks, a SIM card reader, assembled using a kit from Adafruit Industries, was used to extract contact lists from the participants’ cell phones (Satyanarayan, Kapur, Azhar, Yeldandi, & Schneider, 2015; Schneider, Zhou, & Laumann, 2015). This approach to network generation—used instead of a conventional ‘name generator’ to elicit the names of individuals linked to an index respondent—is valued, in part, because it diminishes the likelihood of recall bias which is commonly associated with survey-based name generators (Peseckas, 2016). Additionally, given the high degree of phone-sharing in India (Ling & Campbell, 2009; Steenson & Donner, 2009), a phone-based network generation method may provide a more accurate estimate of network dimensions (Peseckas,

2016). The card reader used pySIM, a free, open-source SIM card-reading software package. pySIM was utilized to extract phonebook entries into a .csv file for each respondent interview. Cellphone numbers were then linked to study respondents to populate the virtual social network used for subsequent analyses (see Schneider, Zhou et al. 2015).

Measures

Respondents' age, religion, neighborhood (North, Northeast, Northwest, South, Southeast, Southwest, West and East), marital status, intercourse role (*mostly insertive, mostly receptive, and versatile*), HIV-status, and any history of sex work (whether for exchange of money or other resources/benefits) were captured during the confidential interviews. Caste system was measured as a series of dichotomous variables indicating inclusion/exclusion in: 1) Other/forward caste; 2) Scheduled Caste (SC); 3) Scheduled Tribe (ST); 4) or Backwards Cast (BC) (Perkins, Khan et al. 2009). Respondents' height and weight were measured during the interview using a calibrated medical scale. Photos of the forearm were taken for each subject, given that, apart from the face, the forearm is typically the most visible to others. Photos were taken with a Sony® Cyber-shot™ camera using normal room illumination and no flash, at a distance of 20 centimeters, with a white board placed behind every picture to provide a white balance. Images were saved in a JPEG format. *ImageJ* was downloaded from the National Institutes of Health's website and used for image processing and analysis.

Skin color was estimated using a melanin index calculation described by Yamamoto (Yamamoto, Takiwaki et al. 2008), beginning with normalization of the image background. The image was loaded into *ImageJ* and split into the appropriate RGB component images. The mean brightness of the background of each component image was calculated by selecting a 300 × 300 pixel region of the white background. The brightness of each component image was multiplied by 200/mean brightness to achieve the same brightness for each component image. The component images were then merged to create a composite image. The mean brightness of three random *300 × 300*-pixel regions was calculated using *ImageJ*, and the mean of these values was recorded as the calculated melanin index.

Social network measures included in-degree, betweenness, constraint, and bridging (Fang et al., 2015). *In-degree* references the number of times a participant is nominated, or referenced/referred, by another participant in the network (i.e., the number of incoming ties), with a higher in-degree corresponding to a greater number of ties within the network. *Betweenness* represents the number of times the shortest path between two other participants includes the participant in question. Participants with greater betweenness are generally more central and are better bridges. *Constraint* quantifies how much of a participant's connections are also connected to one another—this is another measure of bridging. The inverse of the network measure of constraint was used for the regression model (SP Borgatti, Candance, & Everett, 1998). Lastly, *bridging* is a measure of how much a participant connects different groups within the network which are otherwise not connected.

Data Analysis

Network metrics were generated from the respondent list using UCINET (SP Borgatti, Everett, & Freeman, 2002) and R (R Core Team 2014). UCINET was used for calculation of in-degree, betweenness, and constraint (ego-network). R was used for calculation of bridging based on systematic link deletion (Valente and Fujimoto 2010). Network measures, along with the anthropometric and sociodemographic data, were imported into Stata v.13 (Stata Statistical Software, Release 13.2013), which was used for the remaining statistical analyses.

Using cut-points newly released and tuned to common anthropometric features of South Asians (Aziz, Kallur, & Nirmalan, 2014; Gray et al., 2011), BMI (kg/m^2) was calculated using weight and height, and then categorized into *underweight* (≤18.4), *healthy* (>18.4≤23), *overweight* (>23-<25), and *obese* (≥25). For ease of interpretation, skin color values were transformed, from raw scores, into categories based on quartiles (Branigan, Wildeman, Freese, & Kiefe 2017, Krieger, Sidney, Coakley, 1998). Similarly, the network metrics of in-degree, betweenness, constraint, and bridging were divided into quartiles. (Statistical results were the same.) Bivariate analyses were performed using ordinal logistic regression to test for associations between the network outcomes (i.e., in-degree, betweenness, constraint, and bridging) and anthropometric predictors of BMI and skin color or sociodemographics (i.e., caste, religion, and age). Using the statistically significant predictors from these bivariate regressions, multivariate ordinal logistic regression models were created for each of the network outcomes.

Findings

Sample characteristics are presented in Table 1. Briefly, the final sample included 206 study participants. The majority of the sample (57.3%) was under the age of 25. Additionally, roughly 87.5% of the sample identified as Hindu. The most common caste was Backward (n=100; 59.5%), followed by Other/Forward (n=37; 22.0%). The majority of participants described their MSM intercourse role as receptive (n=128; 62.1%), and most reported engaging in sex work (n=120; 58.3%). No statistically significant bivariate associations were revealed between sociodemographic factors, including caste and religion, HIV status, and network measures (data not shown).

Respondents who were overweight (BMI >23.1-<25 kg/m^2) were significantly more likely to be more centrally located in the network as measured by the three metrics of in-degree, betweenness, and constraint. Additionally, individuals with the darkest forearm skin color were significantly less likely to be in a higher quartile of in-degree and betweenness. We further determined that additional sexual behavior factors were also driving social network structure. MSM's intercourse role was significantly associated with in-degree, betweenness, and constraint: compared to those with a receptive intercourse role, those with insertive and versatile intercourse roles were more likely to have lower centrality across these three measures.

Multivariate model results for each of the network measures are outlined in Table 2. Overall, overweight respondents had lower constraint (i.e., more likely to be a network bridge) as

compared to normal weight respondents (adjusted odds ratio (aOR) of inverse constraint; 2.85, 95% CI 1.25-6.47). In addition, overweight respondents demonstrated a trend towards having a higher in-degree (i.e., more centrally located) compared to those with a normal BMI (aOR 2.20; 95% CI 0.88-5.50). Participants with the darkest skin color (4^{th} quartile) had a lower centrality, as measured by in-degree, in contrast to individuals with the lightest skin color (1^{st} quartile) (aOR, 0.37; 95% CI 0.10-0.92). Participants with the darkest skin color (4^{th} quartile) also demonstrated a trend toward lower centrality, as measured by betweenness, than did individuals with lightest skin color (aOR, 0.44; 95% CI 0.18-1.05). MSM's intercourse role remained significantly associated with in-degree, betweenness, and constraint: compared to those with a receptive intercourse role, those with insertive and versatile intercourse roles were more likely to have lower centrality across all three measures (aORs range, 0.02-0.20; p=0.002-<0.001).

Discussion

This exploratory analysis illuminates the potential value in assessing observable bodily characteristics to understand social network structure. Using a sample of individuals frequenting 20 well-defined cruising venues in India, we found that skin color and BMI significantly shape the organization of MSM's social networks. Our work, in determining that a larger BMI is associated with lower constraint (higher local bridging network position), is consistent with Burt's early investigations into social networks and his identification of bridging individuals' intricate acquisition of higher social capital (Burt 1980, Burt 2000). The present analysis suggests that increasing BMI may reflect higher social status and greater access to resources, particularly among middle-to-lower income MSM who frequent sex markets in South India. Importantly, however, this relationship is attenuated when BMI is at the highest level (i.e., obesity), suggesting that physical/sexual attraction may also be playing an indirect role in centralizing actors within the social network. Interpersonal sexual attraction among persons whom have only recently met, and whom have very limited information about one another, reflects information which is essentially restricted to readily observable physical attributes. These cues about relative sexual attractiveness are subject to subconscious—or subliminal—orderings of approach or avoidance that are, in turn, rooted in cultural (or learned) stereotypes reflecting dominant societal status rank-orders.

At the margins of these observed social reproductions, when one is choosing between two or more potential partners, one is implicitly guided by culturally acquired status-order preferences to the extent to which they can be discerned or discriminated based on the cues available. Our analysis hints at a broad preference among participants for lighter-skinned partners (a trait which, in turn, may be associated with a higher caste) (Bailey, 1963). In contrast, the preference for higher BMI may be more societally specific—to wit, in India, people might generally find increasing weight to be a reliable indicator of relatively higher social status (e.g., because of differential food availability across the population at-large).

Our work provides tentative evidence that characteristics often deemed to be important in the selection of social and sexual partners in India, such as caste and religion, may not be particularly salient, or as salient, for MSM communities, as are social markers such as skin

color and BMI. Put simply, forms of *bodily capital* (e.g. skin color and BMI) may indeed be converted into *social capital.* In addition, our results showed that HIV status did not have a statistically significant effect on network structure; it is possible that respondents may not have definitively known their HIV status, or that they simply may not have been adjusting their social and sexual activity given their sexual partners' HIV status. Accordingly, this situational dynamic is worth exploring in future investigative work or HIV/STI prevention interventions.

There were limitations to our analysis. First, given the smaller sample, the study has limited generalizability, with observations here providing only a provisional read of the nature of network dynamics in this population. Further, since this study was cross-sectional and used purposive sampling for venues, only correlational conclusions can be drawn vis-à-vis participant features and relationships between participants' captured anthropometrics and network structures. However, it is unlikely that network structure creates changes in largely fixed variables, such as skin color, though, the rise of skin bleaching and whitening in India (Biswas, Mukherjee, Kar, et al., 2016, Shankar & Subish, 2016) may eventually engender a more tactile degree of skin color alterability. Also, despite the referenced advantages of a phone-based method of network generation (Peseckas, 2016), such an approach would not incorporate respondents' social network members whom do not own a phone, although this proportion is hypothesized to be low (Ling & Campbell, 2009). Moreover, the exact nature of respondents' relationships with individual phone contacts, and the extent of these relationships, cannot be precisely determined; though the study's sampling approach lends provisional credence to the interpretations outlined here.

Another limitation to the study was that data on socioeconomic status, including measures on education and income, was not collected and thus could not be analyzed as a potential confounder. Also, much of the research on colorism uses standardized measures of skin tone that are deemed to be more objective, such as the use of spectrophotometers (Borrell, Kiefe et al. 2006), which typically measure the skin reflectance of respondents' inner arms. Since social stratification is directly related to the activation of biases and stereotypes linked to the perception of the darkness of the face, rather than the inner arm, measures such as ours may not adequately capture interactions with respondents in the context of perceived discrimination.

Finally, there was no *a priori* justification to infer that skin reflectance scores are commensurate with the *social perception* of the lightness or darkness of an individual's skin. For example, *social* categories of color may be more predictive of health inequality than 'objectively' measured skin color using melanin reflectance scores from a spectrophotometer (Gravlee 2005). Alternatively, self-reported skin color may be a stronger predictor of perceived discrimination than interviewer-rated skin color and more directly related to health outcomes (Monk 2015).

Continuing, with nearly 60% of the sample being self-reported sex workers, it is possible that the presence of sex workers skewed the observed measures of centrality; the findings nevertheless carry significance for understanding sex worker transitions within networks and opportunities for engaging this population. Data suggest that networks of male sex workers,

for example, may be connected to networks of other groups, such as female sex workers, injection drug users, and other groups known to be at higher risk for HIV (Williams, Bowen et al. 2003). Consequently, more central members of these social networks may be the most ideal to target for intervening in the transmission of various STIs, including HIV. In our study, it is possible that certain social privileges were granted to male sex workers on the basis of skin color and body weight. Further research should be done to more fully enumerate these interactional elements and better characterize reasons for the particular positionality of more central members.

Given the observed importance of skin color and body weight on the likelihood of one being a bridge and being central to a social network, future STI interventions may obtain a greater impact on the social-sexual network structure by focusing on individuals with particular observable body characteristics, including lighter skin tone or being overweight. Such bridges may be instrumental in altering the behavioral dynamics of the social and sexual networks of MSM. Male sex workers, particularly those from less developed countries where politically legitimated antagonism and stigma against sex workers and sexual minorities may be especially elevated, represent a population largely neglected in the context of the global response to HIV/AIDS (Baral, Friedman et al. 2015).

In closing, we found skin color was a stronger predictor of social network structure as compared to commonly used social categories such as caste or religion. This finding complements extant scholarship showing skin color is more strongly associated with socioeconomic status than ostensibly more salient social categories such as ethnoracial census categories (e.g., black, brown, or white in Brazil) (Travassos, Laguardia et al. 2011, Monk 2016). It is unclear if culturally-adapted categories such as these have evolved over time, or if they have always been problematic in operationalizing and predicting socioeconomic status. Nonetheless, we found that skin color was a demonstrably stronger marker of social strata in an India-based male sex market and may meaningfully signify risk for HIV and other STIs.

ABBREVIATIONS:

AOR	Adjusted odds ratio
BMI	Body mass index
CBO	Community-based Organization
MSM	Men who have sex with men

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Table 1:

Characteristics of men who have sex with men sampled from social venues in Hyderabad, India in 2011 (N=206)

Characteristic	N (% of total)
Age	
≤22	62 (30.1)
22-25	56 (27.2)
25-28	37 (18.0)
>28	51 (24.8)
Caste Type[a]	
Other/Forward Caste	37 (22.0)
Backward	100 (59.5)
Scheduled Caste	29 (17.3)
Scheduled Tribe	2 (1.2)
MSM Intercourse Role	
Insertive	19 (9.2)
Receptive	128 (62.1)
Versatile	41 (19.9)
None	18 (8.7)
Religion	
Hindu	175 (87.5)
Muslim	20 (10.0)
Christian	5 (2.5)
Self-reported Sex Worker Status	
Yes	120 (58.3)
No	86 (41.8)

[a] *Other/Forward Caste* consists of the historically advantaged castes including the three highest *varnas. Backward* (same as *Other Backward Caste*), *Scheduled Caste* (same as *Dalits*, consist of the fourth *varna—sudra*), and *Scheduled Tribe* (*Adivasi*) are the historically disadvantaged castes (as recognized by the Constitution of India).

Table 2:

Multivariate models depicting factors associated with measures indicating social network position of MSM in Hyderabad, India in 2011 (N=206)

	In-degree[a,c] AOR	Betweenness[a,d] AOR	Constraint[a,e] AOR	Bridging[b,f] AOR
BMI (kg/m^2)[+]				
Underweight (≤ 18.4)	0.63 (0.25-1.58)	0.64 (0.28–1.46)	0.75 (0.37–1.54)	—
Healthy (18.5-23)	1.00	1.00	1.00	—
Overweight (23.1-25)	2.20 * (0.88-5.50)	1.79 (0.71–4.56)	2.85 ** (1.25–6.47)	—
Obese (>25)	0.79 (0.32-1.98)	0.99 0.39–2.50)	1.93 * (0.88–4.21)	—
Skin color				
1st quartile (lightest)	1.00	1.00	—	1.00
2nd quartile	0.80 (0.33–1.92)	0.62 (0.27–1.45)	—	0.78 (0.34–1.79)
3rd quartile	0.89 (0.37–2.13)	1.06 (0.45–2.49)	—	1.27 (0.53–3.03)
4th quartile (darkest)	0.37 ** (0.1 –0.92)	0.44 * (0.18–1.05)	—	0.45 * (0.19–1.08)

[a] Multivariate model also includes the following variables, which were significant in bivariate analyses: HIV-status, MSM intercourse role, and Neighborhood.

[b] Multivariate model also includes the following variables, which were significant in bivariate analyses: HIV-status, MSM intercourse role, Neighborhood, and Age (Categorical)

[c] Indegree: The number of times a participant is nominated by another participant in the network.

[d] Betweenness: Measures the number of times the shortest path between two other participants includes the participant in question. Participants with greater betweenness are more central and better bridges.

[e] Constraint: Quantifies how much of a participant's connections are also connected to one another—another measure of bridging. The inverse of the network measure of constraint was used for the regression model: overweight and obese participants are less constrained and better bridges than healthy participants.

[f] Bridging: Measures of how much a participant connects different groups within the network that are otherwise not connected.

[+] Uses BMI cut-points adjusted for common anthropometric features of South Asians (Aziz, Kallur, & Nirmalan, 2014; Gray et al., 2011)

* $p < 0.10$

** $p < 0.05$