HHS Public Access

Author manuscript

Sleep Health. Author manuscript; available in PMC 2021 October 01.

Published in final edited form as:

Sleep Health. 2020 October ; 6(5): 662–670. doi:10.1016/j.sleh.2020.02.010.

Poor sleep health is associated with increased mental health problems, substance use, and HIV sexual risk behavior in a large, multistate sample of gay, bisexual and other men who have sex with men (GBMSM) in Nigeria, Africa

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Abstract

Background: Poor sleep health has been linked to mental health problems, substance use, and sexual risk-taking among gay, bisexual, and other men who have sex with men (GBMSM). No known published study has examined these relationships among African GBMSM. Consequently, we investigated poor sleep health and associated health-related factors among a large multistate sample of Nigerian GBMSM.

Methods: Between March and June 2019, 406 GBMSM were recruited from Abuja, Delta, Lagos, and Plateau and asked to complete an interviewer-administered survey. Bivariate and multivariable logistic regression models were constructed to examine the relationship between poor sleep health and other health-related factors.

Results: In the past month, 45.5% of participants reported sleeping an average of 6 hours or less every night, and 30.7% reported experiencing a sleep problem. Factors associated with increased

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odds of reporting short sleep included: residing in Delta [adjusted odds ratio (aOR) 2.16; 95% confidence interval (CI): 1.15 to 4.04] and Lagos (aOR 2.40; 95% CI: 1.29 to 4.45), depressive symptoms (aOR 1.94; 95% CI: 1.13 to 3.32), and reporting lifetime history of using four or more drugs (aOR 2.52; 95% CI: 1.06 to 6.01). Reporting condom use at last anal sex was associated with decreased odds of reporting short sleep in the last month (aOR 0.54; 95% CI: 0.31 to 0.92). Factors associated with increased odds of reporting sleep problems included: reporting an STI diagnosis in the last year (aOR 1.79; 95% CI: 1.05 to 3.05) and reporting monthly or higher polydrug use in the last 3 months (aOR 2.19; 95% CI: 1.14 to 4.24).

Discussion: Sleep health interventions should be developed for Nigerian GBMSM, which may improve mental health and reduce substance use and sexual risk-taking.

Keywords

Nigeria; Gay and bisexual men; MSM; Sleep health; Africa; Psychosocial health

Introduction

Sleep is a critical determinant of health and well-being.[1] Poor sleep health has been implicated in poor health outcomes across populations,[1] including increased risk for cardiovascular disease,[2] obesity,[3] and mental health problems (e.g., depression and anxiety).[4] Recent research has documented disparities in sleep health among sexual minority communities.[5] In general, compared to their heterosexual counterparts, sexual minority individuals report shorter sleep duration and lower quality of sleep.[5] In addition to disparities in sleep health,[5] sexual minority populations experience numerous other disparities in physical health outcomes, including heart disease, hypertension, obesity, and stroke.[6]

An emerging body of literature has linked quality and duration of sleep with sexual health outcomes among gay, bisexual, and other men who have sex with men (GBMSM) in the United States (U.S.). In a national online survey of GBMSM in the U.S., tiredness, due to lack of adequate sleep, was reported as a leading reason for engaging in receptive anal intercourse.[7] Researchers also found that self-reported sex without condoms occurred more around the time of reported tiredness, compared to sex with condoms.[7] Furthermore, tiredness was associated with greater severity of substance use among GBMSM in the same sample.[8] Sleep health may also be poorer among GBMSM who are living with HIV.[9–11] Poor sleep health has been associated with greater symptoms of depression and anxiety as well as suboptimal outcomes along the HIV care continuum, including lower levels of adherence to antiretroviral treatment and greater odds of having a detectable HIV viral load.[9,10] In the wake of scientific evidence that confirms that maintaining an undetectable HIV viral load results in no risk of transmission of HIV,[12] identifying factors—such as sleep health—that can help people living with HIV achieve and maintain an undetectable viral load is critical to achieving an AIDS-free generation. Taken together, the literature suggests that sleep health may impact the risk for HIV infection among GBMSM through its impacts on sexual behavior, substance use, and mental health.

Nigerian GBMSM experience several dimensions of stressors, including individual-interpersonal-, and structural- level stressors, which may negatively impact their sleep health. Previous studies have demonstrated that high levels of depressive symptoms, suicide ideation, hazardous drinking, and illicit drug use, may contribute to poor sleep health.[13–15] Additionally, compared to their heterosexual counterparts, Nigerian GBMSM were more likely to report depressive symptoms, parental neglect, suicide ideation, and lower resilience.[16] Another study found that major sources of stress for Nigerian GBMSM include concerns about safety and discrimination, having to conceal their sexual orientation, and experiences of homophobia perpetrated by healthcare providers.[17] In Nigeria, same-sex activity is legally defined as "indecent practices between males," "acts of gross indecency with other male persons," and having "carnal knowledge of any person against the orderof nature," and is punishable bya 14-year jail term. The culmination of these multilevel stressors may contribute to poor sleep health among Nigerian GBMSM.

To date, most empirical research investigating factors associated with sleep health among GBMSM has been conducted in North America.[5] Consequently, there is a need to understand this topic among GBMSM in other settings, especially settings where non-heterosexual sexual orientation and same-sex practices are criminalized. To date, no known studies have investigated the relationship between demographic, sexual behavior, mental health, and substance use, and sleep health among African GBMSM broadly or among Nigerian GBMSM specifically. Consequently, we conducted a secondary analysis of a cross-sectional study to investigate the prevalence of poor sleep health (i.e., sleep duration and sleep-related problems) and associated health-related factors among a large multistate sample of GBMSM in Nigeria.

Methods

Participants and procedures

Between March and June 2019, 406 GBMSM were recruited from Abuja (n=107), Delta (n=102), Lagos (n=112), and Plateau (n=85) through community-based organizations (CBOs) and snowball sampling. Peer educators, outreach workers, and key opinion leaders from CBOs based in the four study sites provided potential participants with information about the study and a study phone number. Individuals who expressed interest in the study were screened for eligibility. Eligibility criteria were: (1) being 18 years of age or older, (2) currently residing in one of four Nigerian states (Abuja, Delta, Lagos, or Plateau), (3) identifying as a cis-gender male (i.e., participants who were assigned male sex at birth and currently identify as men), and 4) any history of sex (oral or anal) with another male. Eligible participants were told to provide information about the study to members of their social networks.

Data collection occurred in the private offices of each CBO. Each participant provided verbal informed consent and completed the quantitative survey with the help of a trained research assistant. All research assistants underwent training in quantitative data collection, responsible conduct of research, and research study protocols. A vast majority of the research assistants were affiliated with the partner CBOs and personally identified as GBMSM. The survey took around 1 hour to 1.5 hours to complete. Upon completion of the

survey, participants were compensated with 4,000 Naira (equivalent to 10 US dollars). The study protocols were approved by the institutional review boards at Brown University and the Nigerian Institute of Medical Research.

Measures

Demographics—Participants reported the following demographic characteristics: age, relationship status (single or not single), education attainment (senior secondary school or lower, some university or vocational school, university degree or higher, or other), sexual orientation (gay/homosexual, bisexual, straight/heterosexual, questioning, or other).

Social factors—Participants provided their personal monthly income in Naira, and the responses were categorized as: ₦0-₦10,000, ₦10,000e ₦30,000, ₦30,000e₦50,000, ₦50,000e₦100,000, or ₦100,000 or more. Employment status was assessed as employed (working now, full-time, working now, part-time, self-employed) versus unemployed (unemployed, looking for work, unemployed not looking for work). Financial hardship was assessed by asking: “How difficult is it for you to meet monthly payment on bills (rent, electricity, transportation, food, etc.)?” and dichotomized into high financial hardship (“somewhat difficult,” “very difficult,” or “extremely difficult”) versus low financial hardship (“not at all difficult” or “not very difficult”)[18]. History of incarceration was assessed by asking: “Have you ever spent time in a prison, jail, or detention center?” with response options yes versus no.

Sexual health—Sexual position was assessed as: “How would you describe your sexual role with respect to anal sex?” (“I do not have anal sex,” “bottom,” “versatile bottom,” “versatile,” “versatile top,” “top,” or “other”). HIV status was assessed as (“HIV-negative,” “HIV-positive,” or “I don’t know”). HIV status responses were dichotomized into HIV-negative/I don’t know versus HIV-positive. History of sexually transmitted infections (STIs) was assessed by asking: “In your lifetime, have you ever been told by a medical provider that you have an STI, not including HIV such as gonorrhea, syphilis, chlamydia, genital warts, herpes, etc.?” with response options yes versus no. STIs in the last year was assessed by asking: “In the past year, have you ever been told by a medical provider that you have an STI, not including HIV such as gonorrhea, syphilis, chlamydia, genital warts, herpes, etc.?” with response options yes versus no.

The number of receptive anal sex acts in the last 30 days was assessed as: “How many times did you have receptive anal sex (bottom) with a male sexual partner in the past 30 days?” with continuous response options. Responses were categorized (0, 1, 2–3, 4–5, or 6+). The number of insertive anal sex acts in the last 30 days was assessed as: “How many times did you have insertive anal sex (top) with a male sexual partner in the past 30 days?” with continuous response options. Responses were categorized (0, 1, 2–3, 4–5, or 6+). Condom use at last anal sex was assessed as: “Was a condom used the last time that you had anal sex with a man?” with response options yes versus no. Hookup App usage was assessed as: “Have you used a website or mobile app to find male partners for sexual activity in the last 3 months?” with response options yes versus no.

Psychosocial factors—Depressive symptoms were assessed using the Center for Epidemiologic Studies Depression Scale (CES-D),[19] a 20-item scale used to screen for clinically significant depressive symptoms. The items were scored on a 4-point scale from 0e3, with a higher score indicating more severe depressive symptoms. Responses were dichotomized into depressive symptoms (16 or higher) and no depressive symptoms (15 or lower). Suicidal thoughts were assessed as: "Have you ever thought about ending your life or committing suicide?" (yes/no). Suicide attempt was assessed by asking: "Have you ever attempted to end your life?" (yes/no).

Loneliness was assessed using the UCLA Loneliness Scale,[20] an 8-item validated scale that measures various aspects of loneliness on a 4-point Likert scale. Scores were summed, and higher scores indicated greater perceived loneliness. Anxiety was assessed using the Generalized Anxiety Disorder 7-item (GAD-7) scale,[21] a 7-item validates scale that measures recent symptoms of generalized anxiety disorder on a 4-point Likert scale. Scores were summed, and a higher score indicated greater anxiety.

Perceived social support was assessed using the Multidimensional Scale of Perceived Social Support (MSPSS),[22] a 12-item validated scale to measure perceived social support from family, friends, and significant others scored on a 7-point Likert scale. Scores were summed, and higher scores indicated greater perceived social support. Self Esteem was assessed using the Rosenberg Self-Esteem Scale,[23] a 10item validated scale that measures global self-worth by assessing positive and negative feelings about yourself scored on a 4-point Likert scale. Scores were summed, and a higher score indicated greater self-esteem.

Minority stress was assessed using the LGBT Minority Stress Measure,[24] a 50-item scale developed to measure the seven components of the minority stress model: prejudice events, victimization events, the anticipation of rejection, identity concealment, and internalized homophobia, everyday discrimination, and community connectedness. We utilized the internalized homophobia and community connectedness subscales for the current study. The internalized homophobia subscale contains 3 items and is scored on a 5-point Likert scale, with a higher score indicating higher levels of internalized homophobia. The community connectedness subscale contains five items and is scored on a 5-point Likert scale with a higher score indicating higher levels of community connectedness.

Substance use—Participants were asked about their alcohol and drug use. Problematic alcohol use was assessed with the AUDIT-C,[25] a 3-item screening for heavy drinking or alcohol dependence. The AUDIT-C is scored on a scale of 0–12; a score of 4 or greater indicated hazardous drinking. Lifetime marijuana use was assessed as: "In your lifetime, have you ever used cannabis (igbo, marijuana, pot, grass, hash, etc.)." History of polysubstance use was assessed by asking participants about lifetime recreational use of the following drugs: tramadol, Rohypnol (flunitrazepam), codeine, poppers (alkyl nitrites), cocaine, prescription stimulants (Ritalin, Concerta, Dexedrine, Adderall,or diet pills), methamphetamines, inhalants, sedative/sleeping pills, hallucinogens, street opioids, and prescription opioids. Responses were categorized into 0, 1, 2–3, and 4+. Recent polysubstance use was assessed by asking participants about recreational use of the following drugs in the last 3 months: tramadol, Rohypnol (flunitrazepam), codeine, poppers

(alkyl nitrites), cocaine, prescription stimulants (Ritalin, Concerta, Dexedrine, Adderall, or diet pills), methamphetamines, inhalants, sedative/sleeping pills, hallucinogens, street opioids, and prescription opioids. Responses were categorized into none, once or twice, and monthly or more.

Sleep health—We assessed sleep health (i.e., sleep duration and sleep-related problems) through self-reported sleep duration and three aspects of sleep problems using the Pittsburgh Sleep Quality Index,[26] a validated scale to measure sleep quality and patterns.

Sleep duration—To assess sleep duration, we asked: "During the past month, how many hours of actual sleep did you get each night?" Participant responses were open-ended but restricted to a single integer. Consistent with prior literature,[27] we categorized sleep duration into 6 hours or less (short sleep) and 7 hours or more (not short sleep).

Sleep-related problems—To assess sleep-related problems, we asked three questions: (1) During the past month, how often have you taken medicine to help you sleep? (2) During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in your daily activities? (3) During the past month, how often did you have trouble with not being able to fall asleep within 30 minutes of going to bed? Responses were scored on a 4-point Likert scale, and experiencing any of the three symptoms was coded as having a sleep-related problem.

Data analysis

We assessed the distribution (percentages and means) of all variables by sleep duration and sleep-related problems. Chi-square global tests of independence were used to assess the independent association between variables. Bivariate and multivariable logistic regression models were constructed to examine the relationship between poor sleep health [i.e., sleep duration (multivariable model 1), sleep-related problems (multivariable model 2)] and other health-related factors. Variables that were significant at the $p<0.05$ level in the bivariate models were retained in each of the two multivariable models assessing these outcomes. Data were analyzed using SAS version 9.4 (Cary, NC)

Results

Sample characteristics

Sample demographic characteristics are presented in Table 1. Participants ranged in age from 18 to 60 years (mean¼29.2, standard deviation (SD)¼5.8), a majority (59.7%) identified as bisexual, and 62.2% were single. Most (61.8%) of the sample reported experiencing high financial hardship, and 22.3% reported a history of incarceration. Almost one-fourth (23.9%) screened for depressive symptoms; 21.3% had a history of suicidal thoughts and 10.3% self-reported suicide attempts in the past. One-fourth (24.8%) of the sample reported living with HIV, and one-third (32.3%) reported an STI diagnosis in the last year.

Sleep duration

Almost half (45.5%) of participants reported sleeping an average of 6 hours or less every night in the past month, with an average (SD) of 6.76 (1.83) hours. In the multivariable model (Table 2), factors significantly associated with increased odds of reporting short sleep in the last month included: residing in Delta [adjusted odds ratio (aOR) 2.16; 95% confidence interval (CI): 1.15 to 4.04] and Lagos (aOR 2.40; 95% CI: 1.29 to 4.45) versus residing in Abuja, having clinically significant depressive symptoms (aOR 1.94; 95% CI: 1.13 to 3.32), and reporting lifetime history of using four or more drugs compared to lifetime history of no drug use (aOR 2.52; 95% CI: 1.06 to 6.01). Reporting condom use at last anal sex was associated with decreased odds of reporting short sleep in the last month (aOR 0.54; 95% CI: 0.31 to 0.92)

Sleep problems

Almost a third (30.7%) of the sample reported having a sleep-related problem. In the bivariate model (Table 2), we found that perceived social support (OR 0.98; 95% CI: 0.96 to 0.99) and community connectedness (OR 0.94; 95% CI: 0.89 to 0.99) were marginally associated with decreased odds of having a sleep-related problem. In the multivariable model (Table 2), factors significantly associated with increased odds of reporting sleep problems included: reporting a STI diagnosis in the last year (aOR 1.79; 95% CI: 1.05 to 3.05) and reporting monthly or higher polydrug use compared to none in the last 3 months (aOR 2.19; 95% CI: 1.14 to 4.24).

Discussion

This is the first known study to investigate sleep health among GBMSM in Nigeria, and generally, in Africa. We found that almost half of participants (45.5%) reported experiencing a sleep duration of 6 hours or less in the last month, and almost a third (30.7%) reported having a sleep-related problem. These rates mirror those of a similar study conducted among GBMSM in London, England.[27] The high rates of reporting short sleep and sleep-related problems suggests that poor sleep health might be of public health significance among GBMSM in Nigeria. Similarly, previous studies among the general population in Nigeria found high levels of poor quality of sleep (50e54%).[28,29] Our results suggest that further research is needed to investigate the structural-level predictors of poor sleep health, especially related to sexual minority stress and discriminatory events, and warrant the development and implementation of interventions to address them, especially among Nigerian GBMSM.

We found disparities in sleep health by geographical location. Specifically, residing in Delta and Lagos, compared to Plateau, was significantly associated with reporting short sleep in the past month. This finding might be attributable to Delta and Lagos being major financial and economical hubs in the southwestern and eastern part of Nigeria with high population density and job industries. Warridthe city where data collection took place in Delta statedis one of the major hubs of petroleum activities and businesses in southern Nigeria. Lagosdwhich boasts a population of 17.5 million and has the 4th largest gross domestic product (GDP) on the African continentdwas listed as the second least livable city in the

world by the Economist Intelligence Unit in 2019. These geographical characteristics and factors may contribute to the observed shorter sleep duration due to the stress and daily hustle associated with residing in these two major cities. Future research and public health campaigns aiming to improve sleep health should further consider addressing geographical disparities observed in this study.

We found that individuals who reported 7 hours or more of sleep in the last month were more likely to report condom use during their last anal sex, compared to individuals who reported short sleep. This finding is in line with previous studies that have shown short sleep duration to be associated with a higher number of anal sex partners (an indicator of sexual risk) among GBMSM.[27] This suggests that better sleep health might be associated with engaging in lower risk sexual behaviors, which has major implications considering the rising HIV epidemic among Nigerian GBMSM.[30] It is critical that interventions aiming to address psychosocial health problems among Nigerian GBMSM provide information about the importance of getting adequate amounts of sleep on a regular basis and the sexual health implications of maintaining a healthy sleep schedule, particularly in the context of HIV/STI prevention. Our finding that reporting 4–5 receptive anal sex acts in the last 30 days compared to none was associated with reporting no sleep problems conflicts with other studies that showed the opposite effect.[27,31] It is important to note that those studies were conducted in major European cities (London and Paris) and assessed condomless receptive anal sex in the previous 3 months. More research is needed to elucidate the relationship between sleep health and sexual risk-taking, especially among GBMSM.

Our finding that clinically significant depressive symptoms was significantly associated with reporting short sleep in the past month is consistent with studies that have shown similar effects both among GBMSM[27] and other populations.[32,33] Prior population-based studies have found that objectively measured suboptimal sleep duration (i.e., less than 7 hours per night), as well as mental health disorders, were strong predictors of persistent insomnia.[34] Notably, there may be a positive feedback loop wherein the presence of objective short sleep duration potentiates the risk of developing mental health disorders (including depression), which in turn increases the risk for further sleep-related issues, such as persistent insomnia.[34] Short sleep duration and insomnia have also been implicated as a risk factor in cardiovascular disease,[35] weight gain,[36] impaired neurocognitive function,[37] amongst several other negative physical health outcomes.[38] While there has been scarce work examining short sleep duration as a risk factor for negative mental health outcomes in LGBTQ-populations specifically,[27] it is clear that short sleep duration is a risk at the population level, and likely maps onto GBMSM populations as well. Consequently, mental health interventions tailored for Nigerian GBMSM should explore the interplay between mental health and sleep health and how intervening on mental health can help improve sleep health and vice-versa.

We found that both the history of and recent polysubstance use were associated with both shorter sleep duration and sleep problems. These findings are in line with other research that has found an association between poor sleep health and substance use both among GBMSM[8,27,31] and other populations.[39–41] Substances may be used as a coping strategy to deal with poor sleep health[42], which may be an indication of general life stressor or stress

due to gender identity and/or sexual orientation discrimination. This is particularly salient in the Nigerian context, where GBMSM are often stigmatized, harassed, and victimized. Interventions aiming at reducing substance use behavior among Nigerian GBMSM should provide participants with tools to devise alternative coping strategies, which may result in better sleep health and overall health outcomes. While experiences of minority stress (internalized homophobia, community connectedness, etc.) were not significantly associated with sleep health outcomes in the multivariable models, those effects may have been mediated by mental health variables and other related outcomes. Ultimately, structural-level policy change that provides legal protection for and ascribes equal rights to sexual minority communities is imperative to achieving significant improvement in the health and wellness of Nigerian GBMSM, including sleep health outcomes.

Our findings, taken together, reveal that short sleep duration and experiences of sleep-related problems in Nigerian GBMSM are linked to various indicators of suboptimal mental health, substance use, and sexual risk outcomes. It is important to note the potential bidirectionality of our observed effect, specifically how poor sleep health might influence mental health, substance use, sexual risk, and inversely how those psychosocial factors could, in turn, contribute to poor sleep health. Interventions that work at the crux of these health issues should consider sleep health as a potential factor that could be integrated as part of holistic healthcare services to improve health. For example, screening for sleep health issues among GBMSM patients who are connected to clinics who offer mental health, substance use, or sexual health services could potentially be a first step in beginning the discussion about sleep health among this group.[43] Moreover, given our findings, there is a need to develop evidence-based sleep health promotion interventions that aim to address short sleep and sleep problems to improve mental health and reduce substance use and sexual risk behaviors among Nigerian GBMSM.

These findings should be interpreted under consideration of some limitations. The cross-sectional design limits our ability to draw any causal inferences from our findings. In addition, participants were mainly recruited through GBMSM CBOs and GBMSM social networks, thus limiting our ability to generalize our findings to GBMSM, who do not seek services at these CBOS or who are outside of the social networks sampled. Further, as participants completed assessments with the help of trained research staff, social desirability may have influenced participants to minimize behaviors they considered socially deviant. Lastly, sleep health was measured through self-reported measures rather than objective measures of sleep health (accelerometer, actigraphy, and polysomnography). Despite these limitations, this work contributes to a limited but growing body of literature on sleep health among sexual minority communities. Further research with larger sample sizes and longitudinal study design is needed to further understand the relationship between sleep health and psychosocial health among GBMSM in Nigeria.

Conclusion

To the best of our knowledge, this study is the first to characterize sleep health among Nigerian—and more generally African—GBMSM. We found that poor sleep health was associated with various negative psychosocial outcomes, specifically mental health,

substance use and sexual risk-taking. Given the high prevalence of shorter sleep duration and experiences of sleep-related problems found in this sample, it is critical to further investigate the potentially long-term detrimental mental, physical, and chronic health outcomes that are likely associated with poor sleep health among Nigerian GBMSM. Interventions that aim to address unhealthy sleeping in tandem with services that aim to improve mental health, as well as reduce substance use and sexual risk behaviors among this group, are needed.

Acknowledgments

We will like to thank all the participants of the study for their time and efforts. We would also like to thank the staff at Centre for Right to Health (Abuja) Equality Triangle Initiative (Delta), Improved Sexual Health and Rights Advocacy Initiative (ISHRAI, Lagos), and Hope Alive Health Awareness Initiative (Plateau). We also extend our gratitude to Olubiyi Oludipe (ISHRAI), Bala Mohammed Salisu (Hope Alive Health Awareness Initiative), Chucks Onuoha, Prince Bethel, Eke Chukwudi, Tochukwu Okereke, Josiah Djagvidi, and Odi Iorfa Agev, for providing logistical support to the project.

Grant Support

This study was supported by an R36 dissertation grant from the National Institute on Drug Abuse [DA047216] (principal investigator [PI]: Adedotun Ogunbajo) and by the Robert Wood Johnson Foundation Health Policy Research Scholars Program, for which the first author is a scholar but the foundation did not provide direct project support.

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Table 1

Self-Reported number of sleep hours and sleep problems among Nigerian GBMSM from March-June 2019

	Total sample (N=406) (n, %) or (mean, SD)	Sleep duration (n=403) (n, %) or (mean, SD)		*P*	Sleep-related problems (n=291) (n, %) or (mean, SD)*		*P*
		6 hours or less (n=177, 45.5%)	7 hours or more (n=212, 54.5%)		Yes (n=91, 30.7%)	(n=205, 69.3%)	
Site				**<.0001**			
Abuja	100 (25.9)	33 (33.0)	67 (67.0)		-	-	
Delta	99 (25.7)	54 (54.5)	45 (45.5)		-	-	
Lagos	105 (27.2)	61 (58.1)	44 (41.9)		-	-	
Plateau	82 (21.2)	28 (34.2)	54 (65.9)		-	-	
Demographics							
Age	29.2 (5.80)	29.9 (6.5)	29.5 (5.9)	0.40	29.4 (5.95)	30.1 (6.68)	0.38
Relationship Status				0.51			0.52
Single	242 (62.2)	107 (44.2)	135 (55.8)		56 (32.2)	118 (67.8)	
Not Single	147 (37.8)	70 (47.6)	147 (52.4)		35 (38.7)	87 (71.3)	
Educational Attainment				**0.02**			0.54
Senior Secondary School or lower	179 (46.0)	68 (38.0)	111 (62.0)		45 (31.5)	98 (68.5)	
Some University or Vocational School	83 (21.3)	45 (54.2)	38 (45.8)		18 (27.3)	48 (72.7)	
University degree or higher	105 (27.0)	56 (53.3)	49 (46.7)		25 (35.2)	46 (64.8)	
Other	22 (5.7)	8 (36.4)	14 (63.6)		3 (18.8)	13 (81.2)	
Sexual Orientation				0.45			0.77
Gay/Homosexual	156 (40.3)	75 (48.1)	81 (51.9)		35 (31.5)	76 (68.5)	
Bisexual	231 (59.7)	102 (44.2)	129 (55.8)		55 (29.9)	129 (70.1)	
Social Factors							
Monthly Income (in Naira)				0.32			0.41
0–10,000	104 (27.0)	43 (41.4)	61 (58.6)		21 (25.3)	62 (74.7)	
10,000–30,000	103 (26.8)	44 (42.7)	59 (57.3)		27 (32.1)	57 (67.9)	
30,000–50,000	78 (20.3)	42 (53.9)	36 (46.1)		14 (25.5)	41 (74.5)	
50,000–100,000	53 (13.8)	22 (41.5)	31 (58.5)		13 (38.2)	21 (61.8)	
100,000+	47 (12.2)	25 (53.2)	22 (46.8)	0.90	14 (38.9)	22 (61.1)	0.58

	Total sample (N=406) (n, %) or (mean, SD)	Sleep duration (n=403) (n, %) or (mean, SD)		*P*	Sleep-related problems (n=291) (n, %) or (mean, SD)*		*P*
		6 hours or less (n=177, 45.5%)	7 hours or more (n=212, 54.5%)		Yes (n=91, 30.7%)	(n=205, 69.3%)	
Employment Status							
Employed	311 (79.9)	141(45.3)	170 (54.7)		77 (31.4)	168 (68.6)	
Unemployed	78 (20.1)	36 (46.2)	42 (53.8)		14 (27.5)	37 (72.5)	
Financial Hardship				0.14			0.78
High financial hardship	238 (61.8)	100 (42.0)	138 (58.0)		57 (30.5)	130 (69.5)	
Low financial hardship	147 (38.2)	73 (49.7)	74 (50.3)		34 (32.1)	72 (67.9)	
History of Incarceration				0.31			0.18
Yes	86 (22.3)	43 (50.0)	43 (50.0)		26 (37.1)	44 (62.9)	
No	299 (77.7)	131 (43.8)	168 (56.2)		64 (28.7)	159 (71.3)	
Sexual Health							
Sexual Position				0.59			0.28
Bottom/Versatile Bottom	108 (28.2)	47 (43.5)	61 (56.5)		22 (28.2)	56 (71.8)	
Versatile	111 (29.0)	47 (42.3)	64 (57.7)		25 (26.3)	70 (73.7)	
Versatile Top/Top	164 (42.8)	79 (48.2)	85 (51.8)		43 (35.8)	77 (64.2)	
HIV Status				0.57			0.27
Positive	99 (24.8)	47 (47.5)	52 (52.5)		19 (25.7)	55(74.3)	
Negative/Unknown	301 (75.2)	133 (44.2)	168 (55.8)		74 (32.5)	154 (67.5)	
Any History of STIs				0.75			0.14
Yes	173 (44.6)	80 (46.2)	93 (53.8)		48 (35.0)	89 (65.0)	
No	215 (55.4)	96 (44.7)	119 (55.3)		43 (27.0)	116 (73.0)	
STIs in the last year				0.54			0.06
Yes	124 (32.3)	54 (43.5)	70 (56.5)		37 (38.1)	60 (61.9)	
No	260 (67.7)	122 (46.9)	138 (53.1)		53 (27.2)	142 (72.8)	
# of Receptive Anal sex acts in last 30 days				0.68			0.20
0	175 (45.1)	83 (47.4)	92 (52.6)		44 (32.8)	90 (67.2)	
1	50 (12.9)	19 (38.0)	31 (62.0)		12 (31.6)	26 (68.4)	
2–3	83 (21.4)	36 (43.4)	47 (56.6)		21 (36.2)	37 (63.8)	
4–5	49 (12.6)	25 (51.0)	24 (49.0)		7 (15.6)	38 (84.4)	

	Total sample (N=406) (n, %) or (mean, SD)	Sleep duration (n=403) (n, %) or (mean, SD)		*P*	Sleep-related problems (n=291) (n, %) or (mean, SD)*		*P*
		6 hours or less (n=177, 45.5%)	7 hours or more (n=212, 54.5%)		Yes (n=91, 30.7%)	(n=205, 69.3%)	
6+	31 (8.0)	13 (41.9)	18 (58.1)	0.96	7 (33.3)	14 (66.7)	0.21
# of Insertive Anal sex acts in last 30 days							
0	127 (32.8)	55 (43.3)	72 (56.7)		27 (27.8)	70 (72.2)	
1	51 (13.2)	24 (47.1)	27 (52.9)		12 (38.7)	19 (61.3)	
2–3	94 (24.3)	45 (47.9)	49 (52.1)		24 (32.0)	51 (68.0)	
4–5	55 (14.2)	24 (43.6)	31 (56.4)		19 (40.4)	28 (59.6)	
6+	60 (15.5)	28 (46.7)	32 (53.3)	**0.04**	9 (20.0)	36 (80.0)	0.73
Condom Use at last anal sex							
Yes	300 (78.1)	127 (42.3)	173 (57.7)		68 (30.1)	158 (69.9)	
No	84 (21.9)	46 (54.8)	38 (45.2)		21 (32.3)	44 (67.7)	
Hookup App Usage				0.64			0.24
Yes	206 (53.0)	96 (46.6)	110 (53.4)		52 (33.8)	102 (66.2)	
No	183 (47.0)	81 (44.3)	102 (55.7)		39 (27.5)	103 (72.5)	
Mental Health and Minority Stress							
Depressive Symptoms							
Yes	93 (23.9)	58 (62.4)	35 (37.6)		23 (33.8)	45 (66.2)	
No	296 (76.1)	119 (40.2)	177 (59.8)		68 (29.8)	160 (70.2)	
Suicide Thoughts				**0.0004**			0.19
Yes	83 (21.3)	52 (62.7)	31 (37.3)		23 (37.7)	38 (62.3)	
No	306 (78.7)	125 (40.9)	181 (59.1)		68 (28.9)	167 (71.1)	
Suicide Attempt				**0.009**			0.30
Yes	40 (10.3)	26 (65.0)	14 (35.0)		11 (39.3)	17 (60.7)	
No	349 (89.7)	151 (43.3)	198 (56.7)		80 (29.8)	188 (70.2)	
Internalized Homophobia	7.1 (3.4)	8.10 (3.55)	7.94 (3.55)	0.65	8.06 (3.75)	8.46 (3.56)	0.38
Perceived Social Support	58.1 (13.73)	56.5(12.4)	59.5 (13.0)	**0.02**	55.6 (13.7)	59.4 (12.75)	0.03
Self Esteem	30.0 (3.77)	29.5 (3.62)	30.3 (3.84)	**0.05**	30.30(4.01)	29.9(3.66)	0.48
Loneliness	17.3 (4.38)	17.9 (4.53)	16.8 (4.22)	**0.02**	17.5 (4.45)	17.1 (4.19)	0.40
Anxiety	5.84 (4.65)	6.92 (4.85)	4.96 (4.32)	**<.0001**	6.4 (4.89)	5.3 (4.40)	0.07

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	Total sample (N=406) (n, %) or (mean, SD)	Sleep duration (n=403) (n, %) or (mean, SD)		*P*	Sleep-related problems (n=291) (n, %) or (mean, SD)*		*P*
		6 hours or less (n=177, 45.5%)	7 hours or more (n=212, 54.5%)		Yes (n=91, 30.7%)	(n=205, 69.3%)	
Community Connectedness	19.8 (4.42)	19.6 (4.35)	20.0 (4.50)	0.38	18.8 (5.0)	20.2 (4.25)	**0.02**
Substance Use							
Hazardous Drinking				0.46			0.87
Yes	75 (18.3)	37 (49.3)	38 (50.7)		17 (29.8)	40 (70.2)	
No	314 (80.7)	140 (44.6)	174 (55.4)		74 (30.9)	165 (69.1)	
Lifetime Marijuana Use				0.51			0.85
Yes	164 (42.3)	78 (47.6)	86 (52.4)		39 (31.5)	85 (68.5)	
No	224 (57.8)	99 (44.2)	125 (55.8)		52 (30.4)	119 (69.6)	
History of Polysubstance Use				**0.03**			0.13
0	242 (62.2)	102 (42.2)	140 (57.8)		51 (27.7)	133 (72.3)	
1	59 (15.2)	25 (42.4)	34 (57.6)		19 (40.4)	28 (59.6)	
2–3	56 (14.4)	28 (50.0)	28 (50.0)		11 (25.6)	32 (74.4)	
4+	32 (8.2)	22 (68.8)	10 (31.2)	0.39	10 (45.5)	12 (54.5)	
Recent Polysubstance Use (Last 3 months)							
None	258 (68.4)	114 (44.2)	144 (55.8)		55 (28.7)	137 (71.3)	
Once or Twice	52 (13.8)	28 (53.8)	24 (46.2)		14 (32.6)	29 (67.4)	
Monthly or more	67 (17.8)	33 (49.3)	34 (50.7)		22 (43.1)	29 (56.9)	

Bold values are statistically significant.

*No data collected on sleep-related problem among participants in Lagos state.

Table 2

Unadjusted and Adjusted Associations between demographics, psychosocial factors and sleep duration and problems among Nigerian GBMSM from MarcheJune 2019

	Short sleep duration (6 hours or less) (n=403)		Sleep-related problems (n=291)	
	Unadjusted OR (95% CI)	**Adjusted OR (95% CI)**	**Unadjusted OR (95% CI)**	**Adjusted OR (95% CI)**
Site				
Abuja	Ref	Ref	-	
Delta	**2.44 (1.37–4.33)** **	**2.16 (1.15–4.04)** **	-	
Lagos	**2.81 (1.49–4.97)** *	**2.40 (1.29–4.45)** **	-	
Plateau	1.05 (0.57–1.95)	0.99 (0.50–1.93)	-	
Demographics				
Age	1.01 (0.98–1.05)		0.98 (0.94–1.02)	
Relationship Status				
Single	0.87 (0.58–1.32)		1.15 (0.70–1.90)	
Not Single	Ref		Ref	
Educational Attainment				
Senior Secondary School or lower	Ref	Ref	Ref	
Some University or Vocational School	1.93 (1.14–3.27) **	1.61 (0.90–2.87)	0.83 (0.44–1.58)	
University degree or higher	1.87 (1.15–3.04) **	1.47 (0.85–2.54)	1.21 (0.66–2.19)	
Other	0.93 (0.37–2.34)	1.06 (0.40–2.83)	0.68 (0.21–2.21)	
Sexual Orientation				
Gay/Homosexual	1.17 (0.78–1.76)		1.18 (0.71–1.95)	
Bisexual	Ref		Ref	
Social Factors				
Monthly Income (in Naira)				
0–10,000	Ref		Ref	
10,000–30,000	1.06 (0.61–1.84)		1.33 (0.69–2.60)	
30,000–50,000	1.66 (0.92–2.99)		0.96 (0.44–2.07)	
50,000–100,000	1.01 (0.51–1.97)		1.77 (0.76–4.13)	
100,000+	1.61 (0.81–3.22)		1.87 (0.83–4.21)	

	Short sleep duration (6 hours or less) (n=403)		Sleep-related problems (n=291)	
	Unadjusted OR (95% CI)	**Adjusted OR (95% CI)**	**Unadjusted OR (95% CI)**	**Adjusted OR (95% CI)**
Employment Status				
Employed	0.97 (0.59–1.59)		1.16 (0.60–2.22)	
Unemployed	Ref		Ref	
Financial Hardship				
High financial hardship	0.74 (0.49–1.10)		0.91 (0.55–1.50)	
Low financial hardship	Ref		Ref	
History of Incarceration				
Yes	1.28 (0.79–2.07)		1.46 (0.83–2.56)	
No	Ref		Ref	
Sexual Health				
Sexual Position				
Bottom/Versatile Bottom	0.83 (0.51–1.35)		0.79 (0.43–1.44)	
Versatile	0.79 (0.49–1.28)		0.64 (0.36–1.15)	
Versatile Top/Top	Ref		Ref	
HIV Status				
Positive	1.14 (0.72–1.80)		0.72 (0.40–1.30)	
Negative/Unknown	Ref		Ref	
Any History of STIs				
Yes	1.07 (0.71–1.59)		1.51 (0.92–2.46)	
No	Ref		Ref	
STIs in the last year				
Yes	0.87 (0.57–1.34)		1.71 (1.03–2.85)**	1.79 (1.05–3.05)**
No	Ref		Ref	Ref
# of Receptive Anal sex acts in last 30 days				
0	Ref		Ref	Ref
1	0.68 (0.36–1.29)		1.07 (0.51–2.25)	1.10 (0.51–2.36)
2–3	0.85 (0.50–1.44)		1.17 (0.62–2.24)	1.28 (0.65–2.51)
4–5	1.16 (0.61–2.18)		0.37 (0.15–0.90)**	0.38 (0.15–0.95)
6+	0.80 (0.37–1.73)		0.98 (0.37–2.60)	1.30 (0.46–3.69)

	Short sleep duration (6 hours or less) (n=403)		Sleep-related problems (n=291)	
	Unadjusted OR (95% CI)	**Adjusted OR (95% CI)**	**Unadjusted OR (95% CI)**	**Adjusted OR (95% CI)**
# of Insertive Anal sex acts in last 30 days				
0	Ref		Ref	
1	1.16 (0.61–2.23)		1.55 (0.67–3.59)	
2–3	1.20 (0.70–2.05)		1.11 (0.58–2.12)	
4–5	1.01 (0.54–1.92)		1.66 (0.80–3.43)	
6+	1.15 (0.62–2.12)		0.60 (0.26–1.39)	
Condom Use at last anal sex				
Yes	**0.60 (0.37–0.99)** **	**0.54 (0.31–0.92)** **	0.88 (0.49–1.57)	
No	Ref	**Ref**	Ref	
Hookup App Usage				
Yes	1.10 (0.74–1.64)		1.28 (0.78–2.09)	
No	Ref		Ref	
Mental Health and Minority Stress Outcomes				
Depressive Symptoms				
Yes	**2.47 (1.53–3.98)** *	**1.94 (1.13–3.32)** *	1.23 (0.70–2.18)	
No	**Ref**	**Ref**	Ref	
Suicide Thoughts				
Yes	**2.43 (1.37–4.00)** *	1.47 (0.72–2.98)	1.43 (0.80–2.57)	
No	**Ref**	Ref	Ref	
Suicide Attempt				
Yes	**2.44 (1.23–4.82)** *	1.55 (0.61–3.95)	1.52 (0.68–3.38)	
No	**Ref**	Ref	Ref	
Internalized Homophobia	1.01 (0.96–1.07)		0.97 (0.91–1.04)	
Perceived Social Support	0.98 (0.97–1.00) **		**0.98 (0.96–0.99)** **	**0.98 (0.96–0.99)**
Self Esteem	0.95 (0.90–1.00)		1.02 (0.96–1.09)	
Loneliness	**1.06 (1.01–1.10)** **		1.03 (0.97–1.09)	
Anxiety	**1.10 (1.04–1.15)** *		1.05 (0.99–1.10)	

	Short sleep duration (6 hours or less) (n=403)		Sleep-related problems (n=291)	
	Unadjusted OR (95% CI)	**Adjusted OR (95% CI)**	**Unadjusted OR (95% CI)**	**Adjusted OR (95% CI)**
Community Connectedness	0.98 (0.94–1.03)		**0.94 (0.89–0.99)** **	
Substance Use				
Hazardous Drinking				
Yes	1.21 (0.73–2.00)		0.92 (0.49–1.72)	
No	Ref		Ref	
Lifetime Marijuana Use				
Yes	1.15 (0.76–1.72)		1.03 (0.63–1.69)	
No	Ref		Ref	
History of Polysubstance Use				
0	Ref	Ref	Ref	
1	1.01 (0.57–1.80)	1.09 (0.58–2.04)	1.84 (0.95–3.55)	
2–3	1.37 (0.77–2.46)	1.38 (0.74–2.60)	0.86 (0.40–1.83)	
4þ	**3.02 (1.37–6.65)** **	**2.52 (1.06–6.01)** **	1.84 (0.77–4.40)	
Recent Polysubstance Use (last 3 months)				
None	Ref		Ref	Ref
Once or Twice	1.47 (0.81–2.68)		1.08 (0.54–2.17)	1.19 (0.56–2.48)
Monthly or more	1.23 (0.72–2.10)		**1.96 (1.04–3.67)** **	**2.19 (1.14–4.24)** **

Bold values are statistically significant.

* $P < 0.01$.

** $P < 0.05$.