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From “Getting Under Your Skin” Down to the Subcutaneous Level: Internalized Homophobia and its Possible Link with Obesity.

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in Epidemiology

by

Drake Anthony Edgett

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ABSTRACT OF THE THESIS

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Master of Science in Epidemiology

University of California, Los Angeles, 2020

Professor Pamina Gorbach, Chair

Men who have Sex with Men (MSM) face sociopolitical hardships that can manifest into a Homonegativity, a form of psychological distress. As Homonegativity is associated with poor mental health outcomes, it could also extend into physiological outcomes like obesity where the relationship would hypothetically be positively correlated. Participants of this study come from the mStudy, a Los Angeles based cohort focusing on young MSM of color. Logistic Regression was used to analyze the association between Homonegativity and obesity (defined as having a Body Mass Index ≥ 30), where quasibinomial and generalized additive models (GAMs) were used to assess the robustness of the logistic regression. Increasing Homonegativity was associated with about 3.5% lower odds (OR: 0.965, CI: 0.94-0.99) for both unadjusted and fully adjusted models, a finding contrary to the original hypothesis.

The thesis of Drake Anthony Edgett is approved.

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Introduction

Men who have Sex with Men (MSM) face many sociopolitical hardships that can manifest into a form of psychological distress known as Internalized Homophobia (IH) or Homonegativity. This Homonegativity has been described as "not an inherent personal response from individuals but is a product of social and political stigma" as well as "LGB (Lesbian Gay Bisexual) individuals' direction of societal anti-homosexual attitudes towards the self"[2,3]. IH and Homonegativity has generally been associated with drug abuse, HIV positive serostatus, and consistently poor mental health[4,5]. However, the majority of the literature on homonegativity looks at its relationship with a relatively narrow set of endpoints, like depressive symptoms and/or risky behaviors such as unprotected sex and substance use.

Homonegativity, beyond just doing psychological harm, could possibly translate into deleterious physiological conditions. One condition could theoretically be obesity that is partially mediated via clinical psychological manifestations such as depression[6]. Homonegativity is often associated with depressive symptomology, and those with depression are often clinically obese or overweight according to a meta-analysis and systematic review[5,7]. Unfortunately, the relationship between depression and obesity is possibly bidirectional. This bidirectionality is due to obesity creating inflammatory markers that go on to cause depression, and depression causing inactivity/diet changes that then go on to contribute to obesity[8]. If Homonegativity manifests into obesity, then homonegativity could be a point of intervention for MSM to reduce the risks associated with obesity, as well as the other negative outcomes linked to this form internalized stigma.

Methods

Participants

The participants in this paper include 544 Men who have Sex with Men and Women (MSM/W) who are enrolled in the mSTUDY, a longitudinal cohort focusing on MSM/W and substance users in Los Angeles, California. This cohort consists of individuals between the ages of 18-45 at first visit who are majority Black/African-American, assigned a male sex at birth, and includes an oversampling of HIV-positive individuals. For the purposes of this study, 10 individuals were omitted from the original 544, leaving 534, because of impossible BMI values that were less than 3, most likely due to data entry error.

Measures

Variables used in this study were collected via self-report and lab measurements, and consist of: 1) Stimulant use in the past 6 months (yes/no); 2) Opiate use in the past 6 months (yes/no); 3) No drug use which is defined as no stimulant or opioid use in the past 6 months (yes/no) but may include marijuana, hallucinogen, and alcohol use; 4)Age at visit as an integer; 5) Homonegativity inventory consisting of 9 questions assessing negative feelings or dislike of the participants' own sexuality using a Likert Scale (1 = Strongly disagree to 5 = Strongly agree) that has been summed into a composite score where the minimum score one can have is 9; 6) Obesity, that has been dichotomized as 1 or 0 for those with a BMI greater than or equal to 30 or lower than 30 respectively; 7) Self-reported Race groups of Black/African-American, White, Hispanic/Latinx/Spanish, and Other (American Indian or Alaskan Native, Asian, Asian Indian, Native Hawaiian or Pacific Islander, and Other Race not listed); 8) HIV Status assessed by laboratory tests stratified by HIV status and detectable viral load status (i.e HIV+ (Undetectable), HIV+ (Detectable), and HIV-); 9) Formal Educational attainment ranging from less than high school, high school, college, masters, and PhD or above. Those who only use inhalable

nitrate/poppers and no other drug (n = 61) were included into the no drug use group due to the lack of evidence of poppers alone having an association with obesity and homonegativity. In the regression analyses, Homonegativity was re-centered to set its lowest value at zero, since the lowest possible Homonegativity score is 9. No individuals had to be excluded for missing the independent variable (homonegativity), since they are required measurements in the mStudy.

Data Analysis

This baseline cross-sectional analysis of mStudy participants will attempt to delineate the association between obesity and homonegativity in this study sample. **Table 1** provides summary statistics of the cohort by using means, standard deviations, proportions, and interquartile ranges where appropriate. **Table 2** shows means, standard deviations, and interquartile ranges of Homonegativity stratified by obesity across age, race, drug use, and HIV status. Unadjusted and adjusted logistic regressions on obesity and homonegativity were performed to see if this association between obesity and homonegativity exists and persists following adjustment. Though causation cannot be inferred in this study, the general hypothesis is that this relationship would be positively correlated. The fully adjusted model included substance use, HIV status, race, and age. Depression will not be adjusted for because of the lack of temporal analysis combined with the fact that depression and obesity can each possibly lead to the other, making depression either a collider or mediator as cited above and visually depicted in **Figure 1a** and **Figure 1b** [5,8]. This means that the effects analyzed in this study are either the Total Direct Effect (**Figure 1a**), since the mediator will not be adjusted for, or the Controlled Direct Effect (**Figure 1b**), since only the direct path from Homonegativity to Obesity will be estimated. To more accurately explore the trend between obesity and homonegativity while checking the robustness of the logistic regressions, quasibinomial logistic regressions of the fully adjusted model were

used to assess overdispersion in **Supplemental Table 1**. Furthermore, graphs of fully adjusted semi-parametric generalized additive models (GAMs), with smooth non-linear functions applied to continuous variables, were generated to create a more accurate and holistic visual representation of this relationship in **Supplemental Figure 1**. Cross validations to test the predictive validity of these models were plotted using Receiver Operator Curve (ROC) graphs to further test the appropriateness of the main binomial logistic regressions compared to more flexible models in **Supplemental Figure 2a** and **Supplemental Figure 2b**. P-values are included in the regression tables for the logistic regressions but, for the purposes of appropriate inference, only confidence intervals will be interpreted to determine the importance of an estimate, since p-values "[convey] no information about the extent to which two groups differ or two variables are associated" and can be misleading[9]. All analyses were performed using R version 3.6.3 and RStudio, graphs and plots were generated using the ggplot2 and pROC packages, tables were created using the qwraps2 and kable packages, and GAMs were conducted using the mgcv package.

Results

Demographics of the study population included in **Table 1** show that participants in this analysis consists of 532 individuals who are predominantly Black/African-American (44%) and Hispanic/Latinx/Spanish (38%), where 41% of the participants reported using opiates or stimulants within the past 6 months, 51% tested positive for HIV, and 25% of the study sample were HIV-positive with a detectable HIV viral load. Mean homonegativity scores and Interquartile ranges for this cohort are lower for the obese individuals, which is represented in **Table 1**. The prevalence of obesity in this study is 21% (n = 115). Of the 37% individuals who

reported stimulant use within the past 6 months, those who are not obese have a higher stimulant use (41% among non-obese and 24% among obese participants).

In **Table 2**, younger individuals (18-24) who are obese show higher values of homonegativity compared to their non-obese counterparts. However, for the older age groups, those who are obese show lower levels of homonegativity compared to non-obese individuals in the same age group. When looking at drug use, non-obese individuals have higher levels of homonegativity than those who are obese in the stimulant use and no drug use groups, where stimulant users have higher values of homonegativity than non-drug users. Due to small cell sizes, the values for opiate users in **Table 2** cannot be interpreted. In this study group, Black/African-American participants have significantly higher homonegativity scores than White and Hispanic Individuals, but for each race group, the obese individuals have lower homonegativity scores than those who are not obese.

In the unadjusted logistic regressions in **Table 3**, homonegativity seems to be negatively correlated with obesity, with a 3.2% decrease in the odds of being obese for each increasing value of homonegativity (Unadjusted OR:0.968; CI: 0.942-0.994). In the fully adjusted model (adjusting for drug use, race, HIV status, and age), Homonegativity is still negatively correlated with obesity, with a 3.5% decrease in odds for each increasing homonegativity score, the same as the unadjusted model (Adjusted OR:0.965; CI:0.938-0.991). When using the same adjustment variables in a generalized additive model (GAM), and allowing for more accurate graphical representations in **Supplemental Figure 1**, obesity seems to have a negative correlation with homonegativity at the higher values and no correlation for less extreme scores. **Figure 2** shows that obese individuals do not have the same extreme scores of homonegativity that non-obese individuals have, which tracks with the results from the regressions. When testing

overdispersion, the quasibinomial standard errors are incredibly close to the binomial logistic regression, as well as having a dispersion perimeter of 1 as shown in **Supplemental Table 1**, ruling out overdispersion as a source of bias. When testing the predictivity of the logistic regression versus the GAM model in **Supplemental Figure 2a**, both seem to be equivalent. **Supplemental Figure 2b** shows that the quasibinomial model and the binomial model are also equivalent.

Discussion

Supposing the assumptions made in these analyses are correct, and the models are not plagued by other issues such as residual confounding, these results go against the general hypothesis that Homonegativity is positively associated with obesity. Given the body of literature showing homonegativity being positively associated with depressive symptomology, and more depressed individuals being obese than not, this negative association was not expected[5,7]. Even if reverse causation is at play here, where those who are obese experience more events that cause higher Homonegativity, the association should still theoretically be positive. One possible explanation is that Homonegativity does lead to depression, but this group of people experience depression differently than the general public; where this group of individuals lose weight instead of gain weight, since the criteria for depression stipulates a fluctuation of weight in either direction[10]. In **Table 2** racial disparities seem to be present, where Black/African-Americans experience some of the highest levels of Homonegativity. This homonegativity among Black/African-American MSM might be due to church involvement and high levels of self-perceived masculinity as reported in previous literature[11]. This is consistent with Meyer's minority stress model, but Homonegativity among Black MSM might also be driven by racism experienced within LGBT communities[12]. The Other race group had measures

of Homonegativity that were higher than those who were Black/African-American, but since there were only 24 individuals it is hard to make inferences about this group. Previous studies showed that older individuals experienced higher levels of Homonegativity, but in this study the relationship is mixed when stratified by obesity[13]. **Table 2** shows that Homonegativity is higher for increasing age groups who are not obese, but among those who are obese Homonegativity is lower across increasing age groups. Some main limitations are the lack of data pertaining to marijuana, hallucinogen, and alcohol use in this study. Not separating cannabis and hallucinogen use from the other drug use groups has the possibility of causing an inappropriate combination of groups and residual confounding. Furthermore, not having data on alcohol use hampers interpretations made from this study; since alcohol has the potential to be associated with psychological outcomes, such as Homonegativity, and implications with BMI due to the calorie content of alcohol. Other limitations of this study include reverse causation between homonegativity and obesity, the bidirectionality between obesity and depression, the lack of temporal analysis due to the cross-sectional nature of the study, and possible residual and unmeasured confounding not previously mentioned, to name some of the more pressing threats to the internal validity. Due to these limitations, causal interpretations cannot be made from this study. Despite these limitations, these findings warrant more research employing analyses utilizing longitudinal data on this subject area, as well as research on how these minority MSM communities experience depression and depressive symptomology.

Table 1. Demographic factors, Drug use, HIV Status, and Homonegativity

Descriptive Table 1	Non-Obese	Obese	Total
Total			
N	418	116	534
%	78.28	21.72	100
Age			
Mean ± SD	31.01 ± 6.94	32.61 ± 6.38	31.36 ± 6.85
Self Reported Drug Use n(%)			
Stimulant use	170 (41)	28 (24)	198 (37)
Opiate use	21 (5)	2 (2)	23 (4)
No Drug Use	176 (42)	63 (54)	239 (45)
HIV Status n(%)			
HIV+ (Detectable)	111 (27)	23 (20)	134 (25)
HIV + (Undetectable)	114 (27)	23 (20)	137 (26)
HIV -	193 (46)	70 (60)	263 (49)
Race n(%)			
Black	183 (44)	51 (44)	234 (44)
Hispanic, Latinx, Spanish	154 (37)	49 (42)	203 (38)
White	61 (15)	12 (10)	73 (14)
Other	20 (5)	4 (3)	24 (4)
Homonegativity			
mean ± SD	17.08 ± 9.08	14.90 ± 6.96	16.61 ± 8.71
IQR	13.00 (9.00, 24.00)	12.00 (9.00, 19.00)	13.00 (9.00, 22.00)
min	9	9	9
max	45	36	45
Education n(%)			
Less than High School	55 (13)	8 (7)	63 (12)
High School	158 (39)	49 (42)	207 (39)
College	96 (23)	33 (28)	129 (25)
Masters	82 (20)	21 (18)	103 (20)
PhD or Above	18 (4)	5 (4)	23 (4)
Missing	9 (2)	0 (0)	9 (2)

Table 2. Mean ± Standard Deviations and Interquartile ranges of Homonegativity stratified by obesity status across HIV status, demographic, and behavioral variables.

Variables	Non-Obese	Obese	Total
Total			
N	418	116	534
%	78.27715	21.72285	100
Homonegativity			
mean ± SD	17.08 ± 9.08	14.90 ± 6.96	16.61 ± 8.71
IQR	13.00 (9.00, 24.00)	12.00 (9.00, 19.00)	13.00 (9.00, 22.00)
Min	9	9	9
Max	45	36	45
Mean ± Standard Deviation (SD)			
Age (mean ± SD)			
18-24	15.98 ± 8.61	18.07 ± 9.82	16.28 ± 8.77
25-35	16.94 ± 8.74	15.54 ± 6.64	16.63 ± 8.33
36-46	18.12 ± 9.94	12.85 ± 5.78	16.78 ± 9.34
Self Reported Drug Use (mean ± SD)			
Stimulant use	17.75 ± 9.37	15.89 ± 7.67	17.48 ± 9.15
Opiate Use	20.14 ± 10.31	26 ± NA	20.35 ± 9.91
No Drug Use	16.51 ± 9.21	14.02 ± 6.49	15.85 ± 8.64
HIV Status (mean ± SD)			
HIV+ (Detectable)	15.76 ± 8.52	14.74 ± 6.33	15.58 ± 8.18
HIV + (Undetectable)	16.83 ± 8.16	15.04 ± 7.31	16.53 ± 8.03
HIV -	17.99 ± 9.82	14.90 ± 7.13	17.17 ± 9.27

Table 2. (continued)

Variables	Non-Obese	Obese	Total
Race (mean ± SD)			
Black	17.74 ± 8.92	15.98 ± 6.83	17.36 ± 8.52
Hispanic, Latinx, Spanish	16.45 ± 9.43	15.10 ± 7.53	16.12 ± 9.01
White	16.11 ± 8.71	9.83 ± 1.99	15.08 ± 8.33
Other	18.90 ± 8.92	13.75 ± 5.62	18.04 ± 8.58
Inter Quartile Range (IQR)			
Age (IQR)			
18-24	12.50 (9.00, 21.25)	17.00 (9.00, 23.50)	13.00 (9.00, 22.00)
25-35	13.00 (9.00, 24.00)	13.00 (9.00, 20.00)	13.00 (9.00, 22.00)
36-46	15.00 (9.00, 24.00)	9.00 (9.00, 16.00)	13.00 (9.00, 22.00)
Self Reported Drug Use Median(IQR)			
Stimulant use	15.00 (9.00, 25.00)	13.50 (9.00, 22.00)	15.00 (9.00, 24.75)
Opiate Use	19.00 (12.00, 24.00)	26 (26, 26)	19.00 (13.50, 24.50)
No Drug Use	13.00 (9.00, 21.00)	11.00 (9.00, 17.50)	12.00 (9.00, 20.00)
HIV Status (IQR)			
HIV+ (Detectable)	12.00 (9.00, 20.00)	11.00 (9.00, 19.00)	11.50 (9.00, 20.00)
HIV + (Undetectable)	15.00 (9.00, 22.75)	13.00 (9.00, 18.50)	14.00 (9.00, 22.00)
HIV -	15.00 (9.00, 25.00)	11.50 (9.00, 19.75)	14.00 (9.00, 23.00)
Race (IQR)			
Black	15.00 (9.00, 25.00)	14.00 (9.00, 21.00)	15.00 (9.00, 24.00)
Hispanic, Latinx, Spanish	12.00 (9.00, 21.00)	11.00 (9.00, 19.00)	12.00 (9.00, 20.00)
White	12.00 (9.00, 22.00)	9.00 (9.00, 9.00)	11.00 (9.00, 18.00)
Other	17.50 (11.75, 22.75)	13.00 (9.00, 17.75)	17.00 (11.00, 21.25)

Table 3. Unadjusted Logistic Regression of Obesity and Homonegativity

	Estimate	95% LCL	95% UCL	Std. Error	Z.Value	P
Homonegativity	0.968	0.942	0.994	0.014	-2.374	0.018

Table 4. Adjusted Logistic Regression of Obesity and Homonegativity

	Estimate	95% LCL	95% UCL	Std. Error	Z.Value	P
Homonegativity	0.965	0.938	0.991	0.014	-2.552	0.011
Adjusted for Drug use, Race, HIV Status, and Age						

Supplemental Table 1. Adjusted Quasibinomial Logistic Regression of Obesity and Homonegativity

	Estimate	95% LCL	95% UCL	Std. Error	T.Value	P
(Intercept)	0.063	0.017	0.220	0.651	-4.241	0.000
Homonegativity	0.965	0.938	0.991	0.014	-2.520	0.012
Stimulant Use[a]	0.498	0.255	0.972	0.340	-2.051	0.041
Opiate Use[a]	0.741	0.108	2.920	0.798	-0.376	0.707
No Drug Use[b]	0.867	0.496	1.541	0.288	-0.495	0.620
Black/African-American[c]	1.333	0.652	2.901	0.378	0.761	0.447
Hispanic/Latinx/Spanish[c]	1.657	0.808	3.617	0.380	1.331	0.184
Other[c]	1.070	0.258	3.752	0.669	0.100	0.920
HIV^+(Undetectable)[d]	0.512	0.281	0.907	0.298	-2.245	0.025
HIV^+(Detectable)[d]	0.501	0.267	0.914	0.313	-2.207	0.028
Age	1.065	1.030	1.103	0.018	3.616	0.000
Dispersion Parameter for Quasibinomial family = 1.028641						
[a]reference: Non use Category [b]reference: Drug use [c]reference: White [d]reference: HIV^-						

Supplemental Table 2. Unadjusted Logistic Regression of Obesity and Homonegativity (All Variables)

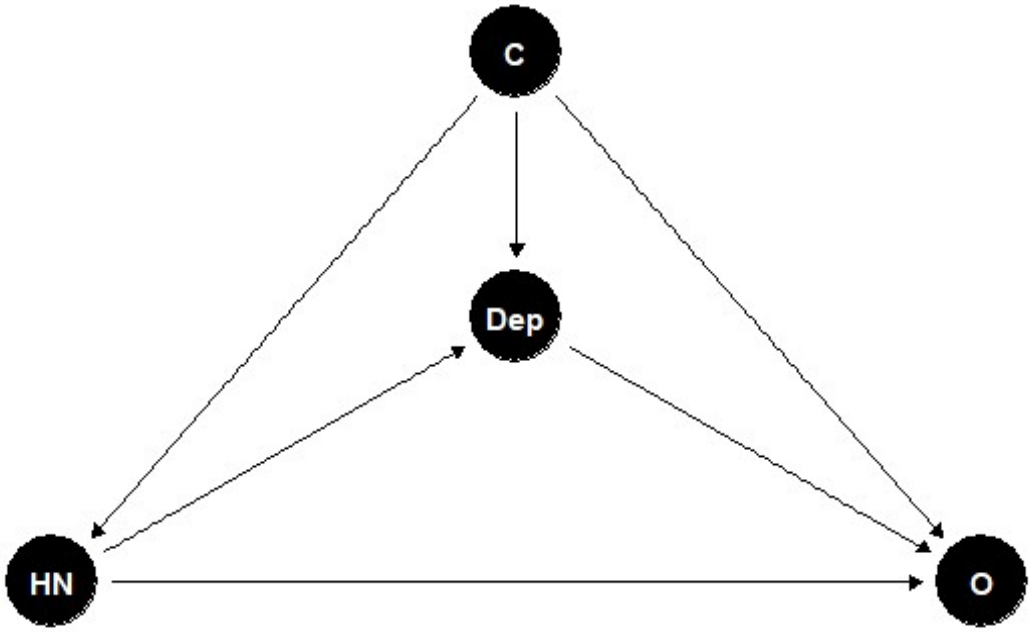
	Estimate	95% LCL	95% UCL	Std. Error	Z.Value	P
(Intercept)	0.347	0.265	0.450	0.135	-7.826	0.000
Homonegativity	0.968	0.942	0.994	0.014	-2.374	0.018

Supplemental Table 3. Adjusted Logistic Regression of Obesity and Homonegativity (All Variables)

	Estimate	95% LCL	95% UCL	Std. Error	Z.Value	P
(Intercept)	0.063	0.017	0.217	0.643	-4.296	0.000
Homonegativity	0.965	0.938	0.991	0.014	-2.552	0.011
Stimulant Use[a]	0.498	0.257	0.964	0.336	-2.077	0.038
Opiate Use[a]	0.741	0.112	2.875	0.788	-0.381	0.703
No Drug Use[b]	0.867	0.499	1.530	0.285	-0.502	0.616
Black/African-American[c]	1.333	0.658	2.871	0.373	0.771	0.441
Hispanic/Latinx/Spanish[c]	1.657	0.816	3.580	0.375	1.348	0.178
Other[c]	1.070	0.263	3.695	0.660	0.102	0.919
HIV^+(Undetectable)[d]	0.512	0.283	0.901	0.294	-2.274	0.023
HIV^+(Detectable)[d]	0.501	0.269	0.907	0.309	-2.235	0.025
Age	1.065	1.030	1.103	0.017	3.662	0.000

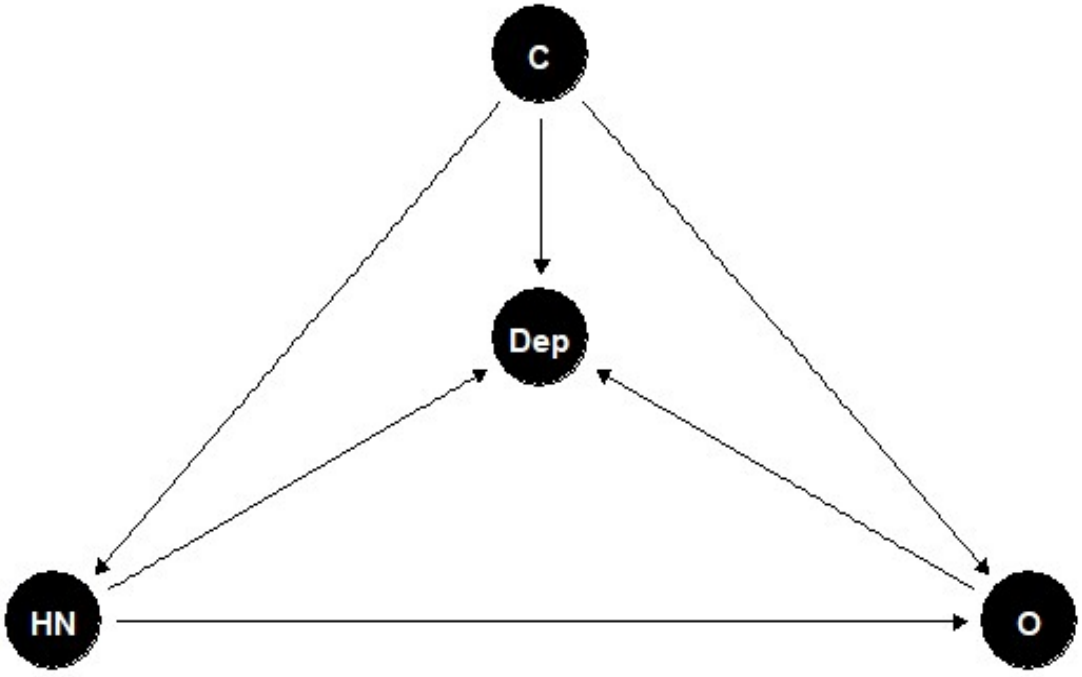
[a]reference: Non use Category
[b]reference: Drug use
[c]reference: White
[d]reference: HIV^-

Figure 1a. Mediating Directed Acyclic Graph



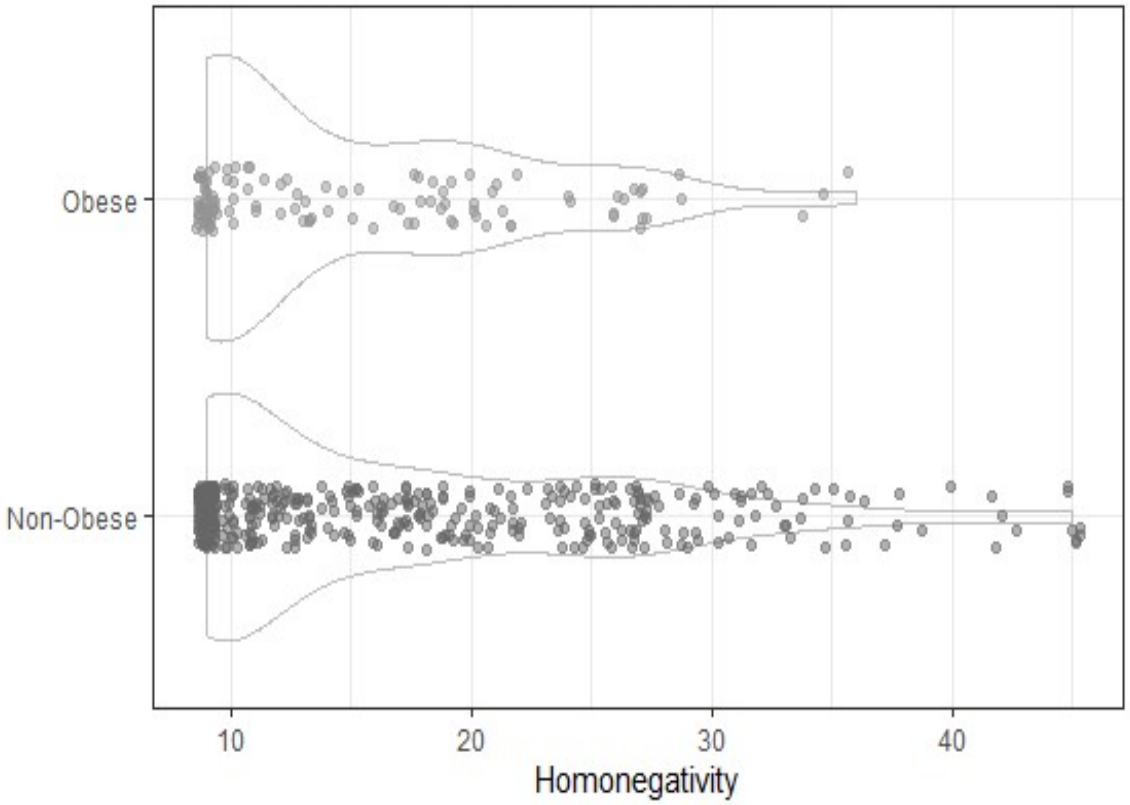
HN = Homonegativity, Dep = Depression, O = Obesity, C = Confounders

Figure 1b. Colliding Directed Acyclic Graph

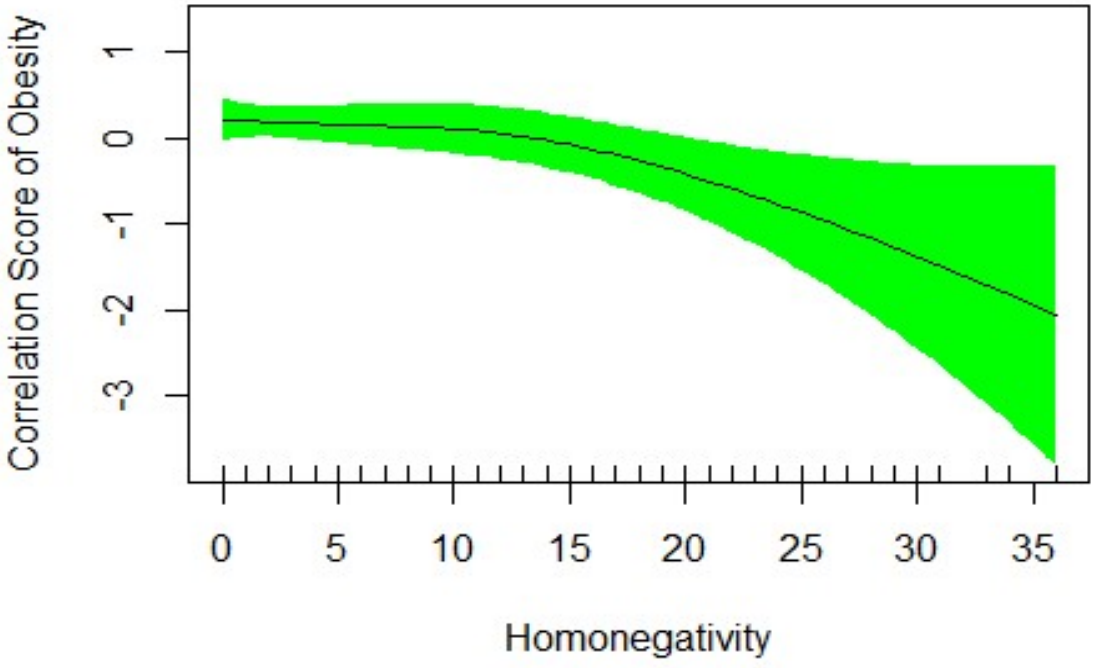


HN = Homonegativity, Dep = Depression, O = Obesity, C = Confounders

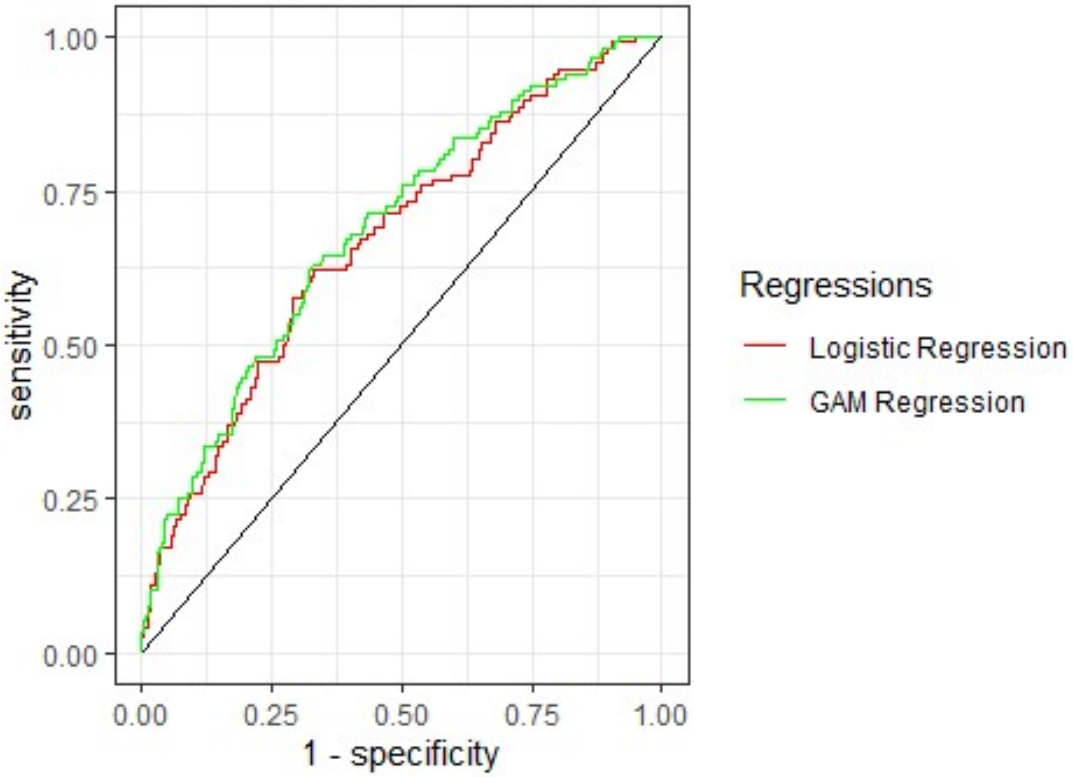
Figure 2.
Violin Plot of Homonegativity and Obesity



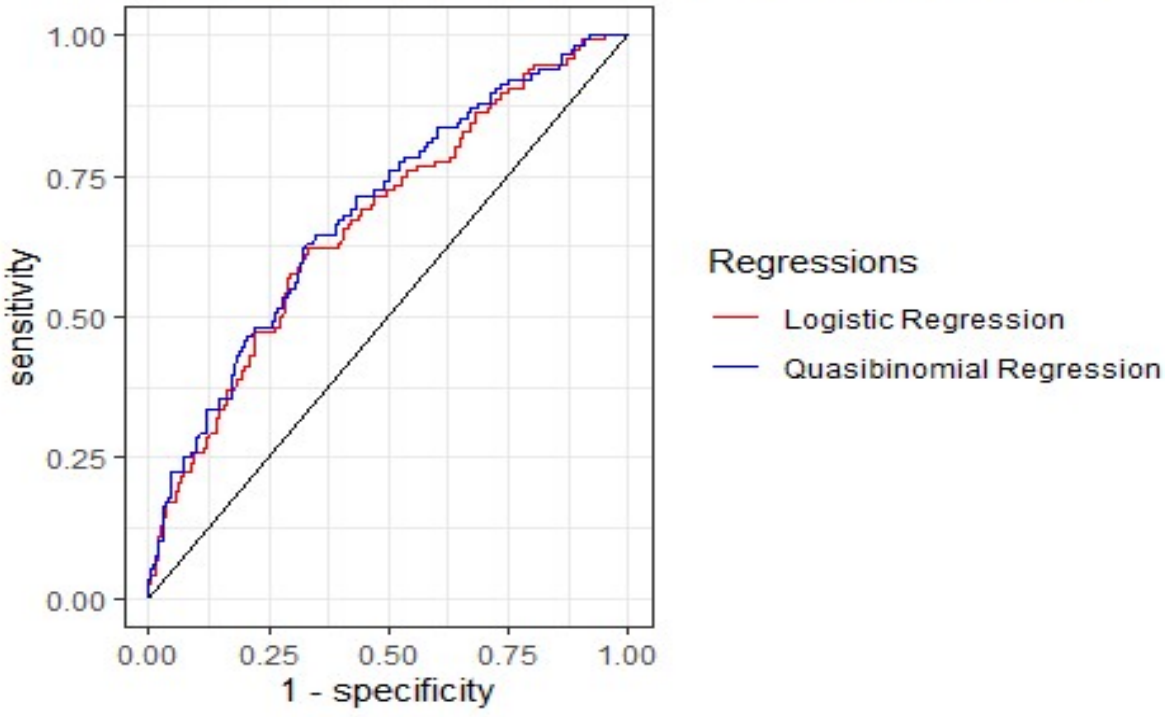
Supplemental Figure 1.
Adjusted Generalized Additive Model



Supplemental Figure 2a.
ROC of Logistic and GAM Regressions



Supplemental Figure 2b.
ROC of Logistic and Quasibinomial Regressions



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