

**A Randomized Controlled Trial of a Game-Based Intervention to Reduce Alcohol Use
among Sexual and Gender Minority Youth**

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Scientific Background

Alcohol is the most commonly used substance among youth,¹ and is disproportionately used by sexual and gender minority youth (SGMY; e.g., lesbian, gay, bisexual, transgender, nonbinary, and gender expansive people <18 years old).¹⁻³⁰ Alcohol use is 123-155% higher among sexual minority youth than heterosexual youth and up to 250% higher among gender minority youth than cisgender youth.^{2,5-7} SGMY are more likely to drink alcohol at earlier ages.¹⁻³⁰ SGMY alcohol use inequities are linked to alcohol-related consequences, morbidity, and mortality inequities later in life (e.g., HIV, substance use disorders).³¹⁻³⁸ This suggests reducing SGMY alcohol use may mitigate related disparities later in the life-course.

Interventions for preventing and reducing SGMY alcohol use inequities are lacking.^{3,39} Without developing and rigorously testing scalable interventions, these inequities will likely persist. Despite researchers and national agencies calling for interventions to reduce SGMY alcohol use,^{3,40,41} our team's systematic review³⁹ revealed that out of all alcohol use intervention studies, only 2 included efficacy testing among SGMY. Those studies^{42,43} had overall poor methodology per a valid checklist,⁴⁴ so their results must be interpreted cautiously. One study found 16 sessions of coordinated mental health services reduced substance use and abuse/dependence symptoms, but this study lacked a comparison group.⁴³ The other study conducted an RCT and found that a brief online intervention reduced drug use, but not alcohol use.⁴² To achieve U.S. federal agencies' goals of reducing alcohol use inequities for SGMY,^{3,40,41} rigorous efficacy tests of new interventions are needed.

Game-based interventions have a well-established role in health promotion and behavior change. Games designed to educate, train, or change behavior as they entertain players (also known as "serious games"⁴⁵) have been shown to improve health outcomes in youth (e.g., smoking, depression, and anxiety).⁴⁶⁻⁷³ Serious games can also enhance players' emotional intelligence and mastering of coping strategies.⁷⁴⁻⁷⁶ Game-based interventions are unique in that they offer opportunities for simulated role play, a highly effective approach for situated learning.⁷⁷ Role play allows players to practice skills in an entertaining way^{78,79} and can influence healthy attitudes and behaviors.^{80,81} This "hands on" approach to learning allows for the acquisition and rehearsal of new skills that can then be transferred to real life situations.⁸² Serious games can create contextualized learning experiences that are meaningful to the player, which are known to create long-term retention of new knowledge and cognitive skills.⁸³ Other advantages of games include increased fidelity and cost-effectiveness.⁸⁴⁻⁹⁰ While the potential for game-based interventions are promising, there continues to be a great need for the development and rigorous testing of theory-driven game-based interventions.⁶³

Web-accessible game-based interventions can improve health among SGM populations and can overcome barriers associated with effectively reaching the growing population of SGMY. Game-based interventions with young men who have sex with men have improved HIV-related outcomes using choose-your-own adventure narratives to help them navigate barriers in a safe space.⁹¹⁻⁹³ Competition-based games using personalized normative feedback have reduced alcohol use among sexual minority adult women.⁹⁴ Also, game-based cognitive behavioral therapy components have taught sexual minority youth behavioral change skills to improve depression.⁹⁵ Web-based game interventions are also an effective way to reach large numbers of SGMY, including those living in rural and high structural stigma locations (i.e., areas with less SGM-inclusive policies, institutions, and attitudes), who may be insufficiently supported by face-to-face programs.^{96,97} Though web-accessible game interventions are effective and overcome common impediments of face-to-face interventions, there is a lack of games aimed at preventing and reducing SGMY alcohol use.

Discrimination, stigma, and minority stressors are primary contributors to SGMY alcohol use inequities. Stigma Theory^{98,99} posits that SGMY experience multiple forms of discrimination (related to their sexual or gender minority statuses) at multiple levels of the social ecological model. Such discrimination includes internalized stigma (i.e., when SGMY internalize negative stereotypes about themselves), interpersonal stigma (i.e., direct or enacted forms of verbal, physical, and sexual harassment because of one's sexual identity or gender,^{100,101} occurring in-person or online), and structural stigma (i.e., locales with fewer SGM-inclusive policies, institutions, and attitudes). Minority Stress^{102,103} posits that these multiple forms of discrimination lead SGMY to experience chronic and acute psychological distress, which in turn lead some to cope via alcohol use. Much empirical research, including our own, has confirmed these theories, and identified discrimination and minority stress as primary contributors of SGMY alcohol use inequities.¹⁰⁴⁻¹⁰⁹ Therefore, interventions for SGMY must aim to prevent discrimination and/or teach SGMY to cope with stress to efficaciously reduce their alcohol use. Such interventions may be particularly useful for SGMY who have multiple minoritized identities (e.g., racial/ethnic minority SGMY) because they face compounding intersectional stigma, discrimination, and stress.

Intervention efficacy for preventing and reducing alcohol use may be moderated by minority stressors. With sexual minority adults, 2 sexuality-affirming interventions had greater efficacy for reducing alcohol use among participants with higher levels of baseline internalized stigma.^{110,111} Said differently, higher internalized stigma was associated with greater treatment benefit for reducing alcohol. Authors speculated men with greater internalized stigma may use alcohol to cope with internalized negative beliefs, and through the intervention they learned alternative coping skills to decrease their drinking behaviors.^{110,111} To build on the rigor of prior research, this R01 will: (1) investigate, for the first time, minority stressors as moderators of intervention efficacy among SGMYs; (2) examine multiple minority stressors at multiple levels of the social ecological model, including structural stigma, interpersonal stigma, and racism; and (3) use mixed methods to quantify the moderating effects and triangulating these data with participant descriptions about why and how minority stress affects intervention efficacy. A mixed methods study investigating whether, how, and why minority stress moderates the impact of interventions for reducing SGMY alcohol use can inform the field about for whom SGMY-affirmative interventions are most beneficial and illuminate for whom additional interventions are needed.

Study Objectives

Aim 1. Test the efficacy of a game-based intervention for reducing alcohol-related harms among SGMY.

Aim 2. Describe how baseline minority stressors (across proximal and distal domains) affect intervention efficacy.

Study Design & Methods

This study is a randomized controlled trial with SGMY (n=1,992) who are recruited via social media from across the United States. Participants will be randomized after baseline to the Intervention or Control condition. We will conduct surveys with SGMY at baseline, 3-, 6-, and 12-month follow-up. All study procedures related to screening, consenting, and surveying will be completed using REDCap, a free and secure HIPAA-compliant website for managing Web-based longitudinal survey studies.

This study will test the efficacy of our game-based intervention, Singularities, for preventing and reducing SGMY alcohol-related harms (primary outcome) and other health risk behaviors. We will examine whether minority stressors at multiple levels of the social ecological moderate intervention efficacy.

Intervention Condition: Singularities

Singularities is a theory-based, community-informed, web-accessible, roleplaying game-based intervention incorporating primary components: reducing alcohol-related harms; fostering healthy identity development in a safe environment; encouraging help-seeking behaviors; encouraging use of productive coping; and encouraging healthy internet and social media use.

Control Condition: Food4Thought

We will compare Singularities against an attention control condition (ACC) in which we will provide participants with similar amounts of research team contact and program contact, but without the active ingredients of Singularities intervention, namely the educational content that aims to enhance SGMY's alcohol protective behavioral strategies, distress tolerance skills, emotional regulation strategies, and healthy social media usage. The ACC will be asked to play a game, titled Pick Your Plate! A Global Guide to Nutrition, developed by the Smithsonian Science Education Center. Participants are instructed to build healthy meals using cuisine from around the world while ensuring they stick to a budget and meet all their nutritional needs. Importantly, this game does not include alcohol. In addition, they will be provided with educational modules based on USDA's nutritional materials, including MyPlate, that teach teens about healthy nutrition. The game and educational modules will be similar in length to the Singularities game and website, but with a different health focus. After their completion in the RCT, we will provide the game at no cost to control participants.

Eligibility Criteria

Inclusion: Individuals will be eligible if they are comfortable participating in English, live in the U.S., are 14-18 years old, have a sexual minority identity (i.e., gay, lesbian, bisexual, or queer) or a gender minority identity (i.e., consider themselves to be transgender or nonbinary), have an internet-accessible computer, smart phone, or tablet, and provide an email address; have drank alcohol in their lifetime or intend to in the next year.

Exclusion: We exclude people who are cisgender heterosexuals.

Statistical Considerations

We will use StataSE. Type I error will be set at 5% for all analyses. We will examine whether baseline characteristics are associated with study arm. We will control for variables (potential confounders) that differ meaningfully across study arms and are prognostic with the outcome.

Our primary analyses will use generalized linear mixed models (i.e., multilevel repeated-measures models) with a random effect for observations nested within persons and a link function dependent on the outcome distribution. Using a parallel two-group design, we will test whether the Poisson event rate ratio ($\lambda_{\text{intervention}} / \lambda_{\text{control}}$) for alcohol-related harms reported at T2 (primary outcome) is different from 1. To examine whether there are greater improvements over time in the intervention versus control conditions, we will test the interaction term of time by condition. We will conduct our primary analyses as intent-to-treat, wherein all participants are included according to the condition they were randomized to (i.e., 1=intervention 0=control). Time will be categorical (T1, T2, T3, T4).

To explore how participants' pre-intervention minority stress levels and demographics moderate the intervention effects on outcomes (e.g., how outcomes differ across subgroups), we will use similar modeling techniques to those used above with some exceptions. Our primary effects of interest in Aim 2 are the 3-way interactions between time × study arm × potential effect modifiers. These multivariable models will contain the 3-way interaction term, all 2-way interaction terms, main effects of time, study arm, potential effect modifier, and any variables that meaningfully differ between study arms at baseline. We will conduct both intent-to-treat and intensity-adjusted analyses. A significant 3-way interaction suggests the presence of intervention effect heterogeneity; we will follow the approach of Kraemer^{112,113} by focusing on effect size derivation rather than formal hypothesis testing. We will use Stata's postestimation "margins" command to probe the 3-way interaction terms to provide simpler meaningful results.

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