

國立臺灣大學公共衛生學院全球衛生碩士學位學程

碩士論文

Global Health Program

College of Public Health

National Taiwan University

Master Thesis



台灣男性性少數使用愛滋病預防性

投藥之服務的阻礙與促進因素

Barriers and Facilitators to Engagement in Pre-Exposure
Prophylaxis Services for Sexual Minority Men in Taiwan

麥晨皓

Daniel Frank Mayo

指導教授：黃柏堯 博士、張齡尹 博士

Advisor: Poyao Huang, PhD, Ling-Yin Chang, PhD

中華民國 112 年 08 月

August, 2023

國立臺灣大學碩士學位論文
口試委員會審定書

National Taiwan University
Verification Letter from the Oral Examination Committee for Master's Students



論文中文題目

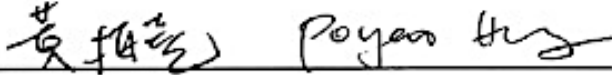
台灣男性性少數使用愛滋病預防性投藥之服務的阻礙與促進因素


論文英文題目

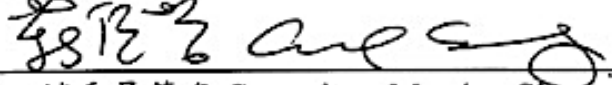
Barriers and Facilitators to Engagement in Pre-Exposure Prophylaxis Services for Sexual
Minority Men in Taiwan

本論文係麥晨皓君 (R10853003) 在國立臺灣大學全球衛生碩士學位學程完成之碩士學位論文，於民國 112 年 07 月 14 日承下列考試委員審查通過及口試及格，特此證明。

This Thesis is written by Daniel Frank Mayo (R10853003) studying in the graduate program in the Global Health Program. The author of this thesis is qualified for a master's degree through the verification of the committee.



(指導教授簽名 Advisor Signature)


(指導教授簽名 Advisor Signature)


(口試委員簽名 Committee Member Signature)


(口試委員簽名 Committee Member Signature)

Acknowledgment



I would like to express my deepest gratitude to the following individuals and institutions who have supported and contributed to the completion of this thesis: My advisors, Professors Poyao Huang and Ling-Yin Chang, for their guidance, encouragement, and unwavering support throughout the research process. Their expertise and insightful feedback have been invaluable in shaping this thesis. The members of my Thesis Committee, Professors Carol Strong and Po-Han Lee, for their valuable insights and constructive criticism, which helped me refine my research and strengthen my arguments. The Global Health Program at National Taiwan University for providing me with a conducive academic environment and access to extensive resources that enriched my learning experience. My family, for their constant love, understanding, and encouragement. Their unwavering belief in my abilities gave me the strength to persevere during challenging times. My friends and classmates, April Hill, Chloe Hemm, Jade Westlake, and Luis Ponce, for their camaraderie and stimulating discussions, which have been both intellectually rewarding and enjoyable. Lastly, I am grateful to all the participants who generously gave their time and shared their experiences, without whom this research would not have been possible. Thank you all for being a part of this journey and for making it a truly enriching and rewarding experience.

摘要



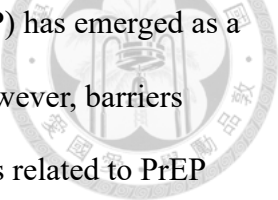
背景：過去十年，愛滋病預防性暴露前預防性投藥（PrEP）在性少數男性（SMM）中已成為 HIV 預防的關鍵策略。然而，SMM 仍面臨 PrEP 接受和利用的障礙。本研究回顧了在臺灣和全球範疇中影響 SMM 群體 PrEP 利用的相關因素。**目的：**本研究考慮了在臺灣 SMM 中 PrEP 利用的誘發、促成和需求因素，並討論這些因素與 PrEP 照護流程之間的關係。**方法：**我們進行了線上橫斷調查，檢視了與 PrEP 利用相關的各種誘發、促成和需求因素。研究招募了 249 名年齡在 18 歲及以上（平均年齡 32.81 歲；標準差 8.75 歲）的臺灣 SMM 參與、他們自認為是男性、且 HIV 測試結果為陰性、目前居住在臺灣。我們使用描述性統計、單變量線性回歸和階層線性回歸等方法來分析數據，深入瞭解參與者特徵，並研究這些特徵與臺灣 SMM 中 PrEP 照護流程得分之間的關聯。**結果：**研究顯示多個因素與 PrEP 照護流程得分之間存在顯著關聯，其中包括關係狀態、身份認同確認、內在恐同、HIV 或性傳染感染（STI）檢測、以及其他與性行為和健康相關的變數。此外，PrEP 效力知識、獲取 PrEP 處方的正式途徑、以及特定網路行為也與 PrEP 照護流程得分呈現相關。階層線性回歸分析顯示，誘發和促成因素的綜合效應解釋了 PrEP 照護流程得分變異的相當大部分（41%）（ $F(17, 210) = 10.82, p < .001$ ）。然而，將需求因素納入回歸模型對 PrEP 照護流程得分的預測並未產生顯著貢獻（ $p > .05$ ）。**結論：**研究結果顯示，關係狀態、HIV 和 STI 檢測、PrEP 相關知識和交友軟體使用是影響臺灣 SMM 中 PrEP 利用的重要因素。這些發現對於臺灣的醫療保健提供者和政策制定者具有實際意義，建議他們進一步發展針對性的干預措施，以改善 SMM 對 PrEP 的接受情況。此外，本研究複製了先

前確認的因素，並闡明了 PrEP 相關被忽視的因素，顯著增進了對全球 SMM 群體 PrEP 利用的理解，凸顯了實施有效 HIV 預防策略所需全面因素的重要性。

關鍵字：預防性預防藥物、愛滋病預防、性少數男性、醫療保健利用



Abstract



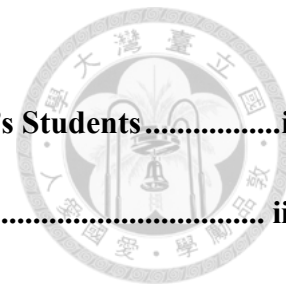
Background: In the past decade, the use of pre-exposure prophylaxis (PrEP) has emerged as a crucial strategy in HIV prevention among sexual minority men (SMM). However, barriers continue to hinder PrEP uptake among SMM. This study reviews the factors related to PrEP utilization among SMM in Taiwan and globally. **Objective:** This study considers the predisposing, enabling, and need factors associated with PrEP utilization among SMM in Taiwan, discussing their relationship with the PrEP care continuum. **Methods:** An online cross-sectional survey was conducted to examine a range of predisposing, enabling, and need factors related to PrEP utilization among eligible SMM. A convenience sample of 249 participants, aged 18 and older ($M = 32.81$ years; $SD = 8.75$), identifying as cisgender SMM with a negative HIV status, residing in Taiwan, was recruited for the study. Descriptive statistics, univariate linear regressions, and hierarchical linear regression were employed to analyze the data, providing insights into participants' characteristics and examining the associations between predisposing, enabling, and need factors and the PrEP care continuum score among eligible SMM in Taiwan. **Results:** The study revealed significant associations between various factors and the PrEP care continuum score. These factors encompassed relationship status, identity affirmation, internalized homophobia, HIV or sexually transmitted infection (STI) testing, and other variables related to sexual behavior and health. Additionally, knowledge of PrEP efficacy, access to formal sources for obtaining a PrEP prescription, and engagement in certain online behaviors also correlated with the PrEP care continuum score. The hierarchical linear regression analysis revealed that the combined effect of predisposing and enabling factors accounted for a substantial proportion (41%) of the variability in the PrEP care continuum score ($F(17, 210) = 10.82, p < .001$). However, the inclusion of need factors in the regression model did not

significantly contribute to the prediction of the PrEP care continuum score ($p > .05$).

Conclusions: Together, the findings suggest that relationship status, HIV and STI testing, PrEP-related knowledge, and dating app use were important factors related to PrEP utilization. These findings have practical implications for Taiwanese healthcare providers and policymakers, who can further develop targeted interventions to improve PrEP uptake among SMM. Furthermore, this study significantly enhances the global understanding of PrEP utilization among SMM populations. It achieves this by replicating previously identified factors and shedding light on previously overlooked factors related to PrEP, underscoring the critical importance of addressing a comprehensive range of factors for the implementation of effective HIV prevention strategies.

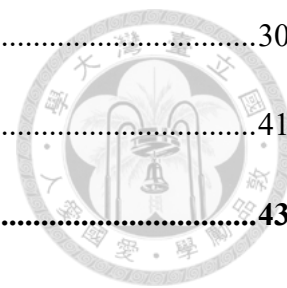
Keywords: Pre-Exposure Prophylaxis, HIV Prevention, Sexual Minority Men, Healthcare Utilization

Table of Contents



Verification Letter from the Oral Examination Committee for Master's Students	i
Acknowledgment	ii
摘要	iii
Abstract	v
Table of Contents	vii
List of Figures	ix
List of Tables	x
Chapter 1: Introduction	1
Overview	1
Current Landscape of PrEP Utilization	2
Research Problem	4
Theoretical Foundations of PrEP Utilization.....	5
The Role of Predisposing Factors.....	7
The Role of Enabling Factors.....	13
The Role of Need Factors.....	20
The Current Study	25
Chapter 2: Methods	29
Participants and Procedures.....	29

Study Measures.....	30
Statistical Analysis.....	41
Chapter 3: Results	43
Sample Characteristics	43
Aim 1	44
Aim 2	45
Chapter 4: Discussion.....	51
Aim 1	51
Aim 2	53
Limitations and Future Directions.....	56
Implications for Practice and Public Health.....	57
Conclusion.....	59
References.....	60



List of Figures

Figure 1. Theoretical Framework of PrEP Utilization.....	81
Figure 2. Distribution of PrEP Care Continuum Stages Among Sexual Minority Men (SMM) in Taiwan, N = 249	82

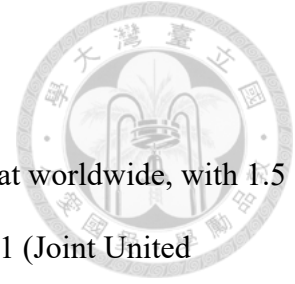


List of Tables



Table 1. Sample Characteristics, N =249	83
Table 2. Descriptive Statistics of Variables of Interest, N = 249	86
Table 3. Predisposing, Enabling, and Need Factors Associated with PrEP Utilization Using Univariate Linear Regressions, N = 249	87
Table 4. Predisposing, Enabling, and Need Factors Associated with PrEP Utilization Using Multivariate Hierarchical Linear Regressions, N = 228.....	89

Chapter 1: Introduction



Overview

The human immunodeficiency virus (HIV) persists as a global threat worldwide, with 1.5 million new diagnoses and 650,000 related deaths reported globally in 2021 (Joint United Nations Programme on HIV/AIDS [UNAIDS], 2022b). Despite advancements in medical research and treatment, the global burden of HIV remains significant. Over the years, significant progress has been made in the development of various HIV treatments and prevention methods. One such prevention method is pre-exposure prophylaxis (PrEP), which has shown remarkable effectiveness in preventing HIV transmission when taken consistently as prescribed (Fonner et al., 2016; Grant et al., 2010; Molina et al., 2022). However, despite the proven efficacy of PrEP, its utilization and effectiveness as an HIV prevention tool face numerous challenges related to a range of individual (e.g., age, education, income) and contextual factors (e.g., stigma and discrimination, social support network, healthcare availability; Hillis et al., 2020; Mayer et al., 2020; Yi et al., 2017). These multifaceted factors on a global scale hinder the widespread adoption and optimal utilization of PrEP as a preventive measure against HIV transmission.

UNAIDS has established a comprehensive set of 95% goals to be achieved globally by the year 2030, aiming to address various aspects of HIV, including prevention, testing, treatment, and reducing discrimination (UNAIDS, 2020). One specific target is to ensure that 95% of individuals at risk of HIV infection have access to combination prevention options. Among the key populations at risk, such as gay, bisexual, and other men who have sex with men (henceforth, referred to as sexual minority men [SMM]), these individuals face unique health challenges arising from their same-sex identity, behavior, and attraction (UNAIDS, 2020, 2022a). Research has highlighted disparities in health access, utilization, and outcomes for the SMM population

(Hatzenbuehler, 2009; Herek, 2009; Meyer, 2003; Pew Research Center, 2020). Notably, in Taiwan, SMM represent a significant majority, accounting for 77.4% of reported HIV cases (Taiwan Centers for Disease Control [CDC], n.d.-b). Therefore, it is crucial to explore strategies that enhance the utilization of PrEP among this key population to achieve the goal of providing comprehensive prevention options. Understanding and improving PrEP use among SMM, both on a global and Taiwan scale, are vital steps in advancing progress toward the 95% goals set by UNAIDS.

Current Landscape of PrEP Utilization

The current landscape of PrEP utilization can be assessed through various dimensions, including awareness, willingness, initiation, usage, adherence, and discontinuation. Operationalizing PrEP utilization encompasses different indicators and measures, reflecting the complexity of individuals' engagement with PrEP (Maxwell et al., 2019; Sidebottom et al., 2018; Z. Sun et al., 2022). Given the diversity in ways to evaluate PrEP utilization, there is a need for a comprehensive framework that allows for the evaluation and monitoring of the different stages of PrEP engagement. To address this, the PrEP care continuum has emerged as a theory-driven framework that captures the continuum of PrEP utilization, offering a systematic approach to understanding and addressing the various stages, from pre-contemplation and preparation to initiation and maintenance (Nunn et al., 2017; Parsons et al., 2017). However, the Transtheoretical Model of Behavior Change, underlying the PrEP care continuum, has been criticized for its arbitrary stages and the perception that health behavior is a continuous progression without a rigid categorization ("Time for a Change," 2005). Despite these criticisms, the PrEP care continuum offers several benefits, including standardized assessment, benchmarking, and a holistic understanding of PrEP utilization. By integrating various stages and

factors related to PrEP utilization, the care continuum provides a valuable tool for evaluating, monitoring, and improving PrEP utilization efforts.

Research on PrEP utilization in Taiwan, similar to studies conducted in countries such as the United States (US), Australia, Canada, and England where PrEP adoption occurred earlier and implementation was more rapid, has primarily focused on aspects like awareness, willingness, adherence, and discontinuation (Hanum et al., 2020; Jin et al., 2021; J. Morgan et al., 2018; Shover et al., 2018). However, there is still a limited understanding in Taiwan of the stages that lie between these key aspects of PrEP utilization as defined by the PrEP care continuum, as well as the exploration of other factors beyond demographic and sexual behavior predictors (Chuang & Newman, 2018; S.-T. Huang et al., 2021; Ko et al., 2016, 2018; Lee et al., 2017; H. Wu et al., 2021; H.-J. Wu et al., 2021). In other settings, there has been a growing recognition of the importance of considering additional factors, such as stigma, discrimination, affirmation, social support networks, healthcare access, healthcare provider attitudes, and socioeconomic determinants, in shaping both the utilization of PrEP (Hillis et al., 2020; Mayer et al., 2020; Yi et al., 2017).

Furthermore, PrEP implementation in Taiwan faces challenges and gaps. Despite Truvada's approval for PrEP use in 2016, accessibility remains an issue due to the lack of coverage by Taiwan's NHI system (Yen-Hao Chu et al., 2020). This results in prohibitively high out-of-pocket costs for the brand name PrEP (i.e., Truvada and Descovy), averaging around NTD\$12,000 per month (P. Huang, 2022). Generic PrEP options are not available (Yen-Hao Chu et al., 2020). Efforts have been made to improve access through initiatives such as CDC programs and patient assistance, but affordability and accessibility barriers persist (Taiwan Centers for Disease Control, n.d.-a). Addressing these gaps and challenges is crucial to ensure

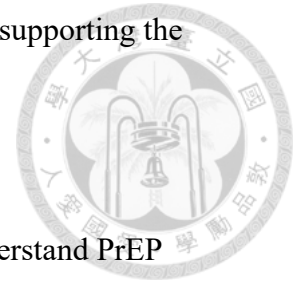
PrEP can become an effective tool in reducing the incidence and morbidity of HIV among SMM in Taiwan, ultimately improving their health outcomes.



Research Problem

The utilization of PrEP as an effective HIV prevention tool is influenced by various individual and contextual factors (Hanum et al., 2020; Jin et al., 2021; J. Morgan et al., 2018; Shover et al., 2018). While previous studies in Taiwan have investigated different aspects of PrEP utilization, such as awareness, willingness, adherence, and discontinuation (Chuang & Newman, 2018; S.-T. Huang et al., 2021; Ko et al., 2016, 2018; Lee et al., 2017; H. Wu et al., 2021; H.-J. Wu et al., 2021), there is still a lack of comprehensive understanding regarding the specific stages within the PrEP care continuum that connect these key aspects. Notably, the application of the PrEP care continuum framework to comprehensively analyze PrEP utilization in the Taiwanese context has not been explored, despite previous research efforts focusing on various aspects of PrEP utilization. Therefore, there is a critical need to develop a more holistic understanding of PrEP use in Taiwan, specifically by identifying the stages of the PrEP care continuum that require further attention and intervention. Such insights can inform targeted strategies and policies to optimize PrEP utilization and enhance HIV prevention efforts in Taiwan. Furthermore, the existing research conducted in Taiwan has primarily concentrated on demographic and sexual behavior predictors, overlooking the potential influence of other factors on PrEP utilization. Consequently, it is essential to comprehensively explore the stages of PrEP engagement in Taiwan while considering additional individual and contextual determinants beyond traditional predictors. This comprehensive approach will enable a more nuanced understanding of PrEP utilization and facilitate the development of targeted strategies and

policies to optimize its use, thereby advancing HIV prevention efforts and supporting the achievement of the 95% goals set by UNAIDS in Taiwan.



Theoretical Foundations of PrEP Utilization

This study adopts a multi-theory approach to comprehensively understand PrEP utilization among SMM, globally and in Taiwan, and develop effective strategies (Figure 1). By integrating multiple theoretical frameworks, the study aims to encompass a broader range of determinants and provide unique perspectives on PrEP utilization. This approach acknowledges the dynamic nature of healthcare utilization and overcomes the limitations of a single-theory approach. Through exploring the complex interrelationships among factors, the study seeks to gain a holistic understanding of PrEP utilization among SMM, globally and in Taiwan, and inform the development of tailored interventions and policies.

The primary theoretical framework in this study is Andersen's Behavioral Model of Health Service Utilization (Andersen, 1968, 1995; Andersen & Davidson, 2007), which serves as the foundation for comprehensively examining the factors influencing PrEP utilization (Bazzi et al., 2019; Li et al., 2019). The model classifies these factors into *predisposing factors*, *enabling factors*, and *need factors* at both individual and contextual levels. Predisposing factors, such as age, sex, education, and community demographics and values, play a significant role in shaping utilization patterns. Enabling factors, including income, employment, health insurance, regular source of care, and contextual factors like the distribution of healthcare facilities, personnel, and health policies, contribute to utilization. Need factors involve individual characteristics such as the perceived need for health services and professional evaluations, as well as contextual factors like morbidity, mortality, and disability rates, which impact the decision to utilize health services. However, it is important to acknowledge that the model has faced criticism for its limited

consideration of cultural factors and social interactions (Guendelman, 1991; Portes et al., 1992). Despite the aforementioned limitation, Andersen's Behavioral Model serves as a valuable tool for comprehensively assessing the multiple layers of influence on health services utilization, including PrEP utilization (Bazzi et al., 2019; Li et al., 2019), among SMM, globally and in Taiwan, by considering predisposing, enabling, and need factors at both individual and contextual levels. It offers insights into the complex interplay of factors that shape healthcare behaviors and provides a framework for understanding the broader context of healthcare decision-making.

To further capture the experiences of SMM, three additional theories are incorporated: Syndemics Theory, Minority Stress Theory, and Social Safety Theory. Syndemics Theory explores the co-occurrence of health conditions within marginalized populations and has the potential to help understand the multiple health challenges faced by SMM (Singer, 1994; Singer et al., 2017). However, the lack of consensus on its definition and its focus primarily on individual-level factors limit its application (Mendenhall & Singer, 2020; Ouafik et al., 2022; Sangaramoorthy & Benton, 2022). Minority Stress Theory examines the unique stressors experienced by minority individuals, such as stigma and discrimination, and has the potential to shed light on the impact of these factors on the health and well-being of SMM (Frost & Meyer, 2023; Meyer, 1995, 2003). Nevertheless, it has been criticized for potentially neglecting resilience, social connections, and intersectionality (Diamond & Alley, 2022; Williams et al., 2020). Social Safety Theory recognizes the importance of safety and social connections for overall well-being (Slavich, 2020, 2022; Slavich et al., 2023), and has the potential to inform our understanding of the social determinants affecting SMM. However, caution is required in evaluating this theory due to its novelty and limited application to specific populations and

contexts. Despite these limitations and critiques, these theories contribute to the multi-theory approach by providing valuable insights into the specific experiences and challenges of SMM. Together, they enhance the comprehensiveness and depth of the study, enabling a more holistic understanding of PrEP utilization, among SMM globally and in Taiwan, and facilitating the development of tailored interventions and policies.

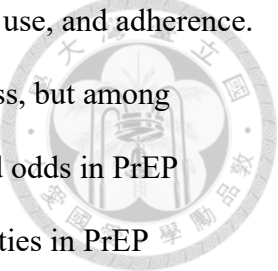
By integrating these additional theories, the study expands the scope of analysis beyond demographic and sexual behavior predictors, acknowledging the complex interplay of additional individual and contextual factors in shaping PrEP utilization. This multi-theory approach goes beyond a singular perspective, providing a broader understanding of the research problem and facilitating the development of targeted interventions and policies. The combined strengths of these theories offer valuable insights into the nuanced experiences of SMM, thereby enhancing our ability to address their specific needs and challenges. By integrating multiple theoretical frameworks, the study aims to advance the field of PrEP utilization research and contribute to the improvement of HIV prevention efforts among sexual minority men in Taiwan.

The Role of Predisposing Factors

PrEP utilization among SMM is associated with individual and contextual characteristics that shape behavior and health service utilization, known as predisposing factors (Andersen, 1995; Andersen & Davidson, 2007). Our study specifically examines two important subsets of predisposing factors: sociodemographic characteristics and identity-related attributes.

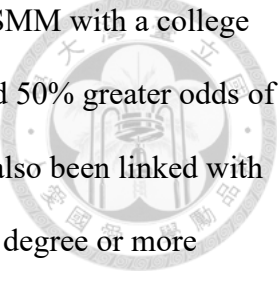
Sociodemographic Characteristics

Sociodemographic characteristics are key factors in PrEP utilization among SMM. By examining variables such as age, education, relationship status, and sexual orientation, we can uncover their association with PrEP utilization and identify barriers or facilitators to access.



Age, for example, is associated with PrEP awareness, willingness to use, and adherence. Among Latino SMM, in the US, age was inversely related to PrEP awareness, but among primarily Black SMM, a decrease in age was associated with 13% increased odds in PrEP awareness (García & Harris, 2017; Garnett et al., 2018). Age-related disparities in PrEP awareness and willingness to pay have been observed internationally, with SMM aged 50 and above having 56% and 20% lower odds of awareness and willingness to self-pay in Canada, respectively, than their peers aged 30 to younger (J. Morgan et al., 2018). Additionally, in China, SMM aged 45 years and older had two times greater odds of willingness to use PrEP than those aged 18 to 24 (Ding et al., 2016). With regards to the use of PrEP, SMM aged 18 to 39 in the US had approximately two times higher odds of current PrEP use compared to those aged 40 years and older (Kota et al., 2021). Similarly, in primarily SMM populations abroad, individuals aged over 26 years old, compared to their peers aged 18 to 25, in Thailand had approximately two-fold higher odds of PrEP adherence, while individuals aged 25 to 34, compared to those aged 18 to 24, in Brazil, demonstrated 51% lower odds of PrEP adherence compared to older individuals (Grinsztejn et al., 2018; Holtz et al., 2019). In conjunction with age, educational attainment has demonstrated associations with PrEP utilization.

Research has found associations between the highest level of education an individual has completed and their utilization of PrEP. For example, greater levels of education attainment were associated with current PrEP use among Latino SMM in the US (García & Harris, 2017). Similarly, SMM in Canada with some university education or more had 50% or greater odds of PrEP awareness than their counterparts with less than a high school education (J. Morgan et al., 2018). Another study from the US found primarily Black SMM with more than a high school education had 70% higher odds of willingness to use PrEP than those with less than a high



school education (Garnett et al., 2018). Conversely, in China, compared to SMM with a college education or more, those with a senior middle school education or lower had 50% greater odds of willingness to use PrEP (Zhang et al., 2013). PrEP use and adherence have also been linked with education attainment. Specifically, SMM in the US with a four-year college degree or more exhibited two times or higher odds of current PrEP use compared to their peers with less than a college education (Kota et al., 2021). However, for primarily Black SMM each additional educational level completed was associated with a 45% decrease (Eaton et al., 2017). Other international findings revealed that a primarily SMM population from Brazil with at least 12 years of schooling demonstrated 2.48 times higher odds of PrEP adherence than those with less than 12 years of schooling, and in Thailand, having a college education or more was associated with 62% higher odds of PrEP adherence compared to not having a college education (Grinsztejn et al., 2018; Holtz et al., 2019). In addition to educational attainment, relationship status is another important factor to consider with PrEP utilization.

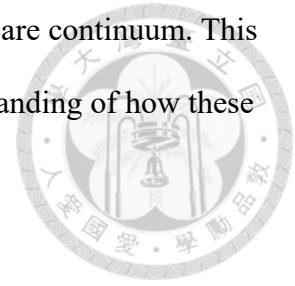
People may have different relationship statuses, such as being single or in a relationship, which can vary in terms of openness or exclusivity, and these factors are linked to PrEP utilization. To illustrate, in the US, compared to their single counterparts, primarily Black SMM in a monogamous relationship had a 39% increased odds of PrEP awareness (Eaton et al., 2017). Another group of SMM from the US cited committed relationships as the primary reason for not initiating or discontinuing PrEP use (Kota et al., 2021). Similarly, for SMM in the US, being in an open relationship was associated with higher partner encouragement for PrEP (John et al., 2018). In a different context, SMM in Canada who reported being single or in an open relationship had a higher interest in taking PrEP compared to those not in a relationship (Lachowsky et al., 2019). Likewise, having a steady partner, compared to not having a steady

partner, was associated with 64% lower odds of adhering to PrEP among a primarily SMM population in Brazil (Grinsztejn et al., 2018). Examining different relationship statuses is crucial for understanding PrEP utilization, just as understanding one's sexual orientation is important.

SMM encompass diverse sexual orientations, resulting in varied life experiences, and consequently, variations in PrEP utilization have been documented. For example, bisexual and other non-gay identified SMM in the US had 70 to 80% lower odds of PrEP awareness than gay-identified SMM (Hammack et al., 2018). Moreover, gay and questioning individuals in primarily Black SMM populations had 2.46 to 2.86 times higher odds of awareness compared to their heterosexual peers (Garnett et al., 2018). Similar findings from Canada discovered, compared to gay individuals, bisexual and other sexual orientation groups had 53% and 38% lower odds of awareness, and 20% and 44% lower odds of interest in PrEP, respectively (J. Morgan et al., 2018). In Taiwan, SMM-identified serodiscordant couples had 4.28 times higher odds of willingness to use PrEP than both heterosexuals and people who inject drugs couples (Ko et al., 2018). Sexual orientation has also been related to PrEP adherence. Among primarily SMM populations in the US, non-gay identified individuals had 60 to 70% lower odds of PrEP adherence than their gay-identified counterparts (Shover et al., 2018). However, gay-identified individuals in Australia had 30% and 43% lower odds of adherence compared to bisexual and other groups, respectively (Jin et al., 2021). To capture a comprehensive understanding of PrEP utilization, it is crucial to consider sexual orientation in addition to the variables of age, educational attainment, and relationship status.

Overall, sociodemographic characteristics, including age, education, relationship status, and sexual orientation, are significant factors linked to PrEP utilization among SMM. However, despite extensive investigation, the findings regarding the specific nature of these relationships

are mixed and inconsistent, varying across studies and stages of the PrEP care continuum. This complexity highlights the need for further research to gain a better understanding of how these factors contribute to PrEP utilization among diverse populations of SMM.

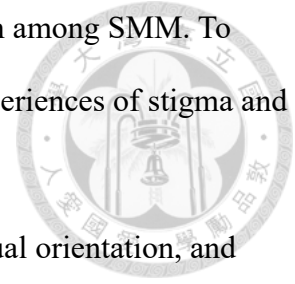


Identity-Related Attributes

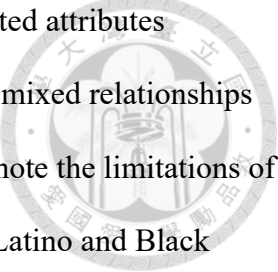
Identity-related factors are important in understanding PrEP utilization among SMM, alongside sociodemographic characteristics. Variables including sexual orientation discrimination, anticipated stigma, internalized homophobia, and sexual identity affirmation are examined to explore their relationship with PrEP utilization.

Previous research has indicated that experiences of stigma and discrimination, including both real-life instances and anticipated or expected instances, are associated with the utilization of PrEP. To illustrate, experiencing more indirect HIV stigma among SMM in Taiwan was linked to a two-fold increase in PrEP acceptability than experiencing less stigma (Chuang & Newman, 2018). Similarly, experiencing higher levels of community homophobia among SMM in China was linked to a 2.74 times higher likelihood of being willing to use PrEP compared to SMM who reported lower levels of homophobia (Zhang et al., 2023). However, the relationship becomes more intricate when considering the role of anticipated future HIV stigma. Compared to experiencing lower levels of future HIV stigma, perceiving more stigma was associated with a 3.65 times higher probability of intending to adhere to PrEP, yet expressing higher levels of community homophobia was associated with a 57% lower likelihood of intending to achieve PrEP adherence than reporting lower levels of homophobia (Zhang et al., 2023). In the US context, anticipated stigma and homophobia have consistently emerged as barriers to PrEP use among Black and Latino SMM, revealed via qualitative investigations (Brooks et al., 2019; Hanna-Walker et al., 2023). These interviews underscore the importance of addressing stigma

and discrimination related to sexual orientation to promote PrEP utilization among SMM. To fully understand PrEP utilization, it is crucial to consider both external experiences of stigma and discrimination, as well as internalized stigma.



Internalized homophobia, or the negative attitudes about one's sexual orientation, and identity affirmation, which involves a positive acceptance of one's sexual orientation, are identity-related factors that play a significant role in influencing PrEP utilization among SMM. In the US, being aware that others knew about their sexual orientation increased the odds of PrEP awareness by 18% among a primarily Black SMM population compared to those who were not aware, and higher levels of internalized homophobia were associated with a 48% higher odds of current PrEP use compared to lower levels of homophobia (Eaton et al., 2017). Another study of SMM couples in the US revealed that experiencing more internalized homophobia made it more challenging to discuss PrEP with one's partner than facing less homophobia (Stephenson et al., 2022). Similarly, Black SMM who reported high levels of internalized and anticipated stigma had 68% and 63% lower odds of accepting PrEP and using it, respectively, than those who expressed lower levels (Turpin et al., 2022). While there is substantial research examining the influence of internalized homophobia on PrEP utilization, there lacks a body of research exploring the role of identity affirmation concerning PrEP use. Limited research on identity affirmation showed that greater affirmation was linked to less awareness of post-exposure prophylaxis (PEP) among Latino SMM (Weinstein et al., 2022). Additionally, among bisexual men in the US, lower affirmation was associated with less unprotected sex (Feinstein et al., 2021). By holistically understanding identity-related factors, including internalized homophobia, identity affirmation, and those related to stigma and discrimination, a comprehensive understanding of PrEP utilization among SMM can be obtained.



Collectively, the findings highlight the need to examine identity-related attributes concerning PrEP utilization among SMM. Specifically, the findings present mixed relationships depending on specific stages of the PrEP care continuum. It is important to note the limitations of the existing studies, which primarily focus on US populations, specifically Latino and Black SMM, and predominantly explore negative factors such as stigma and discrimination, while neglecting positive aspects like affirmation. Further research is needed to deepen our understanding of how these factors contribute to the utilization of PrEP among diverse populations of SMM, highlighting the complexity and importance of studying their influence on HIV prevention efforts.

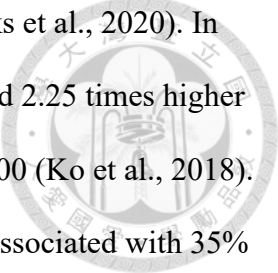
The Role of Enabling Factors

PrEP utilization among SMM is associated with facilitating or hindering access to and utilization of healthcare services, known as enabling factors (Andersen, 1995; Andersen & Davidson, 2007). Our study specifically examines three important subsets of enabling factors: socioeconomic status, awareness and utilization of HIV prevention services, and social support networks.

Socioeconomic Status

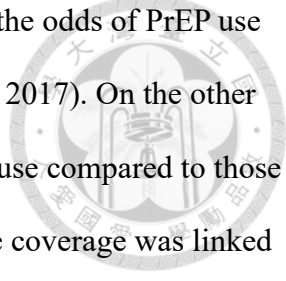
PrEP utilization among SMM is associated with socioeconomic factors, including employment, income, health insurance, residence, and nativity, which can act as either barriers or facilitators to access. Exploring the relationship between these variables and PrEP utilization helps to understand their impact and identify strategies for improving access to PrEP.

Investigations focusing on employment status and income have consistently demonstrated their significant association with PrEP utilization among diverse populations. Compared to Latino SMM in the US with an income of USD\$15,000 or less, individuals earning



from USD\$15,001 to 30,000 had 61% lower odds of accepting PrEP (Brooks et al., 2020). In Taiwan, serodiscordant couples earning NTD\$30,000 or more per month had 2.25 times higher odds of being willing to use PrEP than couples earning less than NTD\$30,000 (Ko et al., 2018). Furthermore, another study from Taiwan found full-time employment was associated with 35% higher odds of willingness to use PrEP compared to other forms of employment among a primarily SMM population (Lee et al., 2017). Comparably, the relationships between employment, income status, and PrEP use have exhibited mixed findings. Among SMM populations, unemployed individuals in England had 65% lower odds of initiating PrEP than their employed peers (Hanum et al., 2020). Additionally, individuals in the US with an annual income of USD\$30,000 or more had 4.13 times higher odds of current PrEP than those earning less than USD\$10,000 (Holloway et al., 2017). SMM in Canada with an income of CAD\$40,000 or more, compared to individuals earning less than CAD\$19,999, had 43% to 107% increased odds of past 6-month PrEP use (J. Morgan et al., 2018). Regarding PrEP adherence, it is important to note that employed SMM in the US had 69% higher odds of adhering to PrEP than their unemployed counterparts (Mannheimer et al., 2019). Although among SMM in China, students had 84% greater odds of poor PrEP adherence compared to the employed (Liu et al., 2021). Health insurance coverage, along with economic factors like employment status and income, is associated with PrEP utilization.

Health insurance coverage, which refers to the ability to pay for healthcare services, has been identified as a factor linked to PrEP utilization among SMM. For example, SMM with prescription insurance in Canada showed greater interest in taking PrEP compared to those without insurance (Lachowsky et al., 2019). Most studies centered on health insurance coverage have primarily focused on the US, given the specificities of its healthcare system. Notably,

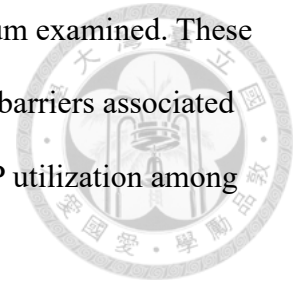


having current health insurance was associated with a two-fold increase in the odds of PrEP use in the past 6 months among SMM than not having insurance (Okafor et al., 2017). On the other hand, SMM without health insurance had 70% lower odds of current PrEP use compared to those with private insurance (Kota et al., 2021). Moreover, inconsistent insurance coverage was linked to higher non-adherence to PrEP among gay men compared to consistent coverage (Dai & Calabrese, 2022). In addition to health insurance coverage, the place of residence and place of origin are important factors to consider with PrEP utilization.

The urban or rural nature of one's place of residence and their nativity status have documented associations with PrEP utilization. In the US, SMM living in rural areas had 74% lower odds of being familiar with PrEP compared to their peers who lived in cities (Hammack et al., 2018). Among SMM couples in the US, each increase in the quartile of rurality was associated with a 30% decrease in the likelihood of using PrEP, both currently and over one's lifetime (Sarno et al., 2021). Similarly, in Canada, SMM in non-urban areas had 13% to 27% lower odds of PrEP awareness compared to those in urban areas (J. Morgan et al., 2018). Regarding nativity status, Latino SMM with undocumented status had 81% lower odds of perceiving PrEP as accessible compared to counterparts with legal residency (Brooks et al., 2020). Yet in China, SMM who were not originally from the local area had 69% higher odds of being willing to use PrEP than local SMM (Ding et al., 2016). Examining geographic factors, along with economic and health coverage factors, contributes to a comprehensive understanding of the factors linked to PrEP utilization among SMM.

Socioeconomic factors, encompassing employment, income, health insurance coverage, urban residence, and nativity, collectively serve as enabling factors influencing the access and utilization of PrEP among SMM. However, the relationship between these factors and PrEP

utilization varies depending on the specific stage of the PrEP care continuum examined. These findings underscore the significance of addressing structural and systemic barriers associated with socioeconomic status to promote equitable access and maximize PrEP utilization among SMM.

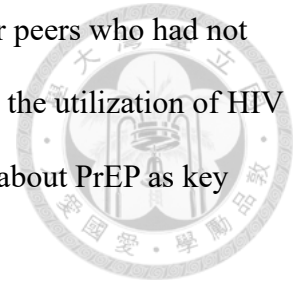


Awareness and Utilization of HIV Prevention Services

HIV prevention services, such as HIV and sexually transmitted infections (STI) testing, prior PEP use, and awareness and knowledge about PrEP, are vital considerations with PrEP utilization. These services have a substantial relationship with access to and utilization of PrEP, making them important elements to explore within the context of HIV prevention efforts.

The decision and frequency of undergoing testing for HIV and STIs are associated with PrEP utilization. In a primarily Black SMM population in the US, individuals who had undergone HIV testing in the past year had higher odds of PrEP awareness, with those who had at least one test having 1.76 times higher odds and those with two or more tests having 3.18 times higher odds (Garnett et al., 2018). Internationally, testing for HIV in the past 12 months or past three months was associated with 32% to 33% higher odds of willingness to use PrEP among primarily SMM populations in Taiwan and Turkiye, respectively, compared to those who had not tested (Lee et al., 2017; Nazli et al., 2022). Testing behaviors have shown a significant association with PrEP utilization. For instance, compared to those who had not tested, among SMM in England, individuals who tested for HIV in the past 12 months had 5.17 times higher odds of initiating PrEP, while those who tested in the past three months had 2.73 times higher odds of PrEP use within the past 12 months (Hanum et al., 2020). The utilization of non-occupational PEP (nPEP), which refers to PEP used for non-occupational reasons, has also been associated with PrEP utilization. Among SMM in Taiwan, individuals who previously used nPEP

had 3.02 and 6.98 times higher odds of being willing to use PrEP than their peers who had not used nPEP (Ko et al., 2016; H.-J. Wu et al., 2021). In addition to exploring the utilization of HIV prevention services, it is crucial to examine the awareness and knowledge about PrEP as key factors in understanding PrEP utilization.



Awareness and knowledge about PrEP are significant factors that can either hinder or enhance PrEP utilization. For example, among SMM, perceiving PrEP as highly effective was associated with a 2.65 increase in the odds of intending to take PrEP in the US than lower perceptions of efficacy (Kahle et al., 2018; Rendina et al., 2017). Moreover, among SMM in Canada, perceiving PrEP as highly effective was linked with a greater interest in taking PrEP (Lachowsky et al., 2019). Moreover, the amount and source of information about PrEP are also linked to its utilization. SMM from the US cited a lack of knowledge about accessing PrEP and doctor recommendations as reasons for non-use (Kota et al., 2021). In a different study of SMM in the US, each unit increase in PrEP knowledge was associated with 8% higher odds of initiating PrEP, while hearing about PrEP from a primary care physician was linked to 16.34 times greater odds compared to hearing about it from social media (Algarin et al., 2019). With regards to PrEP adherence, for each unit increase in PrEP knowledge, gay men in the US had 41% lower odds of non-adherence behavior (Dai & Calabrese, 2022). Comparable trends have been documented in Taiwan. Among primarily SMM populations knowing about PrEP was associated with 50% higher odds of willingness to use compared to not knowing about PrEP (Lee et al., 2017). Conversely, a higher positive attitude about PrEP was linked to a three-fold increase in odds of willingness to use it than SMM with lower positive attitude (Ko et al., 2016). Therefore, investigating an individual's awareness and knowledge about PrEP, especially when

considered alongside their utilization of other HIV-related services, provides valuable context for understanding PrEP utilization.

In summary, prior research emphasizes the significance of assessing awareness and utilization of HIV prevention services, including HIV and STI testing, PEP, and PrEP. Existing studies conducted in diverse settings consistently demonstrate that greater awareness and utilization of these services are linked to increased PrEP utilization among SMM. Therefore, it is crucial to further explore the interplay of these factors with other enabling factors related to PrEP utilization.

Social Support Networks

Existing research has identified a correlation between social support networks, encompassing one's family and local community, and PrEP utilization among SMM. This study specifically investigates the support received from family and community regarding sexual orientation, as well as the influence of dating app usage on PrEP utilization.

The presence of both positive and negative support from family and community regarding one's sexual orientation as an SMM has been linked to PrEP utilization. In a primarily SMM global sample, each additional LGBTQ social group reported was associated with a 4% increase in the probability of initiating PrEP and achieving adherence, and individuals who disclosed their study participation to their parents had a 7% higher likelihood of choosing to take PrEP than those who did not disclose their study participation (Mehrotra et al., 2018). Examining the experiences of SMM in the US revealed that for each additional unit increase in community connectedness score, individuals had 2.27 times higher odds of having a positive attitude towards PrEP (Hammack et al., 2018). Moreover, SMM in the US who had a parental figure as one of their trusted individuals had 3.51 times higher odds of currently using PrEP than their peers

without a parental figure (Chen et al., 2019). Surprisingly, in Kenya, SMM excluded by their family had 35% greater odds of PrEP acceptability compared to those who were not excluded (Ogunbajo et al., 2019). In Australia, a study focusing on a primarily SMM population revealed that individuals living in areas with a lower concentration of gay male residents had 2% to 18% lower odds of PrEP adherence compared to those residing in areas with a higher concentration (Jin et al., 2021). In addition to examining social support from families and communities, it is important to consider the role of other forms of social support on PrEP utilization among SMM.

Given the widespread use of dating apps to meet new people, examining how social connections with individuals met through this method relate to PrEP utilization is important. In Kenya, SMM who utilized dating apps had 2.58 times higher odds of being aware of PrEP than those who did not use dating apps (Ogunbajo et al., 2021). Additionally, in the US, SMM who engaged with these apps had 2.90 times higher odds of actively using PrEP compared to those who did not (Gibson et al., 2022). Moreover, SMM who actively used Grindr, a dating app geared towards SMM, within the past seven days had a 61% higher likelihood of initiating PrEP than peers who were not active users (Hoenigl et al., 2020). Furthermore, SMM who sought sexual partners online or were aware of their sexual partners' HIV status had approximately two-fold higher odds of previous PrEP use compared to those who did not (Anand et al., 2017). With the increased availability of online platforms to meet sexual partners, it becomes important to engage in conversations about HIV status and prevention measures. For instance, one study from the US found 52% of SMM expressed that they were more likely to reach out to someone who disclosed being HIV-negative versus someone who did not disclose, and 47% indicated a higher chance of contacting individuals who were on PrEP versus individuals not on PrEP (Medina et al., 2019). Moreover, SMM who were aware of dating app profile options to share sexual health

information had a 1.16 times higher prevalence of PrEP use in the past 12 months than their unaware counterparts (Hecht et al., 2022). Among Black SMM, those who talked to someone they trust about avoiding HIV infection had 2.26 times higher odds of PrEP awareness compared to those who did not (Chen et al., 2019). Therefore, exploring the role of potential partners who met on dating apps and the presence of conversations about HIV can provide valuable insights into PrEP utilization, particularly when examined in conjunction with other forms of social support networks.

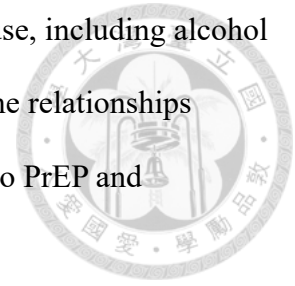
The findings underscore the importance of examining social support networks in understanding PrEP utilization among SMM and its impact on HIV prevention efforts. However, the relationships between social support and PrEP utilization are complex and vary across different stages of the PrEP care continuum and individuals' perceptions of their support networks. It is worth noting that existing studies have focused primarily on US populations, particularly Black SMM. Further research is necessary to enhance our understanding of how these factors contribute to PrEP utilization among diverse populations of SMM, highlighting the need to explore their influence on HIV prevention efforts.

The Role of Need Factors

PrEP utilization among SMM is associated with factors that encompass the health requirements and environmental factors that influence the utilization of healthcare services, known as need factors (Andersen, 1995; Andersen & Davidson, 2007). Our study specifically examines two important subsets of need factors: substance use in recreational and sexual contexts, as well as sexual health and psychological well-being.

Substance Use in Recreational and Sexual Contexts

The utilization of PrEP among SMM is associated with substance use, including alcohol and illicit substances, in recreational and sexual contexts. Understanding the relationships between these factors and PrEP utilization is crucial for enhancing access to PrEP and developing effective strategies.



Research findings on the relationship between substance use and PrEP utilization have demonstrated both hindering and facilitating effects, highlighting the need for a nuanced understanding of these dynamics in different contexts. For example, in the US, compared to non-heavy alcohol use, heavy alcohol use was associated with 39% lower odds of PrEP awareness among Black SMM and a 30% decrease in the odds of current PrEP use among SMM (Garnett et al., 2018; Shover et al., 2018). In a primarily SMM population in Thailand, similar findings were observed, with moderate and heavy alcohol use associated with approximately two times higher odds of PrEP adherence compared to low alcohol use, while stimulant use was associated with a 53% decreased odds of adherence compared to no stimulant use (Holtz et al., 2019). However, contrasting results were found among a primarily SMM population from Brazil, where stimulant users reported a two-fold increase in the odds of PrEP adherence compared to their peers who did not use stimulants (Grinsztejn et al., 2018). On the other hand, SMM in the US who used cannabis and opiates demonstrated decreased odds of PrEP adherence by 3% and 53%, respectively compared to those who did not use substances (Mannheimer et al., 2019; E. Morgan et al., 2018). The context of substance use is important to consider, as certain substances are more commonly used in a sexual context than others, leading to unique relationships to examine.

The use of sex-related substances, such as poppers, stimulants, and gamma-hydroxybutyrate. (GHB), or erectile dysfunction drugs have been associated with increased odds of PrEP utilization among primarily SMM populations in the US and England, with odds ratios


ranging from 1.2 to 3.1 compared to those who did not use substances (Hanum et al., 2020; Shover et al., 2018). Furthermore, in the US, studies have specifically found that popper use, compared to not using poppers, a substance commonly used during sexual activity, is associated with 2.76 and 3.47 times higher odds of PrEP use among SMM (Holloway et al., 2017; Okafor et al., 2017). Similarly, in Taiwan, SMM who reported using recreational drugs before or during sexual activity had 2.57 times higher odds of willingness to use PrEP than those who did not (Lee et al., 2017). Moreover, engaging in chemsex was associated with 33% higher odds of willingness to use PrEP among SMM in Turkiye than not having chemsex (Nazli et al., 2022). In addition to evaluating substance use in general, examining its specific relevance within a sexual context is crucial for comprehending PrEP utilization.

Overall, previous research highlights the importance of considering substance use, both in recreational and sexual contexts, concerning PrEP utilization. However, the existing literature presents mixed findings and lacks conclusive evidence regarding the directionality of this relationship. Further investigations are needed to gain a better understanding of the role of substance use in PrEP utilization among SMM.

Sexual Health and Psychological Well-Being

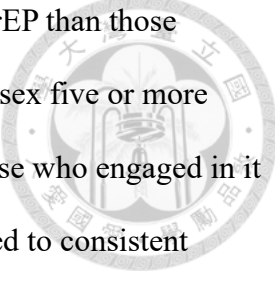
Understanding PrEP utilization among SMM involves considering factors related to sexual health, psychological well-being, and substance use. Variables such as the number of sexual partners, engaging in condomless anal sex, sexual satisfaction, experiences of sexual victimization, and levels of depression are examined to explore their associations with PrEP utilization.

Sexual health, encompassing factors such as the number of sexual partners, condomless anal sex, and sexual satisfaction, is an important consideration in understanding PrEP utilization



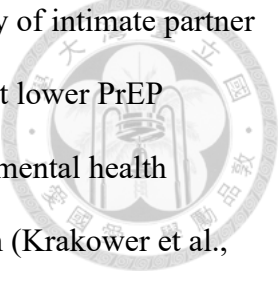
among SMM. Among Black SMM, each additional sex partner in the past month was associated with a 4% and 7% increase in PrEP awareness and use, respectively (Garnett et al., 2018; E. Morgan et al., 2018). Moreover, among another group of Black SMM, each additional female sex partner was linked to a 20% increase in the odds of current PrEP use (Eaton et al., 2017). Among Latino SMM, those who reported having six or more partners had odds that were approximately nine times higher compared to those with two or fewer partners (Brooks et al., 2020). Additionally, a study conducted in the US found that among SMM in general, having six or more anal sex partners in the past six months was associated with approximately a two-fold higher odds of past six-month PrEP use compared to having five or fewer partners (Okafor et al., 2017). Yet, In China, it was found that SMM with 11 or more male sex partners had 2.4 times higher odds of current PrEP use compared to those with one male sex partner, whereas having two female sex partners decreased the odds by 78% compared to having no female sex partners (Ding et al., 2016). In the context of sexual health, STI diagnosis has shown significant associations with PrEP use among SMM in the US, with a recent STI diagnosis being linked to a 15% higher likelihood of current PrEP use compared to no recent diagnosis (Serota et al., 2020). Similarly, SMM in the US who had a recent STI diagnosis had 2.90 times higher odds of PrEP use than their counterparts without a recent diagnosis (Holloway et al., 2017). In examining PrEP utilization, it is crucial to consider factors beyond the number of sexual partners, including the practice of condomless anal sex and the level of sexual satisfaction.

Engaging in condomless anal sex is frequently investigated in the context of PrEP utilization, yet the role of sexual satisfaction with PrEP utilization warrants further investigation. Studies conducted in Taiwan have consistently found that engaging in condomless anal sex is associated with PrEP utilization among SMM. Specifically, individuals who reported condomless



anal sex in the past 12 months had 41% higher odds of willingness to use PrEP than those without condomless anal sex, while those who engaged in condomless anal sex five or more times in the past month had 72% lower odds of using PrEP compared to those who engaged in it less frequently (Lee et al., 2017; H.-J. Wu et al., 2021). In contrast, compared to consistent condom use among SMM in China, individuals engaging in condomless anal sex were linked to a 32% decrease in the odds of willingness to use PrEP, and those who used condom occasionally were associated with a 62% higher odds of poor PrEP adherence (Ding et al., 2016; J. Liu et al., 2021). Condomless anal sex was associated with increased odds of PrEP utilization in the US and England, with approximately five times higher odds of initiating PrEP and past 12-month PrEP use among SMM engaging in condomless anal sex in the past three months, and a 75% higher odds of current PrEP use among Black SMM (Hanum et al., 2020; Serota et al., 2020). In contrast to the limited research on sexual satisfaction and PrEP utilization among SMM, studies have shown that being satisfied with one's sex life was associated with higher odds of willingness to use PrEP in Turkiye, and current PrEP users in Spain reported higher sexual satisfaction than non-users (Nazli et al., 2022; Reiriz et al., 2023). Furthermore, the initiation of PrEP among SMM in the US was linked to increased sexual satisfaction (Montgomery et al., 2021). Given the findings, it is crucial to consider various domains of sexual health when examining PrEP utilization. In addition, the psychological well-being of individuals concerning PrEP utilization is an important aspect that requires further investigation.

Psychological well-being among SMM is influenced by experiences of intimate partner victimization and depression, which are related to PrEP utilization. In Kenya, experiencing coercion during the first sexual encounter was associated with a 60% lower likelihood of PrEP acceptability, while higher levels of depression and anxiety were linked to a 48% lower



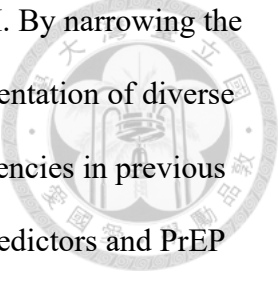
likelihood of PrEP acceptability (Ogunbajo et al., 2019). In the US, a history of intimate partner violence was associated with higher partner encouragement for PrEP use but lower PrEP utilization (Braksmajer et al., 2020; John et al., 2018). A greater number of mental health diagnoses was associated with a 20% increased risk of PrEP discontinuation (Krakower et al., 2019). Additionally, PrEP use in Spain was negatively associated with depression and anxiety (Reiriz et al., 2023). Based on prior research, psychological well-being, and sexual health factors are influential in the decision-making process of individuals when considering PrEP utilization.

The findings as a whole underscore the importance of comprehensively examining the health needs of SMM and their impact on PrEP utilization, while acknowledging the inconsistent nature of these findings across different studies, contexts, and stages of the PrEP care continuum. It is crucial to address the limitations of predominantly Western-focused studies and specific ethnic groups, such as Black SMM, and further research is needed to better understand the role of health needs with PrEP utilization among diverse populations of SMM.

The Current Study

The limitations in the existing literature on PrEP utilization among SMM necessitate a comprehensive approach to address them. The current study aims to overcome these limitations by taking a holistic view of PrEP utilization, encompassing pre-contemplation, contemplation, action and initiation, preparation, and maintenance and adherence. By investigating all stages of the PrEP care continuum, the study seeks to provide a more comprehensive understanding of the factors influencing PrEP utilization among SMM, addressing the fragmented examination of individual stages in previous research.

Furthermore, the study aims to fill the gap in the literature by focusing specifically on Taiwanese SMM. Existing studies have predominantly focused on Western populations,



neglecting the experiences of Asian populations, including Taiwanese SMM. By narrowing the focus to this population, the study will contribute to a more inclusive representation of diverse communities affected by HIV and PrEP utilization. To address the inconsistencies in previous findings, the current study will explore the relationships between various predictors and PrEP utilization as a continuum. By considering both individual and contextual factors, the study seeks to provide a more nuanced understanding of the complexities associated with PrEP utilization among SMM. This approach acknowledges the interplay between personal characteristics, social determinants, and structural factors that influence PrEP uptake and adherence.

Importantly, conducting this study in Taiwan is justified by the continued impact of HIV on Taiwanese SMM. Despite their heightened vulnerability, previous research conducted in Taiwan has focused primarily on demographic and sexual behavior characteristics, failing to capture a comprehensive range of factors relevant to PrEP utilization. By examining a wider range of individual and contextual factors, this study will fill the knowledge gap and contribute to a more comprehensive understanding of the determinants of PrEP utilization among Taiwanese SMM. The study's findings will inform the development of targeted interventions and policies that address the specific needs of this population, ultimately enhancing PrEP uptake and adherence in Taiwan.

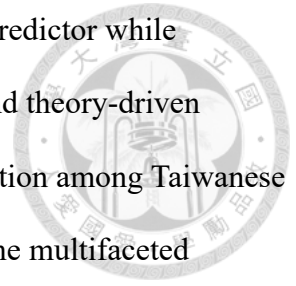
The specific aims of the study are as follows:

Aim 1: Gain a comprehensive understanding of PrEP utilization among SMM in Taiwan by examining the stages of the PrEP care continuum. This aim involves assessing key aspects of PrEP utilization, including pre-contemplation, contemplation, preparation, action and initiation, and maintenance and adherence, among the target population. By systematically evaluating these stages, we can identify existing gaps and challenges in PrEP utilization. To achieve this aim,

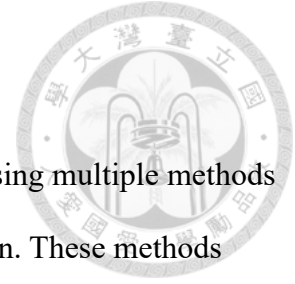
descriptive statistical analyses were employed to assess the prevalence of SMM in each of the five distinct stages of the PrEP care continuum: pre-contemplation, contemplation, action and initiation, preparation, and maintenance and adherence. These stages were carefully defined to capture the various phases of engagement with PrEP. Through this systematic evaluation, the study aimed to provide an accurate portrayal of the utilization patterns and progress within the PrEP care continuum among Taiwanese SMM.

Aim 2: Explore and integrate additional individual and contextual factors beyond demographic and sexual behavior predictors that are empirically linked with PrEP utilization among SMM in Taiwan. By considering these factors comprehensively, we aim to deepen our understanding of their relationship with PrEP utilization and inform the development of tailored strategies and policies to address the specific needs and challenges faced by the target population. To address the inconsistencies in the existing literature regarding multiple predictors of PrEP utilization among Taiwanese SMM, a data-driven approach was adopted, and specific hypotheses were not set. This approach acknowledges the variability and mixed findings reported in previous research and allows for an open and exploratory analysis. The selection of predictors was theory-driven, guided by Syndemic, Minority Stress, and Social Safety Theory, which provides a comprehensive framework for understanding the health of SMM. To explore the role of additional individual and contextual factors, univariate linear regressions were conducted, allowing for the identification of significant predictors beyond demographic and sexual behavior characteristics. Subsequently, significant predictors identified in the univariate analysis were integrated into a hierarchical multiple linear regression model. The model consisted of three blocks representing predisposing, enabling, and need factors, aligning with the Andersen Behavioral Model (Andersen, 1995; Andersen & Davidson, 2007). This analytical approach

allowed for a systematic examination of the unique contributions of each predictor while accounting for the role of other factors. By adopting this comprehensive and theory-driven approach, this study aimed to identify significant predictors of PrEP utilization among Taiwanese SMM. The findings from this analysis will enhance our understanding of the multifaceted determinants of PrEP utilization and contribute to the existing knowledge base of SMM, both globally and in Taiwan.



Chapter 2: Methods



Participants and Procedures

Participants were recruited over two months, April to May 2023, using multiple methods to ensure a diverse and geographically dispersed sample of SMM in Taiwan. These methods included snowball sampling, social media platforms (e.g., Facebook, Instagram, Dcard, Reddit), and collaboration with community-based organizations, which are effective in reaching underrepresented populations, such as SMM (Ellard-Gray et al., 2015; Iribarren et al., 2018; Topolovec-Vranic & Natarajan, 2016), including those not actively engaged in formal healthcare settings or PrEP care.

The study employed a secure online cross-sectional survey on the REDCap platform (Harris et al., 2009, 2019) for data collection. Participants had the convenience of using their electronic devices to complete the survey. The consent process involved reviewing study information and indicating consent, while preliminary questions confirmed eligibility. Attention check items were included to ensure response attentiveness. Participants completed the full survey and had the option to provide contact information separately for a chance to win NTD \$150 gift cards. Participants were eligible for the study if they met the following prespecified criteria: 1) assigned male sex at birth, 2) identified as male gender, 3) identified as gay, bisexual, pansexual, asexual, queer, or questioning, or engaged in same-sex sexual behavior, 4) self-reported as HIV-negative or unknown HIV status, 5) resided in Taiwan, and 6) were between 18 and 59 years of age. Individuals who were unable to provide consent or did not understand either English or Mandarin were excluded from the study.

Ethical measures were implemented to prioritize participant protection and welfare, including IRB approval from National Taiwan University (#202301HM001). Personally

identifiable information was minimized, and participants had the option to provide their email address separately for the raffle draw. Participant contact and payment details were securely stored in a separate REDCap database. Anonymity was ensured through unique study IDs, and participants had the right to withdraw and decline specific questions. The study provided resources for mental and sexual health support and employed culturally relevant and respectful survey measures.

Study Measures

The study utilized measures informed by Syndemics Theory, Minority Stress Theory, and Social Safety Theory (Frost & Meyer, 2023; Meyer, 1995, 2003; Singer, 1994; Singer et al., 2017; Slavich, 2016, 2020, 2022). In the context of this thesis study, measures are categorized following Andersen's Behavioral Model of Health Service Utilization (Andersen, 1995; Andersen & Davidson, 2007). While measures may be associated with multiple types of factors, for this study, they are primarily categorized based on past research findings to align with the relevant factors often considered for populations of SMM. Overall, these measures were selected to investigate the individual and contextual determinants of PrEP utilization among SMM in Taiwan. The online survey included a comprehensive set of self-report measures covering predisposing, enabling, and need factors.

The measures for the study were carefully translated to ensure appropriateness for the target population. Bilingual Mandarin-English speakers, who were also SMM in Taiwan, conducted the initial translation (Tsai et al., 2018). The translations were then reviewed by a small group from the study population to enhance cultural relevance (Cha et al., 2007). Existing Mandarin-translated measures and measures from source articles were also incorporated when

possible. This collaborative approach ensured that the measures accurately captured the constructs of interest and were culturally appropriate for SMM in Taiwan.



Predisposing Factors

Age. Participants reported their age in years, which was categorized into three groups for analysis: “30 years or less,” “31-40 years,” and “41 years or older.”

Educational attainment. Participants’ educational attainment was assessed by asking about their highest level of education completed. Response options included: no education, elementary school, junior high school, high school/vocational school, associate degree, bachelor’s degree, master’s degree, or doctoral degree. For analysis, responses were grouped into three categories: “high school or less,” “college degree,” and “postgraduate degree.” Participants were also asked about their current student status (“yes” or “no”).

Relationship status. Participants indicated their current relationship status using adapted response options based on a previous study (Harrison et al., 2022). Response options included: single, non-romantic sexual relationship, casual dating, exclusively dating, open marriage/civil union/domestic partnership, or closed marriage/civil union/domestic partnership. For analysis, responses were grouped into three categories: “single or non-romantic relationship,” “open relationship,” and “closed relationship.”

Sexual orientation. Participants indicated their current sexual orientation with response options including straight/heterosexual, gay/homosexual, bisexual, pansexual, asexual, queer, and unsure/questioning/exploring. For analysis, the responses were grouped into two categories: “gay” and “other sexual identity.”

Sexual orientation discrimination. The present study utilized the Everyday Discrimination Scale – Short Version (EDS-SV; Sternthal et al., 2011) to measure perceived

discrimination based on sexual orientation, such as “being treated with less courtesy or respect.” Participants rated these experiences on a 5-point response scale ranging from 1 (*never*) to 5 (*almost everyday*). The total score on the scale ranges from 5 to 25, with higher scores indicating a higher frequency of sexual orientation discrimination. The study excluded an item assessing the perceived reason for discrimination to specifically focus on sexual orientation-related discrimination. The EDS-SV has demonstrated validity and reliability in various populations, including Mandarin-speaking and SMM samples (Bi et al., 2022; Cook et al., 2022). In this study, the scale exhibited good internal consistency ($\alpha = 0.86$).

Expectation of rejection. The 3-item Acceptance Concerns subscale of the Lesbian, Gay, and Bisexual Identity Scale (LGBIS; Mohr & Kendra, 2011) expectations of rejection based on their sexual minority status, capturing concerns about being judged and the impact of their sexual orientation on others’ perceptions. One of the items in the Acceptance Concerns subscale is: “I often wonder whether others judge me for my sexual orientation.” Participants rated each item on a 6-point scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). The composite score on the subscale, derived from the mean of the three items, ranged from 1 to 6, with higher scores indicating greater expectations of rejection based on sexual minority status. The scale has been translated and validated with Mandarin-speaking SMM populations in China and Taiwan (Y. Liu, 2015; S. Sun et al., 2020, 2021), demonstrating its relevance and applicability. The subscale exhibited good internal consistency ($\alpha = 0.89$), indicating reliability.

Internalized homophobia. The 3-item Internalized Homonegativity subscale of the LGBIS (Mohr & Kendra, 2011) assessed participants’ self-stigma towards their sexual minority status. One sample item from this subscale is: “I wish I were heterosexual.” Participants rated each item on a 6-point scale from 1 (*strongly disagree*) to 6 (*strongly agree*). The composite

score, derived from the mean of the three items, ranged from 1 to 6, with higher scores indicating higher levels of internalized homophobia. The scale has been previously translated and validated with Mandarin-speaking SMM populations in China and Taiwan (Y. Liu, 2015; S. Sun et al., 2020, 2021), indicating its relevance and suitability. The subscale exhibited excellent internal consistency ($\alpha = 0.93$), demonstrating high reliability.

Identity affirmation. The 3-item Identity Affirmation subscale of the LGBIS (Mohr & Kendra, 2011) was used in this study to measure participants' affirmation of their sexual minority status. One sample item from this subscale is: "I'm glad to be an SMM person." Participants rated their agreement with each item on a 6-point scale from 1 (*strongly disagree*) to 6 (*strongly agree*). The composite score, derived from the mean of the three items, ranged from 1 to 6, with higher scores indicating greater levels of identity affirmation. The subscale has been validated and translated for use in Chinese-speaking SMM populations in China and Taiwan (Y. Liu, 2015; S. Sun et al., 2020, 2021), establishing its relevance to this study. The subscale demonstrated satisfactory internal consistency ($\alpha = 0.84$), indicating reliable measurement.

Enabling Factors

Current Employment. Participants provided information on their employment status, choosing from options such as full-time, part-time, self-employed, temporary worker, unemployed, retired, unable to work, or looking after home or family. Responses were categorized into "full-time employment," "part-time employment," and "unemployed."

Income status. Participants reported their monthly income range in NTD. The income responses were grouped into three categories: "\$30,000 or less," "\$30,000 to \$69,999," and "\$70,000 or more," for data analysis purposes. Participants were also asked about their level of concerns or stress regarding meeting essential expenses in the past 6 months, using a scale from

1 (*never*) to 5 (*always*). The responses were then simplified into two categories: “no” (indicating never) and “yes” (indicating any response other than never), for ease of analysis.

Health insurance coverage. Participants were asked about their healthcare payment methods, with response options including Taiwan’s National Health Insurance (NHI), international health insurance plan, work health insurance plan, school health insurance plan, out-of-pocket, or someone else (e.g., family, partner, friends). Responses were categorized into two groups for analysis: “NHI” and “other payment methods.”

Urban resident. For participants’ residential locations in Taiwan, response options included six special municipalities (Taipei, New Taipei, Taoyuan, Taichung, Tainan, and Kaohsiung), 13 counties, and three cities. These were grouped into two categories for data analysis: urban (one of the six special municipalities) and rural (not one of the six special municipalities).

Nativity status. Participants were asked to indicate their country of birth, allowing for the classification of their nativity status into two categories: “Taiwan-born” and “foreign-born.”

Prior HIV/STI test. Participants were asked about the frequency of their visits to medical providers for HIV or STI testing. The responses were categorized into two groups for data analysis: “never” and “once or more.”

Prior PEP use. Participants were asked if they had used nPEP in the last 12 months. The responses were grouped into two categories for analysis: “no” (indicating never) and “yes” (indicating once or more).

PrEP familiarity. Using a question from the PrEP care continuum (Parsons et al., 2017; Y. Wu et al., 2019), participants indicated their familiarity with PrEP on a scale of 1 to 5, ranging

from “never heard of it” (1) to “knowing a lot about it” (5). Responses were categorized into three groups: “well-informed,” “moderately informed,” and “unaware/uninformed.”

Perceived PrEP efficacy. Participants were asked about their perception of PrEP’s effectiveness in preventing HIV using a question from the PrEP care continuum (Parsons et al., 2017; Y. Wu et al., 2019). Response options were grouped into two categories for data analysis: “accurate” (indicating more than 90% effective) and “inaccurate/unsure” (indicating any response other than more than 90% effective).

Know a formal PrEP source. Participants were asked if they knew where to obtain PrEP, and those who responded affirmatively were further asked about their preferred sources, which included medical services (CDC-funded or self-funded), clinical trials/research studies, online orders, obtaining from friends, or informal sources such as dealers or sex parties. The responses were then categorized into formal (medical services and clinical trials) and informal (other sources) for data analysis.

Family support. The adapted 3-item Family Support subscale of Liu’s (2015) LGBIS was used to assess participants’ perceptions of family support regarding their sexual minority status (Mohr & Kendra, 2011). Participants indicated their level of agreement on a 6-point scale for items such as: “I believe that my parents love me regardless of my sexual orientation.” The subscale was averaged to yield a mean score ranging from 1 (*strongly disagree*) to 6 (*strongly agree*), with higher scores indicating greater perceived family support. The subscale demonstrated satisfactory internal consistency ($\alpha = 0.78$) and has been validated in Chinese-speaking SMM populations in China and Taiwan (Y. Liu, 2015; S. Sun et al., 2021).

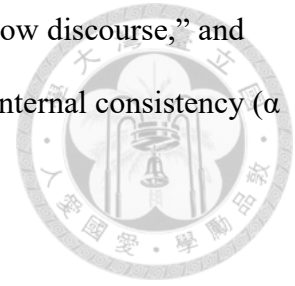
Community connectedness. The 3-item measure used in this study evaluated participants’ connection to other SMM in their community (Brenner et al., 2014). Items such as

"I feel a bond with other LGBT people" were rated on a 6-point scale. The scale was averaged to yield a mean score ranging from 1 (*strongly disagree*) to 6 (*strongly agree*), with higher scores demonstrating a stronger connection to the SMM community. The measure was translated for this study, and it demonstrated good internal consistency ($\alpha = 0.89$) and has been validated in SMM populations (Brenner et al., 2014).

Dating app use. Participants' use and behaviors on dating apps were examined using a set of questions designed based on previous research (Goedel & Duncan, 2015). They reported their use of dating apps as never, prior use, or current use. Average daily time spent on dating apps in the past month was also recorded, categorized as less than 3 hours or 3 hours or more for analysis. Reasons for app usage included making friends, seeking sex, finding dates, connecting with SMM, and entertainment. Specific dating apps used were indicated, with SMM-oriented apps (Grindr, Hornet, Surge, Scruff, Blued, Jack'd, and Growlr) grouped separately from other apps (Tinder, Bumble, TanTan) for data analysis.

HIV disclosure. Participants who reported using dating apps were asked about their attention to HIV status when viewing dating or sexual networking profiles. Response options ranged from "don't pay attention at all" to "pay extreme attention." For data analysis, participants were categorized into three groups: "don't use dating apps," "low attention," and "high attention." Participants also responded to four questions about HIV disclosure. These questions assessed the frequency of disclosing their HIV status, asking about the HIV status of sexual partners, being told about the HIV status of sexual partners, and being asked about their HIV status by sexual partners. Response options ranged from 1 (*never pay attention*) to 5 (*pay extreme attention*). The four items were averaged to calculate a mean score of HIV discourse, with higher scores indicating greater engagement in HIV-related discussions. For data analysis,

participants were categorized into three groups: “don’t use dating apps,” “low discourse,” and “some discourse” or “high discourse.” The four items demonstrated good internal consistency ($\alpha = 0.90$).



Need Factors

Substance Use. The abbreviated version of the World Health Organization Alcohol, Smoking, and Substance Involvement Screening Test (WHO ASSIST Working Group, 2002) was used to assess non-medical substance use prevalence. Participants indicated if they had used 10 substances during their lifetime or the past three months, including tobacco, alcoholic beverages, cannabis, cocaine, amphetamines, inhalants, sedatives, hallucinogens, opioids, and other drugs. Response options were yes (1) or no (0) for each substance. Illicit substance use referred to using any substance, excluding alcohol and tobacco. Polysubstance use was defined as using three or more substances, excluding alcohol and tobacco. The Chinese translation of the WHO ASSIST has been validated for use in this study.

Binge drinking. Binge drinking was defined as consuming five or more drinks within two hours, reported at least once in the past three months. Participants were asked to indicate their frequency of binge drinking using five response options: never, less than monthly, every week, daily or almost daily. For data analysis purposes, participants were categorized into two groups: “Yes” indicating those who reported engaging in binge drinking (i.e., selecting any frequency option other than "never"), and “No” indicating those who reported never engaging in binge drinking.

Chemsex. Participants were asked if they had engaged in chemsex, using substances to enhance their sexual experience before or during sexual activity in the last 6 months. Response options included methamphetamine, popper or rush, GHB, ketamine, mephedrone, or none of the

above. The presence or absence of any substance use was categorized into two groups: yes (indicating the use of any substance) or no (indicating no substance use). The selection of substances aligns with the guidelines provided by the Taiwan CDC for PrEP (Yen-Hao Chu et al., 2020).



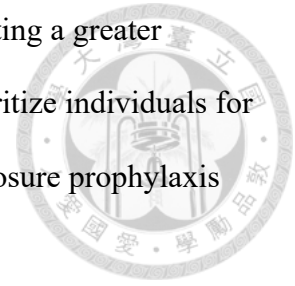
Number of sex partners. Participants provided information about the gender of their sexual partners, with options including men, women, trans men/trans males, trans women/trans females, and genderqueer/gender non-conforming/non-binary individuals. For data analysis, participants were divided into two groups based on whether they exclusively had male sex partners (yes) or had a mix of male and non-male sex partners (no). They were also asked about the number of different men they engaged with as the receptive or insertive partners during anal sex in the past month. Responses were categorized into three groups for analysis: “0 male sex partners,” “1 male sex partner,” and “2 or more male sex partners.”

Condomless anal sex. Participants were queried about their engagement in condomless anal sex. They were asked if they had engaged in condomless anal sex with a man in the past 6 months and to report the number of condomless anal sex partners for both insertive and receptive sex in the past month. Based on their responses, participants were categorized into two groups for data analysis: “Yes” indicating any condomless anal sex, and “No” indicating no instances of condomless anal sex.

STI diagnosis. Participants were queried about their STI diagnosis in the last 6 months, with response options of “yes” or “no.”

HIV risk. The HIRI-MSM is a clinical tool used to assess the HIV risk among sexual minority men (Smith et al., 2012). It takes into account factors such as age, sexual behavior, and substance use (specifically methamphetamine and/or poppers) over the past six months. The total

score on the HIRI-MSM can range from 0 to 47, with higher scores indicating a greater indication of HIV risk. A recommended cutoff score of ≥ 10 is used to prioritize individuals for intensive HIV prevention efforts, including considering the use of pre-exposure prophylaxis (PrEP).



Sexual satisfaction. The 6-item Ego-Centric subscale of the New Sexual Satisfaction Scale measures personal sexual satisfaction during recent sexual experiences (Milhausen et al., 2019). A sample item is “the quality of my orgasms” Participants rated their satisfaction on a scale ranging from 1 (*not at all*) to 5 (*extremely*). The translated measure demonstrated good reliability, with a Cronbach’s alpha coefficient of 0.88, and has been validated in SMM populations (Montgomery et al., 2021)AN. A total score ranges from 5 to 30, with higher scores on this subscale indicated higher levels of personal sexual satisfaction.

Sexual violence. Sexual violence was assessed by asking participants two questions (Siconolfi et al., 2021; Starks et al., 2016). The first question was “Have you ever been forced or frightened by someone into doing something sexually that you did not want to do?” Participants responded with either yes (1) or no (0). Participants who answered no were then asked a follow-up question: “Sometimes people’s views about their experiences change over time. Did you ever have an experience when you felt, at the time, that you were forced or frightened into doing something sexually that you did not want to do?” Participants who answered yes to either question were considered to have a lifetime history of sexual violence.

Depression. The Patient Health Questionnaire-2 (PHQ-2) was used to screen for symptoms of depression (Löwe et al., 2005). It includes two items assessing the frequency of low mood and anhedonia over the past two weeks. Each item is rated on a scale of 0 (*not at all*) to 3 (*nearly every day*). Total scores range from 0 to 6, with scores of 3 or higher indicating a positive

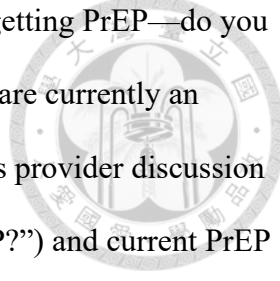
screen for depression. The PHQ-2 has been translated and validated with a Mandarin-speaking population (Z. Liu et al., 2016). In the current study, the Cronbach's alpha coefficient for the PHQ-2 was 0.93, indicating high internal consistency.



PrEP Utilization

Adapted from the Taiwan PrEP prescription guidelines (Yen-Hao Chu et al., 2020), PrEP eligibility for this study was defined as declaring one of the four following criteria: 1) at least one episode of condomless anal intercourse within the last six months, 2) an STI diagnosis in within the last six months, 3) at least one episode of chemsex within the last six months, 4) prior use of non-occupational post-exposure prophylaxis (nPEP) more than once within the last 12 months, or 5) a HIRI-MSM score ≥ 10 . Furthermore, to be deemed eligible for PrEP, participants were required to report their HIV-negative status and recent sexual activity with men within the past six months.

The Motivational PrEP Cascade, validated with a Mandarin-speaking population of SMM (Parsons et al., 2017; Y. Wu et al., 2019), is utilized to assess participants' stage of change concerning PrEP utilization. Participants' responses determined their categorization into the following stages: (1) *pre-contemplation*: unwillingness or non-identification as a PrEP candidate, (2) *contemplation*: willingness and identification as a PrEP candidate, (3) *preparation*: intention to take PrEP and identification of a provider, (4) *action and initiation*: current PrEP usage, and (5) *maintenance and adherence*: ongoing medical engagement and adherence to PrEP. Stage 1 (Pre-contemplation) includes participants meeting the PrEP criteria but not the stage 2 criteria. Stage 2 (Contemplation) assesses willingness (stage 2a: "If PrEP were available for free, would you plan to begin PrEP?") and self-identification (stage 2b: "Do you believe that you are currently an appropriate candidate for PrEP?"). Stage 3 (Preparation)



evaluates provider availability (stage 3a: “Suppose you were interested in getting PrEP—do you know where to get it?”) and intentions (stage 3b: “Do you believe that you are currently an appropriate candidate for PrEP?”). Stage 4 (Action and Initiation) examines provider discussion (stage 4a: “Have you ever spoken to a medical provider about starting PrEP?”) and current PrEP usage (stage 4b: “Have you ever used PrEP (for example, Truvada or Descovy)?”). Stage 5 (Maintenance and Adherence) measures adherence (stage 5a: “Did you take one pill of PrEP per day for at least four days, within the 7 days before you had sex?” or “Did you take two pills 2 to 24 hours before having sex, followed by another pill 24 hours, and a final pill 48 hours after?”) and frequent HIV and STI testing (stage 5b: “How regularly do you schedule visits with a medical provider to receive HIV/STI testing?”). Participants were categorized into the furthest stage along the PrEP care continuum that aligned with all the criteria they fulfilled. Thus, scores range from 1 to 5, with a higher stage signifying greater PrEP utilization, reflecting progression from unawareness or unwillingness to active usage and adherence.

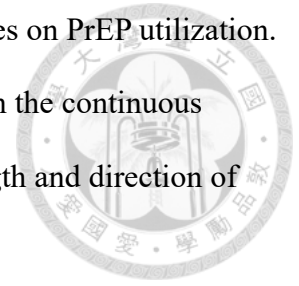
Statistical Analysis

Analyses were conducted using R (R Core Team, 2020) exclusively within the PrEP-eligible participants, providing insights specific to this population. Missing data were appropriately handled through mean imputation (for variables with less than 33% missing data) and exclusion of participants with substantial missing data.

Aim 1. Descriptive statistical analyses were employed to assess the prevalence of SMM in each of the five distinct stages of the PrEP care continuum: pre-contemplation, contemplation, action and initiation, preparation, and maintenance and adherence.

Aim 2. Group comparisons using t-test and analysis of variance (ANOVA) were conducted to examine differences in PrEP utilization based on predictor variables. These

comparisons provided insights into the potential influence of these variables on PrEP utilization. Pearson's correlations were performed to explore the relationships between the continuous predictor variables and PrEP utilization. This analysis quantified the strength and direction of these associations, shedding light on their role in PrEP utilization.



Univariate linear regression models were employed to identify significant associations between individual predictor variables and each step in the PrEP continuum. These models elucidated the factors associated with PrEP utilization among participants. Significant predictors from the univariate regression analysis were subsequently included in a multivariable hierarchical linear regression model, structured based on Andersen's Behavioral Model of Health Service Utilization (Andersen, 1995; Andersen & Davidson, 2007). This model allowed for the examination of independent effects while controlling for other relevant variables, capturing the complex interplay between different levels of factors and their relationship with PrEP utilization. The significance level was set at $p < 0.05$, indicating statistically significant associations between predictor variables and outcomes. These rigorous analytical techniques provided valuable insights into the factors linked to PrEP utilization among SMM in Taiwan, contributing to our understanding of PrEP uptake and informing future interventions and policies in HIV prevention.

Chapter 3: Results

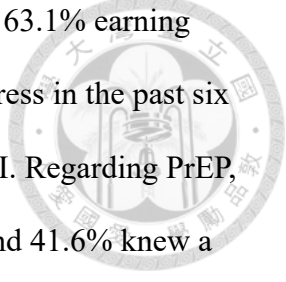
Out of the initial 874 survey respondents, 114 individuals did not complete the eligibility screener, resulting in a total of 760 participants. Among them, 181 participants were deemed ineligible for the study based on various reasons, including age (55 individuals), not identifying as male (74 individuals), not identifying as a sexual minority (56 individuals), and HIV status (71 individuals). Additionally, 127 eligible participants did not complete the full survey.

Ultimately, the final analytical sample consisted of 249 participants, which accounted for 55.1% of the 452 eligible respondents. These 249 participants met the criteria for PrEP eligibility and were included in the analysis to explore associations between variables of interest.

Sample Characteristics

The full sample characteristics ($N = 249$) are presented in Table 1 and Table 2.

Predisposing Factors. The sample had a mean age of 32.81 years ($SD = 8.75$), indicating a diverse and relatively young group. A significant proportion (78.7%) identified as gay, reflecting the predominant sexual orientation. Moreover, 73.1% were in romantic relationships, highlighting diverse partnership statuses. Regarding education, 92.0% held an associate degree or higher, suggesting a relatively high level of education. Additionally, 26.9% were current students, indicating ongoing academic pursuits. Identity affirmation was moderate ($M = 3.97$; $SD = 1.21$), while participants reported moderate levels of internalized homophobia ($M = 2.51$; $SD = 1.45$) and expectation of rejection ($M = 3.38$; $SD = 1.52$), indicating the presence of these stressors. However, participants perceived relatively low levels of sexual orientation discrimination ($M = 8.06$; $SD = 4.14$), suggesting a favorable perception of experienced discrimination.

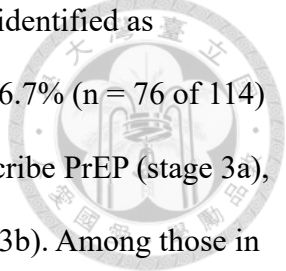


Enabling Factors. Most participants (89.2%) were employed, with 63.1% earning NTD\$30,000 or more per month. However, 81.8% experienced financial stress in the past six months. The majority (85.1%) resided in an urban area, and 90.4% had NHI. Regarding PrEP, 81.6% were familiar with the service, 51.1% knew PrEP's efficacy level, and 41.6% knew a formal PrEP provider. A minority (8.0%) never received an HIV or STI test, and 7.2% used nPEP in the past year. Dating app usage was prevalent (73.9%), primarily for making friends (65.1%) and sexual purposes (63.3%). Participants reported moderate levels of family support ($M = 3.68$, $SD = 1.36$) and community connectedness ($M = 3.65$, $SD = 1.00$), indicating moderate perceived social support.

Need Factors. The study examined various perceived and evaluated needs factors. Lifetime illicit substance use was reported by 32.2%, while 13.2% engaged in polysubstance use. Binge drinking was reported by 27.3% in the past three months. Sexual violence was experienced by 16.1% over their lifetime. In the past month, 85.6% engaged in sexual activity, with 86.7% reporting condomless anal sex in the past six months. 88.0% exclusively had male sex partners. STI diagnosis in the past six months was reported by 7.6%. Chemsex was engaged in by 18.1%. Approximately 90.4% were identified as high risk for HIV acquisition. The mean depression score was 1.68 ($SD = 1.48$), and the mean sexual satisfaction score was 21.90 ($SD = 5.39$).

Aim 1

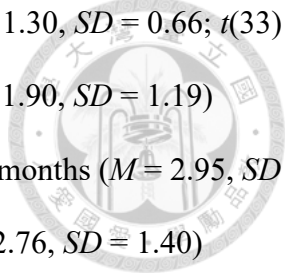
In Figure 2, the progression of eligible participants through the PrEP care continuum is depicted. Among the sample of 249 eligible PrEP participants, 45.8% ($n = 114$ of 249) were categorized in the contemplation stage (stage 2), indicating a significant drop-off at an early stage of the continuum. Within this sample, 77.5% ($n = 193$ of 249) expressed willingness to take



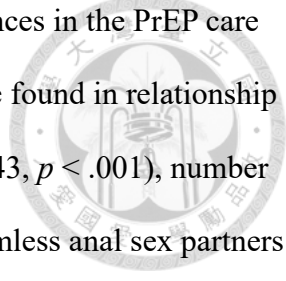
PrEP (stage 2a), while a smaller proportion of 48.2% (n = 120 of 249) self-identified as appropriate candidates for PrEP (stage 2b). Advancing along the cascade, 66.7% (n = 76 of 114) of individuals in stage 2 had healthcare providers who were willing to prescribe PrEP (stage 3a), and all participants (100%, n = 114 of 114) intended to initiate PrEP (stage 3b). Among those in stage 3, 65.8% (n = 50 of 76) engaged in discussions with medical providers regarding PrEP initiation (stage 4a), and 53.9% (n = 41 of 76) were ultimately prescribed PrEP (stage 4b). However, it is important to note that less than half (48.7%, n = 37 of 76) of those in stage 4 fulfilled both criteria, progressing to stage 5. This final stage represents individuals who have successfully initiated PrEP and are eligible for PrEP maintenance and adherence. Analyzing self-reported adherence among individuals prescribed PrEP, 75.7% (n = 28 of 37) reported consistent adherence, indicating that they took PrEP either daily or on-demand before their most recent anal sex act. However, adherence to routine HIV and STI testing every three months, as recommended, was reported by less than half (48.6%, n = 18 of 37) of those prescribed PrEP. Consequently, approximately one-third (35.1%, n = 13 of 37) of the participants met the criteria for PrEP maintenance and adherence, representing the final stage of the cascade. In summary, the PrEP care continuum demonstrates the progression of eligible participants through different stages, with significant drop-offs observed early in the continuum. While willingness to take PrEP and initiation rates were relatively high, challenges were evident in terms of adherence to routine testing and maintenance of PrEP.

Aim 2

Preliminary analysis. Significant group disparities were found for the PrEP care continuum score through independent t-tests (Table 1), indicating differences across various categorical variables. Participants who had undergone prior STI testing ($M = 2.04$, $SD = 1.27$)



differed significantly from those who had never received such testing ($M = 1.30, SD = 0.66; t(33) = -4.34, p < .001$). Additionally, individuals without an STI diagnosis ($M = 1.90, SD = 1.19$) differed significantly from those diagnosed with an STI within the past six months ($M = 2.95, SD = 1.58; t(19) = -2.83, p = .01$). Participants who engaged in chemsex ($M = 2.76, SD = 1.40$) differed significantly from those abstaining from such behaviors in the preceding six months ($M = 1.79, SD = 1.15; t(57) = 4.30, p < .001$). Participants reporting a history of sexual violence ($M = 2.45, SD = 1.40$) demonstrated a significant contrast compared to those without such a history ($M = 1.87, SD = 1.20; t(50) = 2.46, p = .017$). Significant disparities were also found in app utilization. Individuals using apps to connect with same-sex male individuals ($M = 2.48, SD = 1.33$) displayed a higher mean score relative to those not utilizing such platforms for this purpose ($M = 1.85, SD = 1.20; t(62) = 2.94, p = .005$). Similarly, participants leveraging apps for sexual purposes ($M = 2.13, SD = 1.28$) exhibited a greater mean score compared to non-users ($M = 1.69, SD = 1.15; t(202) = 2.77, p = .006$). Moreover, individuals utilizing apps geared towards SMM ($M = 1.70, SD = 1.13$) demonstrated a lower mean score in contrast to those who did not employ such platforms ($M = 2.08, SD = 1.28; t(155) = -2.31, p = .022$). Furthermore, significant disparities were evident concerning participants' knowledge and awareness of PrEP. Those accurately informed about the efficacy of PrEP ($M = 1.64, SD = 1.05$) attained a lower mean score compared to individuals lacking accurate information ($M = 2.18, SD = 1.33; t(240) = -3.58, p < .001$). Additionally, participants familiar with formal sources for PrEP ($M = 2.49, SD = 1.45$) exhibited a higher mean score relative to those unaware of such sources ($M = 1.41, SD = 0.62; t(176) = 7.72, p < .001$). These findings unveil substantial group disparities concerning the examined categorical variables, providing valuable insights into the factors linked to the PrEP care continuum.



ANOVA analyses (Table 2) were performed to assess group differences in the PrEP care continuum score based on categorical variables. Significant variations were found in relationship status ($F(2, 244) = 46.88, p = .002$), familiarity with PrEP ($F(2, 246) = 37.43, p < .001$), number of anal sex partners in the past month ($F(2, 242) = 15.19, p < .001$), condomless anal sex partners in the past six months ($F(2, 245) = 4.69, p = .01$), illicit drug use ($F(2, 245) = 8.85, p < .001$), and polysubstance use ($F(2, 245) = 4.56, p = .011$). These findings emphasize the importance of considering categorical variables when analyzing outcomes and provide insights into the group differences observed in the study.

Pearson's correlations (Table 2) were conducted to examine the relationships between continuous variables and the PrEP care continuum score. The results revealed several significant correlations. Identity affirmation was positively correlated with the PrEP care cascade ($r = 0.13, p = .049$), indicating that individuals who reported higher levels of identity affirmation were more likely to progress along the PrEP care continuum. Internalized homophobia ($r = -0.13, p = .048$), expectation of rejection ($r = -0.15, p = .016$), and sexual orientation discrimination ($r = -0.15, p = .021$) were negatively correlated with the PrEP care cascade, suggesting that higher levels of these factors were associated with lower engagement in the continuum. Additionally, community connectedness was positively correlated with the PrEP care cascade ($r = 0.18, p = .004$), indicating that individuals with stronger connections to their community were more likely to progress along the continuum.

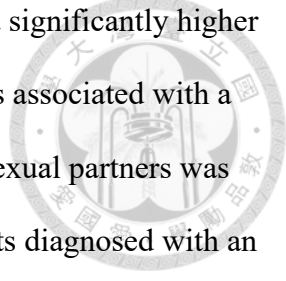
Univariate Linear Regressions. Table 3 presents the results of the univariate linear regression analysis.

Predisposing Factors. Significant associations were found for predisposing factors with the PrEP care continuum score. Participants in an open romantic relationship had a significantly

higher score ($B = 0.42, p = .009$) compared to those who were single or in a non-romantic relationship, while participants in a closed romantic relationship had a significantly lower score ($B = -0.57, p < .001$). Higher levels of identity affirmation were associated with a significantly higher score ($B = 0.13, p = 0.048$), while higher levels of internalized homophobia ($B = -0.11, p = 0.048$), expectation of rejection ($B = -0.13, p = 0.016$), and sexual orientation discrimination ($B = -0.04, p = 0.021$) were associated with lower scores. Other predisposing factors did not show significant associations with the PrEP care continuum score.

Enabling Factors. Significant associations were observed for several enabling factors. Participants employed part-time had a significantly lower score ($B = -0.42, p = .033$) compared to those employed full-time. Participants who had undergone an HIV or STI test had a significantly higher score ($B = 0.74, p = .012$) compared to those who had never been tested. Moderate familiarity with PrEP was associated with a significantly lower score ($B = -0.55, p = .001$) while being well-informed about PrEP was associated with a significantly higher score ($B = 1.59, p < .001$). Other significant associations included awareness of a formal source for receiving a PrEP prescription ($B = 1.08, p < .001$) and knowing PrEP's efficacy level ($B = 0.54, p < .001$). The use of dating apps for sex ($B = 0.44, p = .002$) and connecting with SMM ($B = 0.38, p = .03$) were associated with a lower score while using dating apps geared toward SMM ($B = 0.38, p = .03$) was associated with a higher score in the PrEP care cascade. Furthermore, participants who reported high HIV discourse on dating apps ($B = 0.35, p = .03$) and higher SMM community connectedness ($B = 0.23, p = .004$) also had higher scores. Other enabling factors did not show significant associations with the PrEP care continuum score.

Need Factors. Significant associations were observed for need factors. Recent illicit substance use ($B = 0.89, p < .001$) and polysubstance use ($B = 0.90, p = .006$) were associated

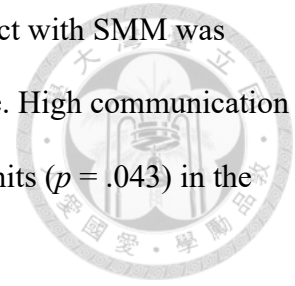


with higher scores. Participants who experienced any sexual violence had a significantly higher score ($B = 0.58, p = .007$). Having one sexual partner in the past month was associated with a significantly lower score ($B = -0.76, p < .001$), while having two or more sexual partners was associated with a significantly higher score ($B = 0.82, p < .001$). Participants diagnosed with an STI within the past six months had a significantly higher score ($B = 1.05, p < .001$), as did participants engaging in chemsex behavior within the past six months ($B = 0.96, p < .001$). Other need factors did not show significant associations with the PrEP care continuum score.

Hierarchical Linear Regression. Table 4 displays the results of the hierarchical linear regression analysis. In the first step of the hierarchical regression model, predisposing factors were examined for their association with the PrEP care continuum score. These predictors accounted for 8% of the variability in the score ($F(6, 221) = 3.23, p = .005$). Participants in a closed relationship had a significant difference of -0.58 units ($p = .007$) compared to those who were single or non-romantic relationship. Other predisposing factors did not show significant associations.

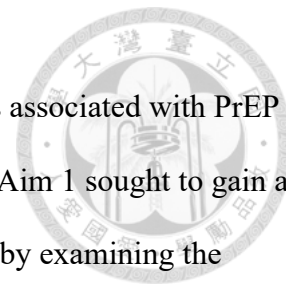
Moving to the second step, enabling factors were included in the regression model. These factors accounted for an additional 33% of the variability in the PrEP care continuum score ($\Delta F = 7.59, p < .001$). Participants in a closed romantic relationship had a significant difference of -0.41 units ($p = .034$) compared to those who were single or non-romantic relationship. Significant associations were found for factors related to PrEP knowledge. Participants who were well-informed about PrEP had a significant difference of 0.86 units ($p = .001$) in the score compared to those who were unaware or uninformed. Similarly, participants who accurately reported the efficacy of PrEP had a significant difference of 0.31 units ($p = .034$) in the score. Participants who knew a formal source for obtaining a PrEP prescription had a significant

difference of 0.73 units ($p < .001$) in the score. Using dating apps to connect with SMM was associated with a significant difference of 0.43 units ($p = .019$) in the score. High communication about HIV disclosure on dating apps had a significant difference of 0.28 units ($p = .043$) in the score. Other enabling factors did not show significant associations.



In the third step, need factors were included in the regression model. These factors did not significantly contribute to the prediction of the PrEP care continuum score ($F(24, 203) = 1.88, p > .05$). However, factors related to PrEP knowledge showed significant associations. Participants who were well-informed about PrEP had a significant difference of 0.60 units ($p = .030$) in the score compared to those who were unaware or uninformed. Similarly, participants who accurately reported the efficacy of PrEP had a significant difference of 0.29 units ($p = .048$) in the score. Participants who knew a formal source for obtaining a PrEP prescription had a significant difference of 0.77 units ($p < .001$) in the score. Using dating apps to connect with SMM had a significant difference of 0.47 units ($p = .010$) in the score. High communication about HIV disclosure on dating apps had a significant difference of 0.28 units ($p = .041$) in the score. Other need factors did not show significant associations. Overall, the second step of the regression model provided the best explanation for the PrEP care continuum score, accounting for 41% of the total variance.

Chapter 4: Discussion



The present study aimed to comprehensively investigate the factors associated with PrEP utilization among SMM in Taiwan, aligning with two main research aims. Aim 1 sought to gain a comprehensive understanding of PrEP utilization among Taiwanese SMM by examining the stages of the PrEP care continuum, including pre-contemplation, contemplation, preparation, action and initiation, and maintenance and adherence. Aim 2 aimed to explore and integrate additional individual and contextual factors beyond demographic and sexual behavior predictors that are empirically linked with PrEP utilization among Taiwanese SMM, utilizing a data-driven approach guided by Syndemic, Minority Stress, and Social Safety Theory. This study contributes to the understanding of PrEP utilization among SMM in Taiwan and provides valuable insights for the development of targeted interventions and policies.

Aim 1

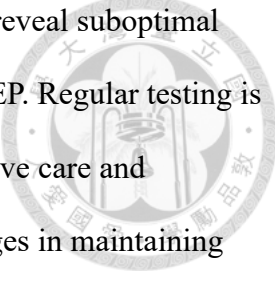
The analysis of PrEP utilization among SMM in Taiwan provides valuable insights into the journey of eligible individuals through the stages of the PrEP Care Continuum. This continuum represents the steps involved in accessing and maintaining PrEP, a preventive measure against HIV.

In the first stage of the PrEP care continuum, referred to as “pre-contemplation,” a significant drop-off was observed, with only a small proportion of participants progressing beyond this stage. This finding aligns with previous research indicating that awareness and willingness to consider PrEP can be limited among populations at risk (Stage 1; Mayer et al., 2020). Strategies to enhance education and awareness about PrEP, emphasizing its effectiveness in preventing HIV transmission, may be crucial in overcoming barriers to progression beyond this stage.

Moving to the second stage, “contemplation,” a higher proportion of participants expressed willingness to take PrEP, demonstrating a positive attitude towards its use. However, self-identification as appropriate candidates for PrEP was lower in comparison. This suggests that while individuals may be open to the idea of PrEP, they may still have reservations or uncertainties about their eligibility for its use. Similar findings have been reported in previous studies, highlighting the importance of addressing misconceptions and providing clear information about PrEP eligibility criteria (Stage 2; Maticcotta et al., 2020).

Advancing along the continuum to the third stage, “preparation,” it is encouraging to see that all participants intended to initiate PrEP and had healthcare providers who were willing to prescribe it. This highlights the role of healthcare providers in supporting PrEP access and uptake, which is consistent with existing literature emphasizing the importance of provider support in facilitating PrEP initiation (Stage 3; Hillis et al., 2020; Maticcotta et al., 2020; Mayer et al., 2008). However, it is important to note that a significant proportion of participants did not engage in discussions with medical providers or were not ultimately prescribed PrEP, indicating potential barriers in the process of transitioning from intention to actual initiation.

Within the fourth stage, “action and initiation,” the findings show that a substantial proportion of participants engaged in discussions with medical providers and were prescribed PrEP. However, less than half of those in this stage fulfilled both criteria, suggesting that there may be challenges in translating intentions into actual PrEP usage. These findings underscore the need for interventions and strategies that facilitate a seamless transition from discussions with providers to the actual initiation of PrEP, addressing barriers such as access and logistical challenges (Stage 4; Hillis et al., 2020; Mayer et al., 2020).



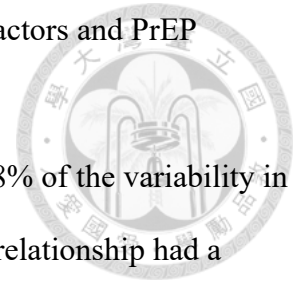
Finally, in the fifth stage, “maintenance and adherence,” the results reveal suboptimal adherence to routine HIV and STI testing among participants prescribed PrEP. Regular testing is essential for monitoring potential seroconversion and ensuring comprehensive care and prevention. These findings align with previous studies highlighting challenges in maintaining routine testing schedules (Stage 5; Mayer et al., 2020). Strategies that promote consistent adherence to both PrEP medication and routine testing, such as reminders and integrated testing services, should be implemented to optimize the benefits of PrEP as an effective HIV prevention tool.

In summary, the findings from this study provide valuable insights into the challenges and successes experienced by eligible participants at different stages of the PrEP care continuum in Taiwan and globally. The significant drop-offs observed early in the continuum emphasize the need for targeted interventions to enhance awareness, address misconceptions, and facilitate a seamless transition from contemplation to PrEP initiation. The results highlight the crucial role of healthcare providers in supporting PrEP access and uptake, while also underscoring the importance of interventions that promote consistent testing practices. By addressing these challenges, healthcare systems and public health interventions can optimize the impact of PrEP in reducing the risk of HIV transmission among at-risk populations, contributing to global efforts to combat the HIV epidemic.

Aim 2

The results of the hierarchical linear regression analysis conducted in this study shed light on the factors associated with the PrEP care continuum score among eligible participants. The regression analysis allowed us to understand how different factors, categorized as predisposing, enabling, and need factors, contribute to the overall score. This comprehensive analysis provides

a more nuanced understanding of the complex interplay between various factors and PrEP utilization.



In the first step of the analysis, predisposing factors accounted for 8% of the variability in the PrEP care continuum score. Notably, participants in a closed romantic relationship had a significantly lower score compared to those who were single or in a non-romantic relationship. This finding suggests that individuals in closed relationships may face additional barriers or challenges in accessing and using PrEP compared to those who are not in such relationships. These findings align with previous research that has identified relationship status as a crucial factor influencing PrEP utilization, with individuals in open relationships being more likely to engage in PrEP (John et al., 2018; Lachowsky et al., 2019).

Moving to the second step of the analysis, enabling factors explained an additional 33% of the variability in the PrEP care continuum score. Several significant associations emerged within this category. Factors related to PrEP knowledge, such as being well-informed about PrEP, accurately understanding its efficacy, and knowing where to obtain a PrEP prescription, were all associated with higher scores on the continuum. These findings underscore the importance of providing accurate information and education about PrEP to potential users, as well as ensuring access to healthcare providers who are knowledgeable about PrEP and can prescribe it. This aligns with existing literature that highlights the critical role of knowledge and access to healthcare resources in facilitating PrEP utilization (Algarin et al., 2019; Kahle et al., 2018). Moreover, the use of dating apps to connect with SMM and engaging in HIV disclosure on dating apps were associated with higher scores on the PrEP care continuum. This finding suggests that technology-based interventions, such as incorporating PrEP information and support within dating apps, may be effective in reaching and engaging individuals who are at risk

for HIV. Leveraging these platforms to promote PrEP awareness, facilitate access to healthcare resources, and encourage open discussions about HIV and PrEP can play a crucial role in increasing PrEP utilization among at-risk populations (Gibson et al., 2022; Hoenigl et al., 2020).

In the third step of the analysis, need factors did not significantly contribute to the prediction of the PrEP care continuum score. However, factors related to PrEP knowledge continued to show significant associations. Participants who were well-informed about PrEP, accurately understood its efficacy, and knew where to obtain a prescription had higher scores on the continuum. These findings emphasize the critical role of accurate information and access to healthcare resources in promoting PrEP utilization among eligible individuals (Hillis et al., 2020; Mayer et al., 2020).

The univariate linear regression analyses revealed significant associations between several factors and the PrEP care continuum score. Specifically, higher levels of identity affirmation, community connectedness, and familiarity with PrEP were positively associated with the PrEP care continuum score. On the other hand, factors such as sexual orientation discrimination, expectation of rejection, internalized homophobia, illicit substance use, polysubstance use, sexual violence experience, number of sexual partners, STI diagnosis, chemsex, using an SMM-oriented dating app, part-time employment, and previous STI testing were negatively associated with the PrEP care continuum score. These findings are consistent with existing literature highlighting the role of these factors on PrEP utilization among SMM (Eaton et al., 2017; Gibson et al., 2022; Holloway et al., 2017; Lee et al., 2017; Ogunbajo et al., 2019; Shover et al., 2018). Although these factors did not show significant associations in the hierarchical regression analysis, their significance in the univariate analysis suggests that they may still have individual effects on the PrEP care continuum score. This means that each factor,

when considered in isolation, may play a role in either facilitating or hindering an individual's engagement in the PrEP care continuum. However, when multiple factors are examined together, their effects may be attenuated or mediated by other factors. These findings underscore the need for tailored interventions that address the specific barriers and facilitators associated with these factors to optimize PrEP uptake and adherence among SMM. Further research is warranted to explore the complex interplay of these factors and their implications for improving PrEP programs and reducing HIV transmission rates among SMM.

Limitations and Future Directions

This study on PrEP utilization among SMM in Taiwan has several limitations that should be acknowledged. Firstly, the cross-sectional design of the study restricts the ability to establish causality or determine the temporal sequence of the examined factors and PrEP utilization. Future longitudinal research is needed to better understand the dynamic relationships between predictors and PrEP utilization over time. Secondly, the reliance on self-reported data introduces potential biases, such as recall bias and social desirability bias, which may impact the accuracy of participants' reports on PrEP-related behaviors. Objective measures or electronic health records could be considered in future studies to obtain more reliable data. Additionally, the study's focus on SMM in Taiwan limits the generalizability of the findings to other populations or geographic regions. Caution should be exercised when applying these results to different populations or settings, and future research should strive to include diverse populations to enhance the generalizability of findings. Furthermore, while the study examined various factors influencing PrEP utilization, it did not comprehensively address other important influences such as healthcare system factors, policy-related factors, and economic factors, which could play a significant role in shaping PrEP utilization. Future research should consider exploring these

additional influences to gain a more comprehensive understanding of the predictors of PrEP utilization.

Despite these limitations, this study has several strengths that contribute to its overall value. Firstly, the study's focus on SMM in Taiwan allows for targeted analysis of PrEP utilization within this specific context, enhancing the applicability of the findings to the target population. Secondly, the comprehensive examination of predisposing factors, enabling factors, and need factors provides a holistic understanding of the multi-faceted influences on PrEP utilization. This approach contributes to a more nuanced understanding of the factors that influence PrEP uptake and retention among SMM in Taiwan. Overall, while this study has limitations, addressing these limitations and considering future research directions will contribute to a more comprehensive understanding of the factors influencing PrEP utilization. The strengths of the study, including its focus on a specific population and its comprehensive analysis, provide valuable insights into PrEP utilization among SMM in Taiwan. By acknowledging the limitations and leveraging the strengths, future research can inform the development of targeted interventions and policies to optimize PrEP uptake and retention among SMM and reduce HIV transmission rates.

Implications for Practice and Public Health

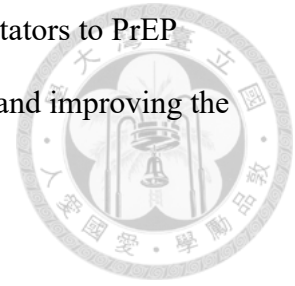
The findings of this study have important implications for practice and health policy, both in Taiwan and globally. HIV remains a significant global health problem (UNAIDS; 2022b), and addressing the factors influencing PrEP utilization is crucial in reducing HIV transmission rates among at-risk populations. In the context of Taiwan, this study provides specific insights into the factors influencing PrEP utilization among SMM, offering a deeper understanding of the unique challenges and opportunities faced by this population. By identifying the stages of the PrEP care

continuum and significant predictors within the Taiwanese context, this study fills a knowledge gap and generates evidence that is specifically relevant to the local context. The findings can inform the development of tailored interventions, educational campaigns, and policy initiatives that are sensitive to the cultural, social, and structural factors influencing PrEP utilization among SMM in Taiwan. By addressing these factors, healthcare systems and public health initiatives can effectively support SMM in making informed decisions regarding PrEP utilization (Hillis et al., 2020; Mayer et al., 2020; Yi et al., 2017), leading to improved HIV prevention outcomes within the country.

Moreover, the insights gained from this study have broader implications for global efforts to combat the HIV epidemic. The significant associations found between factors related to PrEP knowledge, dating app use, and HIV disclosure communication highlight the role of these factors in shaping PrEP behaviors. These findings resonate with research conducted in various cultural and geographical contexts (Maxwell et al., 2019; Yi et al., 2017), suggesting that the factors influencing PrEP utilization are not limited to specific populations but are relevant to SMM globally. Therefore, the insights gained from this study can contribute to the development of evidence-based interventions and policies that can be adapted and implemented in different settings to improve PrEP uptake and retention among SMM worldwide.

Therefore, this study's findings have implications for practice and health policy, both in Taiwan and globally. By addressing the factors associated with PrEP utilization among SMM, healthcare systems can optimize the impact of PrEP in reducing the risk of HIV transmission among at-risk populations. The insights gained from this study can guide the development of targeted interventions, educational campaigns, and policy initiatives that are tailored to the specific needs of SMM in Taiwan while also providing valuable lessons for other countries

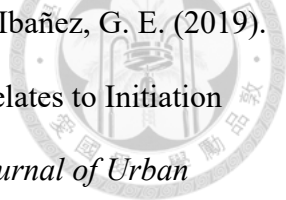
facing similar challenges. By collectively addressing the barriers and facilitators to PrEP utilization, we can make significant strides in reducing the burden of HIV and improving the overall health and well-being of communities affected by the epidemic.



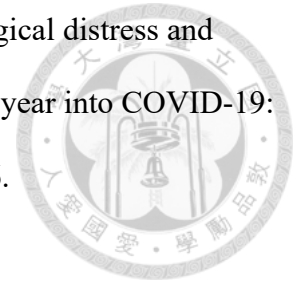
Conclusion

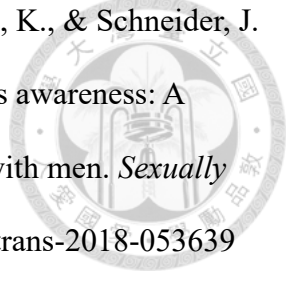
In conclusion, this study successfully achieved its research aims by comprehensively investigating the factors associated with PrEP utilization among SMM in Taiwan. Aim 1 focused on understanding PrEP utilization along the care continuum, revealing significant drop-offs in the early stages and underscoring the need for targeted interventions. Aim 2 explored additional factors beyond demographics and sexual behavior, highlighting the importance of PrEP knowledge, accurate understanding of efficacy, and the use of dating apps for HIV disclosure. These findings significantly contribute to the understanding of PrEP utilization among SMM in Taiwan and provide valuable insights for the development of targeted interventions and policies. Importantly, these findings have broader implications for global HIV prevention efforts. By addressing barriers, promoting knowledge, and leveraging technology-based interventions, healthcare systems can optimize PrEP uptake among men who have sex with men, leading to a reduction in HIV transmission rates. The insights gained from this study can inform evidence-based interventions and policies that can be adapted to different settings worldwide. Overall, this study successfully achieves its research aims and makes a meaningful contribution to improving HIV prevention outcomes and reducing the burden of the epidemic among SMM populations globally.

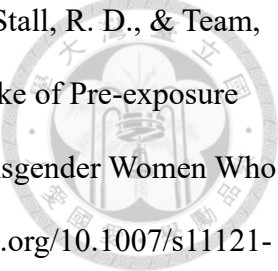
References

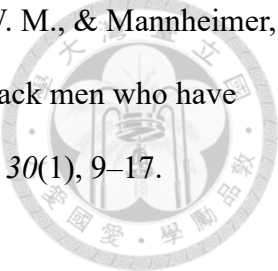
- 
- Algarin, A. B., Shrader, C. H., Bhatt, C., Hackworth, B. T., Cook, R. L., & Ibañez, G. E. (2019). The Pre-exposure Prophylaxis (PrEP) Continuum of Care and Correlates to Initiation Among HIV-Negative Men Recruited at Miami Gay Pride 2018. *Journal of Urban Health, 96*(6), 835–844. <https://doi.org/10.1007/s11524-019-00362-4>
- Anand, T., Nitpolprasert, C., Trachunthong, D., Kerr, S. J., Janyam, S., Linjongrat, D., Hightow-Weidman, L. B., Phanuphak, P., Ananworanich, J., Phanuphak, N., & Adam's Love study team. (2017). A novel Online-to-Offline (O2O) model for pre-exposure prophylaxis and HIV testing scale up. *Journal of the International AIDS Society, 20*(1), 21326. <https://doi.org/10.7448/IAS.20.1.21326>
- Andersen, R. M. (1968). *A behavioral model for families' use of health services*. University of Chicago Press.
- Andersen, R. M. (1995). Revisiting the Behavioral Model and Access to Medical Care: Does it Matter? *Journal of Health and Social Behavior, 36*(1), 1. <https://doi.org/10.2307/2137284>
- Andersen, R. M. & Davidson. (2007). Improving access to care in America: Individual and contextual indicators. In Andersen RM, Rice TH, & Kominski EF (Eds.), *Improving access to care in America. Changing the US health care system: Key issues in health services policy and management* (3a ed., pp. 3–31). Jossey-Bass.
- Bazzi, A. R., Drainoni, M.-L., Biancarelli, D. L., Hartman, J. J., Mimiaga, M. J., Mayer, K. H., & Biello, K. B. (2019). Systematic review of HIV treatment adherence research among people who inject drugs in the United States and Canada: Evidence to inform pre-exposure prophylaxis (PrEP) adherence interventions. *BMC Public Health, 19*(1), 31. <https://doi.org/10.1186/s12889-018-6314-8>

- Bi, K., Yeoh, D., Jiang, Q., Wienk, M. N. A., & Chen, S. (2022). Psychological distress and everyday discrimination among Chinese international students one year into COVID-19: A preregistered comparative study. *Anxiety, Stress, & Coping*, 1–16. <https://doi.org/10.1080/10615806.2022.2130268>
- Braksmajer, A., Walters, S. M., Crean, H. F., Stephenson, R., & McMahon, J. M. (2020). Pre-exposure Prophylaxis Use Among Men Who Have Sex with Men Experiencing Partner Violence. *AIDS and Behavior*, 24(8), 2299–2306. <https://doi.org/10.1007/s10461-020-02789-2>
- Brenner, P. S., Serpe, R. T., & Stryker, S. (2014). The Causal Ordering of Prominence and Salience in Identity Theory: An Empirical Examination. *Social Psychology Quarterly*, 77(3), 231–252. <https://doi.org/10.1177/0190272513518337>
- Brooks, R. A., Landrian, A., Lazalde, G., Galvan, F. H., Liu, H., & Chen, Y.-T. (2020). Predictors of Awareness, Accessibility and Acceptability of Pre-exposure Prophylaxis (PrEP) Among English- and Spanish-Speaking Latino Men Who have Sex with Men in Los Angeles, California. *Journal of Immigrant and Minority Health*, 22(4), 708–716. <https://doi.org/10.1007/s10903-019-00955-w>
- Brooks, R. A., Landrian, A., Nieto, O., & Fehrenbacher, A. (2019). Experiences of Anticipated and Enacted Pre-exposure Prophylaxis (PrEP) Stigma Among Latino MSM in Los Angeles. *AIDS and Behavior*, 23(7), 1964–1973. <https://doi.org/10.1007/s10461-019-02397-9>
- Cha, E.-S., Kim, K. H., & Erlen, J. A. (2007). Translation of scales in cross-cultural research: Issues and techniques. *Journal of Advanced Nursing*, 58(4), 386–395. <https://doi.org/10.1111/j.1365-2648.2007.04242.x>



- 
- Chen, Y.-T., Kolak, M., Duncan, D. T., Schumm, P., Michaels, S., Fujimoto, K., & Schneider, J. A. (2019). Neighbourhoods, networks and pre-exposure prophylaxis awareness: A multilevel analysis of a sample of young black men who have sex with men. *Sexually Transmitted Infections*, *95*(3), 228–235. <https://doi.org/10.1136/sextrans-2018-053639>
- Chuang, D.-M., & Newman, P. A. (2018). Pre-Exposure Prophylaxis (PrEP) Awareness and Acceptability Among Men Who Have Sex With Men in Taiwan. *AIDS Education and Prevention*, *30*(6), 490–501. <https://doi.org/10.1521/aeap.2018.30.6.490>
- Cook, S. H., Slopen, N., Scarimbolo, L., Mirin, N., Wood, E. P., Rosendale, N., Chunara, R., Burke, C. W., & Halkitis, P. N. (2022). Discrimination is associated with C-reactive protein among young sexual minority men. *Journal of Behavioral Medicine*, *45*(4), 649–657. <https://doi.org/10.1007/s10865-022-00307-4>
- Dai, M., & Calabrese, C. (2022). Socio-behavioral factors related to PrEP non-adherence among gay male PrEP users living in California and New York: A behavioral theory informed approach. *Journal of Behavioral Medicine*, *45*(2), 240–251. <https://doi.org/10.1007/s10865-021-00275-1>
- Diamond, L. M., & Alley, J. (2022). Rethinking minority stress: A social safety perspective on the health effects of stigma in sexually-diverse and gender-diverse populations. *Neuroscience & Biobehavioral Reviews*, *138*, 104720. <https://doi.org/10.1016/j.neubiorev.2022.104720>
- Ding, Y., Yan, H., Ning, Z., Cai, X., Yang, Y., Pan, R., Zhou, Y., Zheng, H., Gao, M., Rou, K., Wu, Z., & He, N. (2016). Low willingness and actual uptake of pre-exposure prophylaxis for HIV-1 prevention among men who have sex with men in Shanghai, China. *BioScience Trends*, *10*(2), 113–119. <https://doi.org/10.5582/bst.2016.01035>

- 
- Eaton, L. A., Matthews, D. D., Driffin, D. D., Bukowski, L., Wilson, P. A., Stall, R. D., & Team, T. P. S. (2017). A Multi-US City Assessment of Awareness and Uptake of Pre-exposure Prophylaxis (PrEP) for HIV Prevention Among Black Men and Transgender Women Who Have Sex with Men. *Prevention Science, 18*(5), 505–516. <https://doi.org/10.1007/s11121-017-0756-6>
- Ellard-Gray, A., Jeffrey, N. K., Choubak, M., & Crann, S. E. (2015). Finding the Hidden Participant: Solutions for Recruiting Hidden, Hard-to-Reach, and Vulnerable Populations. *International Journal of Qualitative Methods, 14*(5), 160940691562142. <https://doi.org/10.1177/1609406915621420>
- Feinstein, B. A., Swann, G., Sarno, E. L., Moran, K. O., Newcomb, M. E., & Mustanski, B. (2021). Minority Stressors and Identity Affirmation as Predictors of Condomless Sex Among Self-Identified Bisexual Men: The Role of Partner Gender. *Archives of Sexual Behavior, 50*(3), 1057–1065. <https://doi.org/10.1007/s10508-020-01775-y>
- Fonner, V. A., Dalglish, S. L., Kennedy, C. E., Baggaley, R., O'Reilly, K. R., Koechlin, F. M., Rodolph, M., Hodges-Mameletzis, I., & Grant, R. M. (2016). Effectiveness and safety of oral HIV preexposure prophylaxis for all populations. *AIDS, 30*(12), 1973–1983. <https://doi.org/10.1097/QAD.0000000000001145>
- Frost, D. M., & Meyer, I. H. (2023). Minority Stress Theory: Application, Critique, and Continued Relevance. *Current Opinion in Psychology, 101579*. <https://doi.org/10.1016/j.copsyc.2023.101579>
- García, M., & Harris, A. L. (2017). PrEP awareness and decision-making for Latino MSM in San Antonio, Texas. *PLOS ONE, 12*(9), e0184014. <https://doi.org/10.1371/journal.pone.0184014>

- 
- Garnett, M., Hirsch-Moverman, Y., Franks, J., Hayes-Larson, E., El-Sadr, W. M., & Mannheimer, S. (2018). Limited awareness of pre-exposure prophylaxis among black men who have sex with men and transgender women in New York city. *AIDS Care*, *30*(1), 9–17. <https://doi.org/10.1080/09540121.2017.1363364>
- Gibson, L. P., Kramer, E. B., & Bryan, A. D. (2022). Geosocial Networking App Use Associated With Sexual Risk Behavior and Pre-exposure Prophylaxis Use Among Gay, Bisexual, and Other Men Who Have Sex With Men: Cross-sectional Web-Based Survey. *JMIR Formative Research*, *6*(6), e35548. <https://doi.org/10.2196/35548>
- Goedel, W. C., & Duncan, D. T. (2015). Geosocial-Networking App Usage Patterns of Gay, Bisexual, and Other Men Who Have Sex With Men: Survey Among Users of Grindr, A Mobile Dating App. *JMIR Public Health and Surveillance*, *1*(1), e4. <https://doi.org/10.2196/publichealth.4353>
- Grant, R. M., Lama, J. R., Anderson, P. L., McMahan, V., Liu, A. Y., Vargas, L., Goicochea, P., Casapía, M., Guanira-Carranza, J. V., Ramirez-Cardich, M. E., Montoya-Herrera, O., Fernández, T., Veloso, V. G., Buchbinder, S. P., Chariyalertsak, S., Schechter, M., Bekker, L.-G., Mayer, K. H., Kallás, E. G., ... Glidden, D. V. (2010). Preexposure Chemoprophylaxis for HIV Prevention in Men Who Have Sex with Men. *New England Journal of Medicine*, *363*(27), 2587–2599. <https://doi.org/10.1056/NEJMoa1011205>
- Grinsztejn, B., Hoagland, B., Moreira, R. I., Kallas, E. G., Madruga, J. V., Goulart, S., Leite, I. C., Freitas, L., Martins, L. M. S., Torres, T. S., Vasconcelos, R., De Boni, R. B., Anderson, P. L., Liu, A., Luz, P. M., Veloso, V. G., Adão, V. M., Alencastro, P. R., Amaral, A. P., ... Zuccaro, N. (2018). Retention, engagement, and adherence to pre-exposure prophylaxis for men who have sex with men and transgender women in PrEP

Brasil: 48 week results of a demonstration study. *The Lancet HIV*, 5(3), e136–e145.

[https://doi.org/10.1016/S2352-3018\(18\)30008-0](https://doi.org/10.1016/S2352-3018(18)30008-0)

Guendelman, S. (1991). Health Care Users Residing on the Mexican Border: What Factors

Determine Choice of the U.S. or Mexican Health System? *Medical Care*, 29(5), 419–429.

<https://doi.org/10.1097/00005650-199105000-00003>

Hammack, P. L., Meyer, I. H., Krueger, E. A., Lightfoot, M., & Frost, D. M. (2018). HIV testing and pre-exposure prophylaxis (PrEP) use, familiarity, and attitudes among gay and bisexual men in the United States: A national probability sample of three birth cohorts.

PLOS ONE, 13(9), e0202806. <https://doi.org/10.1371/journal.pone.0202806>

Hanna-Walker, V., Simon, K. A., Lawrence, S. E., Driver, R., Kalinowski, J., Watson, R. J., &

Eaton, L. A. (2023). Black Sexual Minority Men’s Stigma-Based Experiences

Surrounding Pre-exposure Prophylaxis in the Southern United States. *LGBT Health*,

10(3), 245–251. <https://doi.org/10.1089/lgbt.2022.0118>

Hanum, N., Cambiano, V., Sewell, J., Phillips, A. N., Rodger, A. J., Speakman, A., Nwokolo, N.,

Asboe, D., Gilson, R., Clarke, A., Miltz, A. R., Collins, S., & Lampe, F. C. (2020). Use of

HIV pre-exposure prophylaxis among men who have sex with men in England: Data from the AURAH2 prospective study. *The Lancet Public Health*, 5(9), e501–e511.

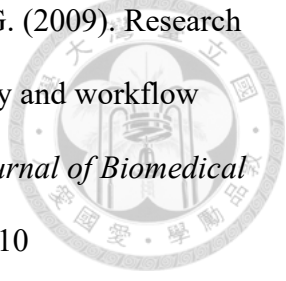
[https://doi.org/10.1016/S2468-2667\(20\)30186-9](https://doi.org/10.1016/S2468-2667(20)30186-9)

Harris, P. A., Taylor, R., Minor, B. L., Elliott, V., Fernandez, M., O’Neal, L., McLeod, L.,

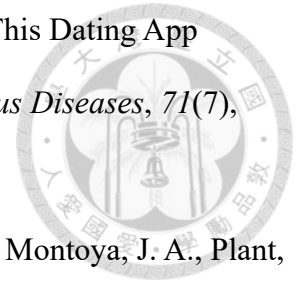
Delacqua, G., Delacqua, F., Kirby, J., & Duda, S. N. (2019). The REDCap consortium:

Building an international community of software platform partners. *Journal of*

Biomedical Informatics, 95, 103208. <https://doi.org/10.1016/j.jbi.2019.103208>

- 
- Harris, P. A., Taylor, R., Thielke, R., Payne, J., Gonzalez, N., & Conde, J. G. (2009). Research electronic data capture (REDCap)—A metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Informatics*, 42(2), 377–381. <https://doi.org/10.1016/j.jbi.2008.08.010>
- Harrison, M. G., McAnulty, R. D., & Canevello, A. (2022). College Students’ Motives for In-Person Meetings with Dating Application Matches. *Cyberpsychology, Behavior, and Social Networking*, 25(2), 130–134. <https://doi.org/10.1089/cyber.2021.0031>
- Hatzenbuehler, M. L. (2009). How does sexual minority stigma “get under the skin”? A psychological mediation framework. *Psychological Bulletin*, 135(5), 707–730. <https://doi.org/10.1037/a0016441>
- Hecht, J., Zlotorzynska, M., Sanchez, T. H., & Wohlfeiler, D. (2022). Gay Dating App Users Support and Utilize Sexual Health Features on Apps. *AIDS and Behavior*, 26(6), 2081–2090. <https://doi.org/10.1007/s10461-021-03554-9>
- Herek, G. M. (2009). Sexual Stigma and Sexual Prejudice in the United States: A Conceptual Framework. In D. A. Hope (Ed.), *Contemporary Perspectives on Lesbian, Gay, and Bisexual Identities* (Vol. 54, pp. 65–111). Springer New York. https://doi.org/10.1007/978-0-387-09556-1_4
- Hillis, A., Germain, J., Hope, V., McVeigh, J., & Van Hout, M. C. (2020). Pre-exposure Prophylaxis (PrEP) for HIV Prevention Among Men Who Have Sex with Men (MSM): A Scoping Review on PrEP Service Delivery and Programming. *AIDS and Behavior*, 24(11), 3056–3070. <https://doi.org/10.1007/s10461-020-02855-9>
- Hoenigl, M., Little, S. J., Grelotti, D., Skaathun, B., Wagner, G. A., Weibel, N., Stockman, J. K., & Smith, D. M. (2020). Grindr Users Take More Risks, but Are More Open to Human

Immunodeficiency Virus (HIV) Pre-exposure Prophylaxis: Could This Dating App Provide a Platform for HIV Prevention Outreach? *Clinical Infectious Diseases*, 71(7), e135–e140. <https://doi.org/10.1093/cid/ciz1093>



Holloway, I. W., Dougherty, R., Gildner, J., Beougher, S. C., Pulsipher, C., Montoya, J. A., Plant, A., & Leibowitz, A. (2017). Brief Report: PrEP Uptake, Adherence, and Discontinuation Among California YMSM Using Geosocial Networking Applications. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 74(1), 15–20. <https://doi.org/10.1097/QAI.0000000000001164>

Holtz, T. H., Chitwarakorn, A., Hughes, J. P., Curlin, M. E., Varangrat, A., Li, M., Amico, K. R., Mock, P. A., Grant, R. M., & Thai HPTN 067/ADAPT Study Team. (2019). HPTN 067/ADAPT: Correlates of Sex-Related Pre-exposure Prophylaxis Adherence, Thai Men Who Have Sex With Men, and Transgender Women, 2012-2013. *Journal of Acquired Immune Deficiency Syndromes (1999)*, 82(2), e18–e26. <https://doi.org/10.1097/QAI.0000000000002131>

Huang, P. (2022). Sexual health as surplus: The marketization of PrEP in Taiwan. *BioSocieties*. <https://doi.org/10.1057/s41292-022-00273-9>

Huang, S.-T., Huang, J.-H., & Chu, J.-H. (2021). Health Beliefs Linked to HIV Pre-Exposure Prophylaxis Use Intention Among Young Men Who Have Sex with Men in Taiwan. *AIDS Patient Care and STDs*, 35(12), 474–480. <https://doi.org/10.1089/apc.2021.0146>

Iribarren, S. J., Ghazzawi, A., Sheinfil, A. Z., Frasca, T., Brown, W., Lopez-Rios, J., Rael, C. T., Balán, I. C., Crespo, R., Dolezal, C., Giguere, R., & Carballo-Diéguez, A. (2018). Mixed-Method Evaluation of Social Media-Based Tools and Traditional Strategies to Recruit

- High-Risk and Hard-to-Reach Populations into an HIV Prevention Intervention Study. *AIDS and Behavior*, 22(1), 347–357. <https://doi.org/10.1007/s10461-017-1956-6>
- Jin, F., Amin, J., Guy, R., Vaccher, S., Selvey, C., Zablotska, I., Holden, J., Price, K., Yeung, B., Ogilvie, E., Quichua, G. C., Clackett, S., McNulty, A., Smith, D., Templeton, D. J., Bavinton, B., & Grulich, A. E. (2021). Adherence to daily HIV pre-exposure prophylaxis in a large-scale implementation study in New South Wales, Australia. *AIDS*, 35(12), 1987–1996. <https://doi.org/10.1097/QAD.0000000000002970>
- John, S. A., Starks, T. J., Rendina, H. J., Grov, C., & Parsons, J. T. (2018). Should I Convince My Partner to Go on Pre-Exposure Prophylaxis (PrEP)? The Role of Personal and Relationship Factors on PrEP-Related Social Control among Gay and Bisexual Men. *AIDS and Behavior*, 22(4), 1239–1252. <https://doi.org/10.1007/s10461-017-1835-1>
- Joint United Nations Programme on HIV/AIDS. (2020). *2025 AIDS targets*. UNAIDS.
- Joint United Nations Programme on HIV/AIDS. (2022a). *Dangerous inequalities: World AIDS Day report 2022*.
- Joint United Nations Programme on HIV/AIDS. (2022b). *IN DANGER: UNAIDS Global AIDS Update 2022*.
- Kahle, E. M., Sullivan, S., & Stephenson, R. (2018). Functional Knowledge of Pre-Exposure Prophylaxis for HIV Prevention Among Participants in a Web-Based Survey of Sexually Active Gay, Bisexual, and Other Men Who Have Sex With Men: Cross-Sectional Study. *JMIR Public Health and Surveillance*, 4(1), e13. <https://doi.org/10.2196/publichealth.8089>
- Ko, N.-Y., Chen, B.-J., Li, C.-W., Ku, W.-W., & Hsu, S.-T. (2016). Willingness to Self-Pay for Pre-exposure Prophylaxis in Men Who Have Sex With Men: A National Online Survey in

Taiwan. *AIDS Education and Prevention*, 28(2), 128–137.

<https://doi.org/10.1521/aeap.2016.28.2.128>

Ko, N.-Y., Wu, H.-J., Strong, C., Li, C.-W., Ku, W.-W., & Hsu, S.-T. (2018). Differences in awareness of and willingness to use pre-exposure prophylaxis and anticipated condom use among serodiscordant couples in Taiwan. *AIDS Care*, 30(10), 1306–1310.

<https://doi.org/10.1080/09540121.2018.1481195>

Kota, K. K., Mansergh, G., Stephenson, R., Hirshfield, S., & Sullivan, P. (2021).

Sociodemographic Characteristics of HIV Pre-Exposure Prophylaxis Use and Reasons for Nonuse Among Gay, Bisexual, and Other Men Who Have Sex with Men from Three US Cities. *AIDS Patient Care and STDs*, 35(5), 158–166.

<https://doi.org/10.1089/apc.2020.0261>

Krakower, D., Maloney, K. M., Powell, V. E., Levine, K., Grasso, C., Melbourne, K., Marcus, J. L., & Mayer, K. H. (2019). Patterns and clinical consequences of discontinuing HIV preexposure prophylaxis during primary care. *Journal of the International AIDS Society*, 22(2), e25250. <https://doi.org/10.1002/jia2.25250>

Lachowsky, N. J., Lawson Tattersall, T., Sereda, P., Wang, C., Edwards, J., & Hull, M. (2019). Community awareness of, use of and attitudes towards HIV pre-exposure prophylaxis (PrEP) among men who have sex with men in Vancouver, Canada: Preparing health promotion for a publicly funded PrEP program. *Sexual Health*.

<https://doi.org/10.1071/SH18115>

Lee, Y.-C., Chang, S.-Y., Lin, K.-Y., Chang, L.-H., Liu, W.-C., Wu, C.-H., Sun, H.-Y., Hung, C.-C., & Chang, S.-C. (2017). Awareness and willingness towards pre-exposure prophylaxis against HIV infection among individuals seeking voluntary counselling and testing for



HIV in Taiwan: A cross-sectional questionnaire survey. *BMJ Open*, 7(10), e015142.

<https://doi.org/10.1136/bmjopen-2016-015142>

Li, J., Berg, C. J., Kramer, M. R., Haardörfer, R., Zlotorzynska, M., & Sanchez, T. H. (2019). An Integrated Examination of County- and Individual-Level Factors in Relation to HIV Pre-exposure Prophylaxis Awareness, Willingness to Use, and Uptake Among Men Who Have Sex with Men in the US. *AIDS and Behavior*, 23(7), 1721–1736.

<https://doi.org/10.1007/s10461-018-2334-8>

Liu, J., Deng, R., Lin, B., Pan, H., Gao, Y., Dai, J., Liang, H., Huang, A., & Zhong, X. (2021). Risk Management on Pre-Exposure Prophylaxis Adherence of Men Who Have Sex with Multiple Men: A Multicenter Prospective Cohort Study. *Risk Management and Healthcare Policy*, Volume 14, 1749–1761. <https://doi.org/10.2147/RMHP.S295114>

Liu, Y. (2015). *The survey study of lesbian, gay, bisexual, and transgender identity in Taiwan (master dissertation)*. National Chi Nan University.

Liu, Z., Yu, Y., Hu, M., Liu, H., Zhou, L., & Xiao, S. (2016). PHQ-9 and PHQ-2 for Screening Depression in Chinese Rural Elderly. *PLOS ONE*, 11(3), e0151042.

<https://doi.org/10.1371/journal.pone.0151042>

Löwe, B., Kroenke, K., & Gräfe, K. (2005). Detecting and monitoring depression with a two-item questionnaire (PHQ-2). *Journal of Psychosomatic Research*, 58(2), 163–171.

<https://doi.org/10.1016/j.jpsychores.2004.09.006>

Mannheimer, S., Hirsch-Moverman, Y., Franks, J., Loquere, A., Hughes, J. P., Li, M., Amico, K. R., & Grant, R. M. (2019). Factors Associated With Sex-Related Pre-exposure Prophylaxis Adherence Among Men Who Have Sex With Men in New York City in

HPTN 067. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 80(5), 551–558.

<https://doi.org/10.1097/QAI.0000000000001965>

Matacotta, J. J., Rosales-Perez, F. J., & Carrillo, C. M. (2020). HIV Preexposure Prophylaxis and Treatment as Prevention — Beliefs and Access Barriers in Men Who Have Sex with Men (MSM) and Transgender Women: A Systematic Review. *Journal of Patient-Centered Research and Reviews*, 7(3), 265–274. <https://doi.org/10.17294/2330-0698.1737>

Maxwell, S., Gafos, M., & Shahmanesh, M. (2019). Pre-exposure Prophylaxis Use and Medication Adherence Among Men Who Have Sex With Men: A Systematic Review of the Literature. *Journal of the Association of Nurses in AIDS Care*, 30(4), e38–e61. <https://doi.org/10.1097/JNC.000000000000105>

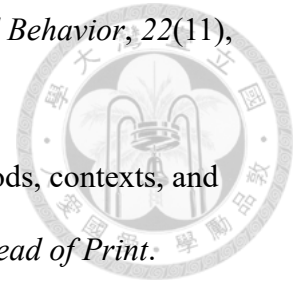
Mayer, K. H., Agwu, A., & Malebranche, D. (2020). Barriers to the Wider Use of Pre-exposure Prophylaxis in the United States: A Narrative Review. *Advances in Therapy*, 37(5), 1778–1811. <https://doi.org/10.1007/s12325-020-01295-0>

Mayer, K. H., Bradford, J. B., Makadon, H. J., Stall, R., Goldhammer, H., & Landers, S. (2008). Sexual and Gender Minority Health: What We Know and What Needs to Be Done. *American Journal of Public Health*, 98(6), 989–995. <https://doi.org/10.2105/AJPH.2007.127811>

Medina, M. M., Crowley, C., Montgomery, M. C., Tributino, A., Almonte, A., Sowemimo-Coker, G., Nunn, A., & Chan, P. A. (2019). Disclosure of HIV Serostatus and Pre-exposure Prophylaxis Use on Internet Hookup Sites Among Men Who have Sex with Men. *AIDS and Behavior*, 23(7), 1681–1688. <https://doi.org/10.1007/s10461-018-2286-z>

Mehrotra, M. L., Rivet Amico, K., McMahan, V., Glidden, D. V., Defechereux, P., Guanira, J. V., & Grant, R. M. (2018). The Role of Social Relationships in PrEP Uptake and Use Among

Transgender Women and Men Who Have Sex with Men. *AIDS and Behavior*, 22(11), 3673–3680. <https://doi.org/10.1007/s10461-018-2151-0>



Mendenhall, E., & Singer, M. (2020). What constitutes a syndemic? Methods, contexts, and framing from 2019. *Current Opinion in HIV and AIDS*, Publish Ahead of Print. <https://doi.org/10.1097/COH.0000000000000628>

Meyer, I. H. (1995). Minority Stress and Mental Health in Gay Men. *Journal of Health and Social Behavior*, 36(1), 38. <https://doi.org/10.2307/2137286>

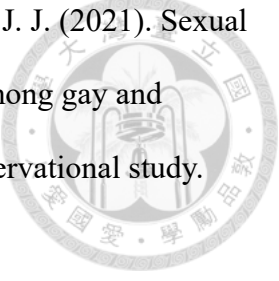
Meyer, I. H. (2003). Prejudice, social stress, and mental health in lesbian, gay, and bisexual populations: Conceptual issues and research evidence. *Psychological Bulletin*, 129(5), 674–697. <https://doi.org/10.1037/0033-2909.129.5.674>

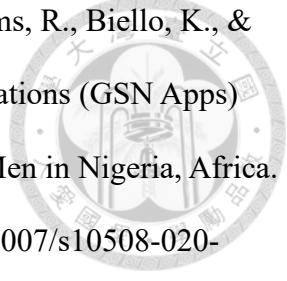
Milhausen, R. R., Sakaluk, J. K., Fisher, T. D., Davis, C. M., & Yarber, W. L. (Eds.). (2019). *Handbook of Sexuality-Related Measures* (4th ed.). Routledge. <https://doi.org/10.4324/9781315183169>

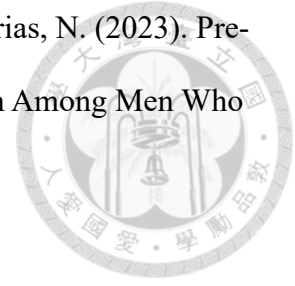
Mohr, J. J., & Kendra, M. S. (2011). Revision and extension of a multidimensional measure of sexual minority identity: The Lesbian, Gay, and Bisexual Identity Scale. *Journal of Counseling Psychology*, 58(2), 234–245. <https://doi.org/10.1037/a0022858>

Molina, J.-M., Ghosn, J., Assoumou, L., Delaugerre, C., Algarte-Genin, M., Pialoux, G., Katlama, C., Slama, L., Liegeon, G., Beniguel, L., Ohayon, M., Mouhim, H., Goldwirt, L., Spire, B., Loze, B., Surgers, L., Pavie, J., Lourenco, J., Ben-Mechlia, M., ...

Costagliola, D. (2022). Daily and on-demand HIV pre-exposure prophylaxis with emtricitabine and tenofovir disoproxil (ANRS PREVENIR): A prospective observational cohort study. *The Lancet HIV*, 9(8), e554–e562. [https://doi.org/10.1016/S2352-3018\(22\)00133-3](https://doi.org/10.1016/S2352-3018(22)00133-3)

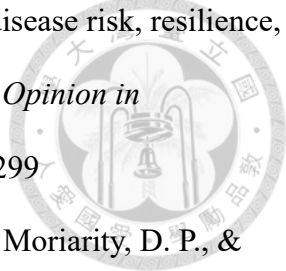
- 
- Montgomery, M. C., Ellison, J., Chan, P. A., Harrison, L., & Van Den Berg, J. J. (2021). Sexual satisfaction with daily oral HIV pre-exposure prophylaxis (PrEP) among gay and bisexual men at two urban PrEP clinics in the United States: An observational study. *Sexual Health, 18*(4), 319–326. <https://doi.org/10.1071/SH20207>
- Morgan, E., Moran, K., Ryan, D. T., Mustanski, B., & Newcomb, M. E. (2018). Threefold Increase in PrEP Uptake Over Time with High Adherence Among Young Men Who Have Sex With Men in Chicago. *AIDS and Behavior, 22*(11), 3637–3644. <https://doi.org/10.1007/s10461-018-2122-5>
- Morgan, J., Ferlatte, O., Salway, T., Wilton, J., & Hull, M. (2018). Awareness of, interest in, and willingness to pay for HIV pre-exposure prophylaxis among Canadian gay, bisexual, and other men who have sex with men. *Canadian Journal of Public Health, 109*(5–6), 791–799. <https://doi.org/10.17269/s41997-018-0090-1>
- Nazli, A., Garner, A., & Gokengin, D. (2022). Awareness of HIV pre-exposure prophylaxis among men who have sex with men using apps for sexual encounters in Turkiye. *International Journal of STD & AIDS, 33*(13), 1124–1133. <https://doi.org/10.1177/09564624221126867>
- Nunn, A. S., Brinkley-Rubinstein, L., Oldenburg, C. E., Mayer, K. H., Mimiaga, M., Patel, R., & Chan, P. A. (2017). Defining the HIV pre-exposure prophylaxis care continuum. *AIDS, 31*(5), 731–734. <https://doi.org/10.1097/QAD.0000000000001385>
- Ogunbajo, A., Kang, A., Shangani, S., Wade, R. M., Onyango, D. P., Odero, W. W., & Harper, G. W. (2019). Awareness and Acceptability of pre-exposure prophylaxis (PrEP) among gay, bisexual and other men who have sex with men (GBMSM) in Kenya. *AIDS Care, 31*(10), 1185–1192. <https://doi.org/10.1080/09540121.2019.1612023>

- 
- Ogunbajo, A., Lodge, W., Restar, A. J., Oginni, O. A., Iwuagwu, S., Williams, R., Biello, K., & Mimiaga, M. J. (2021). Correlates of Geosocial Networking Applications (GSN Apps) Usage among Gay, Bisexual, and Other Men Who Have Sex with Men in Nigeria, Africa. *Archives of Sexual Behavior*, *50*(7), 2981–2993. <https://doi.org/10.1007/s10508-020-01889-3>
- Okafor, C. N., Gorbach, P. M., Ragsdale, A., Quinn, B., & Shoptaw, S. (2017). Correlates of Preexposure Prophylaxis (PrEP) Use among Men Who Have Sex with Men (MSM) in Los Angeles, California. *Journal of Urban Health*, *94*(5), 710–715. <https://doi.org/10.1007/s11524-017-0172-z>
- Ouafik, M. R., Buret, L., & Scholtes, B. (2022). Mapping the current knowledge in syndemic research applied to men who have sex with men: A scoping review. *Social Science & Medicine*, *306*, 115162. <https://doi.org/10.1016/j.socscimed.2022.115162>
- Parsons, J. T., Rendina, H. J., Lassiter, J. M., Whitfield, T. H. F., Starks, T. J., & Grov, C. (2017). Uptake of HIV Pre-Exposure Prophylaxis (PrEP) in a National Cohort of Gay and Bisexual Men in the United States. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, *74*(3), 285–292. <https://doi.org/10.1097/QAI.0000000000001251>
- Pew Research Center. (2020). *The Global Divide on Homosexuality Persists*.
- Portes, A., Kyle, D., & Eaton, W. W. (1992). Mental Illness and Help-seeking Behavior Among Mariel Cuban and Haitian Refugees in South Florida. *Journal of Health and Social Behavior*, *33*(4), 283. <https://doi.org/10.2307/2137309>
- R Core Team. (2020). *R: A language and environment for statistical computing* [Computer software]. R Foundation for Statistical Computing. <https://www.R-project.org/>



- Reiriz, M., Rodríguez-Expósito, B., Jiménez-García, A. J., Uceda, S., & Arias, N. (2023). Pre-Exposure Prophylaxis, Anxiety, Depression and Sexual Satisfaction Among Men Who Have Sex With Men. *Psicothema*, *35.2*, 159–169.
<https://doi.org/10.7334/psicothema2022.230>
- Rendina, H. J., Whitfield, T. H. F., Grov, C., Starks, T. J., & Parsons, J. T. (2017). Distinguishing hypothetical willingness from behavioral intentions to initiate HIV pre-exposure prophylaxis (PrEP): Findings from a large cohort of gay and bisexual men in the U.S. *Social Science & Medicine*, *172*, 115–123.
<https://doi.org/10.1016/j.socscimed.2016.10.030>
- Sangaramoorthy, T., & Benton, A. (2022). Intersectionality and syndemics: A commentary. *Social Science & Medicine*, *295*, 113783.
<https://doi.org/10.1016/j.socscimed.2021.113783>
- Sarno, E. L., Bettin, E., Jozsa, K., & Newcomb, M. E. (2021). Sexual Health of Rural and Urban Young Male Couples in the United States: Differences in HIV Testing, Pre-exposure Prophylaxis Use, and Condom Use. *AIDS and Behavior*, *25*(1), 191–202.
<https://doi.org/10.1007/s10461-020-02961-8>
- Serota, D. P., Rosenberg, E. S., Sullivan, P. S., Thorne, A. L., Rolle, C.-P. M., Del Rio, C., Cutro, S., Luisi, N., Siegler, A. J., Sanchez, T. H., & Kelley, C. F. (2020). Pre-exposure Prophylaxis Uptake and Discontinuation Among Young Black Men Who Have Sex With Men in Atlanta, Georgia: A Prospective Cohort Study. *Clinical Infectious Diseases*, *71*(3), 574–582. <https://doi.org/10.1093/cid/ciz894>
- Shover, C. L., Javanbakht, M., Shoptaw, S., Bolan, R. K., Lee, S.-J., Parsons, J. T., Rendina, J., & Gorbach, P. M. (2018). HIV Preexposure Prophylaxis Initiation at a Large Community

- Clinic: Differences Between Eligibility, Awareness, and Uptake. *American Journal of Public Health*, 108(10), 1408–1417. <https://doi.org/10.2105/AJPH.2018.304623>
- Siconolfi, D., Storholm, E. D., Vincent, W., Pollack, L., Rebchook, G. M., Huebner, D. M., Peterson, J. L., & Kegeles, S. M. (2021). Prevalence and Correlates of Sexual Violence Experienced by Young Adult Black Men Who Have Sex with Men. *Archives of Sexual Behavior*, 50(8), 3621–3636. <https://doi.org/10.1007/s10508-021-02011-x>
- Sidebottom, D., Ekström, A. M., & Strömdahl, S. (2018). A systematic review of adherence to oral pre-exposure prophylaxis for HIV – how can we improve uptake and adherence? *BMC Infectious Diseases*, 18(1), 581. <https://doi.org/10.1186/s12879-018-3463-4>
- Singer, M. (1994). Aids and the health crisis of the U.S. urban poor; the perspective of critical medical anthropology. *Social Science & Medicine*, 39(7), 931–948. [https://doi.org/10.1016/0277-9536\(94\)90205-4](https://doi.org/10.1016/0277-9536(94)90205-4)
- Singer, M., Bulled, N., Ostrach, B., & Mendenhall, E. (2017). Syndemics and the biosocial conception of health. *The Lancet*, 389(10072), 941–950. [https://doi.org/10.1016/S0140-6736\(17\)30003-X](https://doi.org/10.1016/S0140-6736(17)30003-X)
- Slavich, G. M. (2016). Life Stress and Health: A Review of Conceptual Issues and Recent Findings. *Teaching of Psychology*, 43(4), 346–355. <https://doi.org/10.1177/0098628316662768>
- Slavich, G. M. (2020). Social Safety Theory: A Biologically Based Evolutionary Perspective on Life Stress, Health, and Behavior. *Annual Review of Clinical Psychology*, 16(1), 265–295. <https://doi.org/10.1146/annurev-clinpsy-032816-045159>

- 
- Slavich, G. M. (2022). Social Safety Theory: Understanding social stress, disease risk, resilience, and behavior during the COVID-19 pandemic and beyond. *Current Opinion in Psychology*, 45, 101299. <https://doi.org/10.1016/j.copsyc.2022.101299>
- Slavich, G. M., Roos, L. G., Mengelkoch, S., Webb, C. A., Shattuck, E. C., Moriarity, D. P., & Alley, J. C. (2023). Social Safety Theory: Conceptual foundation, underlying mechanisms, and future directions. *Health Psychology Review*, 1–55. <https://doi.org/10.1080/17437199.2023.2171900>
- Smith, D. K., Pals, S. L., Herbst, J. H., Shinde, S., & Carey, J. W. (2012). Development of a Clinical Screening Index Predictive of Incident HIV Infection Among Men Who Have Sex With Men in the United States. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 60(4), 421–427. <https://doi.org/10.1097/QAI.0b013e318256b2f6>
- Starks, T. J., Tuck, A. N., Millar, B. M., & Parsons, J. T. (2016). Linking Syndemic Stress and Behavioral Indicators of Main Partner HIV Transmission Risk in Gay Male Couples. *AIDS and Behavior*, 20(2), 439–448. <https://doi.org/10.1007/s10461-015-1248-y>
- Stephenson, R., Chavanduka, T. M. D., Sullivan, S., & Mitchell, J. W. (2022). Partner Support and Communication for Pre-exposure Prophylaxis (PrEP) Use Among Male Couples. *Archives of Sexual Behavior*, 51(5), 2549–2562. <https://doi.org/10.1007/s10508-021-02118-1>
- Sternthal, M. J., Slopen, N., & Williams, D. R. (2011). RACIAL DISPARITIES IN HEALTH: How Much Does Stress Really Matter? *Du Bois Review: Social Science Research on Race*, 8(1), 95–113. <https://doi.org/10.1017/S1742058X11000087>
- Sun, S., Hoyt, W. T., Tarantino, N., Pachankis, J. E., Whiteley, L., Operario, D., & Brown, L. K. (2021). Cultural context matters: Testing the minority stress model among Chinese sexual

minority men. *Journal of Counseling Psychology*, 68(5), 526–537.

<https://doi.org/10.1037/cou0000535>



Sun, S., Whiteley, L., & Brown, L. K. (2020). HIV Testing Among Chinese Men Who Have Sex with Men: The Roles of HIV Knowledge, Online Social Life, and Sexual Identity Concerns. *AIDS and Behavior*, 24(2), 437–449. <https://doi.org/10.1007/s10461-019-02471-2>

Sun, Z., Gu, Q., Dai, Y., Zou, H., Agins, B., Chen, Q., Li, P., Shen, J., Yang, Y., & Jiang, H. (2022). Increasing awareness of HIV pre-exposure prophylaxis (PrEP) and willingness to use HIV PrEP among men who have sex with men: A systematic review and meta-analysis of global data. *Journal of the International AIDS Society*, 25(3). <https://doi.org/10.1002/jia2.25883>

Taiwan Centers for Disease Control. (n.d.-a). 公費 PrEP 計畫擴大服務據點及名額. https://www.cdc.gov.tw/Bulletin/Detail/jVWtrYy3T_D0ubOnccZE4A?typeid=9

Taiwan Centers for Disease Control. (n.d.-b). 愛滋病統計資料 [111 年度 12 月]. <https://www.cdc.gov.tw/Category/Page/rCV9N1rGUz9wNr8lggsh2Q>

Time for a change: Putting the Transtheoretical (Stages of Change) Model to rest. (2005). *Addiction*, 100(8), 1036–1039. <https://doi.org/10.1111/j.1360-0443.2005.01139.x>

Topolovec-Vranic, J., & Natarajan, K. (2016). The Use of Social Media in Recruitment for Medical Research Studies: A Scoping Review. *Journal of Medical Internet Research*, 18(11), e286. <https://doi.org/10.2196/jmir.5698>

Tsai, T.-I., Luck, L., Jefferies, D., & Wilkes, L. (2018). Challenges in adapting a survey: Ensuring cross-cultural equivalence. *Nurse Researcher*, 26(1), 28–32. <https://doi.org/10.7748/nr.2018.e1581>

- Turpin, R., Smith, J., Watson, L., Heine, B., Dyer, T., & Liu, H. (2022). Latent profiles of stigma and HIV pre-exposure prophylaxis among Black sexual minority men: An exploratory study. *SN Social Sciences*, 2(9), 192. <https://doi.org/10.1007/s43545-022-00490-w>
- Weinstein, E. R., Lozano, A., Jones, M. A., Safren, S. A., & Harkness, A. (2022). Factors Associated with Post-Exposure Prophylaxis Awareness Among Latino Sexual Minority Men in South Florida. *AIDS Patient Care and STDs*, 36(10), 405–412. <https://doi.org/10.1089/apc.2022.0090>
- WHO ASSIST Working Group. (2002). The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST): Development, reliability and feasibility. *Addiction*, 97(9), 1183–1194. <https://doi.org/10.1046/j.1360-0443.2002.00185.x>
- Williams, S. L., Job, S. A., Todd, E., & Braun, K. (2020). A critical deconstructed quantitative analysis: Sexual and gender minority stress through an intersectional lens. *Journal of Social Issues*, 76(4), 859–879. <https://doi.org/10.1111/josi.12410>
- Wu, H., Wen-Wei Ku, S., Chang, H. H., Li, C., Ko, N., & Strong, C. (2021). Imperfect adherence in real life: A prevention-effective perspective on adherence to daily and event-driven HIV pre-exposure prophylaxis among men who have sex with men – a prospective cohort study in Taiwan. *Journal of the International AIDS Society*, 24(5). <https://doi.org/10.1002/jia2.25733>
- Wu, H.-J., Ku, S. W.-W., Li, C.-W., Ko, N.-Y., Yu, T., Chung, A.-C., & Strong, C. (2021). Factors Associated with Preferred Pre-Exposure Prophylaxis Dosing Regimen Among Men Who Have Sex with Men in Real-World Settings: A Mixed-Effect Model Analysis. *AIDS and Behavior*, 25, 249–258. <https://doi.org/10.1007/s10461-020-02964-5>

Wu, Y., Xie, L., Meng, S., Hou, J., Fu, R., Zheng, H., He, N., & Meyers, K. (2019). Mapping Potential Pre-Exposure Prophylaxis Users onto a Motivational Cascade: Identifying Targets to Prepare for Implementation in China. *LGBT Health*, 6(5), 250–260.
<https://doi.org/10.1089/lgbt.2018.0256>



Yen-Hao Chu, I., Wen-Wei Ku, S., Li, C.-W., Toh, H. S., Yang, C.-J., Wu, K.-S., Wu, H.-J., Chen, S.-S., Kuo, J.-H., Lin, H.-H., & Ko, N.-Y. (2020). Taiwan guideline on oral pre-exposure prophylaxis for HIV prevention – 2018 update. *Journal of Microbiology, Immunology and Infection*, 53(1), 1–10. <https://doi.org/10.1016/j.jmii.2019.09.003>

Yi, S., Tuot, S., Mwai, G. W., Ngini, C., Chhim, K., Pal, K., Igbinedion, E., Holland, P., Choub, S. C., & Mburu, G. (2017). Awareness and willingness to use HIV pre-exposure prophylaxis among men who have sex with men in low- and middle-income countries: A systematic review and meta-analysis. *Journal of the International AIDS Society*, 20(1), 21580.
<https://doi.org/10.7448/IAS.20.1.21580>

Zhang, Y., Peng, B., She, Y., Liang, H., Peng, H.-B., Qian, H.-Z., Vermund, S. H., Zhong, X.-N., & Huang, A. (2013). Attitudes Toward HIV Pre-Exposure Prophylaxis Among Men Who Have Sex with Men in Western China. *AIDS Patient Care and STDs*, 27(3), 137–141.
<https://doi.org/10.1089/apc.2012.0412>

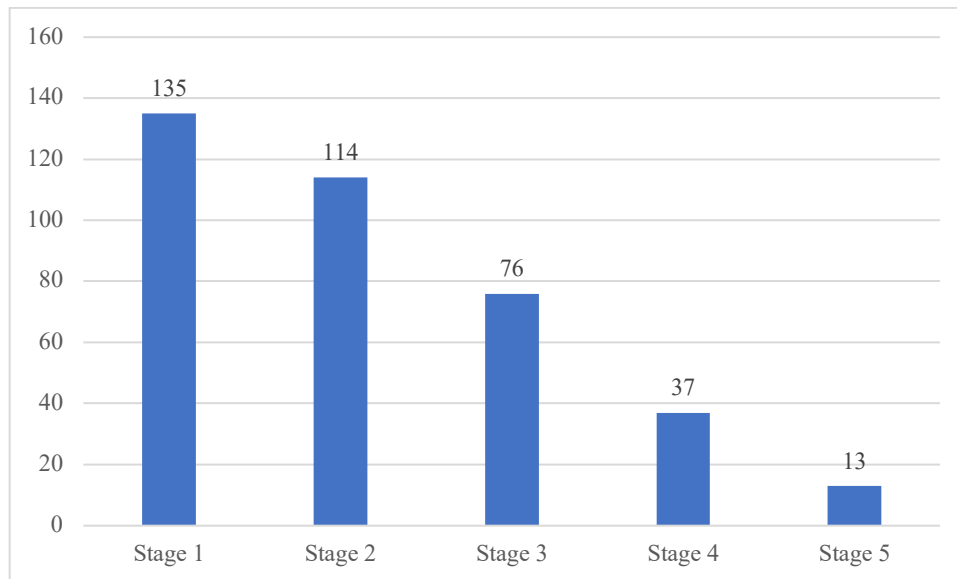
Zhang, Y., Shi, L., Fu, G., Yang, C., Zaller, N. D., Wei, C., & Yan, H. (2023). Willingness to use and intention to adhere to pre-exposure prophylaxis (PrEP) among men who have sex with men in Jiangsu Province, China. *AIDS Care*, 1–9.
<https://doi.org/10.1080/09540121.2023.2200992>

Figure 1. Theoretical Framework of PrEP Utilization



This figure visually presents the four main theories used in this thesis to understand PrEP utilization among sexual minority men (SMM), globally and in Taiwan. Each theory is represented by a distinct circle, highlighting their contributions to the understanding of PrEP utilization. The theories encompass various perspectives and frameworks that inform the factors associated with PrEP uptake among SMM.

Figure 2. Distribution of PrEP Care Continuum Stages Among Sexual Minority Men (SMM) in Taiwan, N = 249



This figure visually presents the distribution of PrEP care continuum stages among SMM in Taiwan. The stages depicted in the figure include pre-contemplation (Stage 1; 54.2%), contemplation (Stage 2; 45.8%), preparation (Stage 3; 30.5%), action and initiation (Stage 4; 14.9%), and maintenance and adherence (Stage 5; 5.2%). Each stage represents a specific phase in the PrEP care continuum, reflecting the progression of individuals from initial consideration to sustained utilization of PrEP.

Table 1. Sample Characteristics, N =249



Predisposing Factors	n	%	M	SD	t or F	p-value
<i>Age, years</i>	249				2.25	>.05
≤30	103	41.4	1.8	1.17		
31 to 40	98	39.4	2	1.26		
>40	48	19.3	2.25	1.34		
<i>Educational attainment</i>	249				0.87	>.05
Master's or higher	73	29.3	2.11	1.38		
Associate or bachelor's	156	62.7	1.92	1.22		
High school or less	20	8.0	1.75	0.91		
<i>Current student</i>	249				1.14	>.05
Yes	67	26.9	1.82	1.17		
No	182	73.1	2.02	1.28		
<i>Relationship status</i>	247				6.22	.002
Single or non-romantic relationship	65	26.3	2.05	1.19		
Closed romantic relationship	102	41.3	2.21	1.37		
Open romantic relationship	80	32.4	1.57	1.03		
<i>Sexual orientation</i>	249				1.55	>.05
Gay	196	78.7	2.02	1.29		
Other sexual identity	53	21.3	1.75	1.05		
Enabling Factors	n	%	M	SD	t or F	p-value
<i>Employment status</i>	246				2.47	>.05
Full-time	172	69.9	2.08	1.34		
Part-time	50	20.3	1.64	0.92		
Not employed	24	9.8	1.92	1.14		
<i>Monthly income, NTD</i>	240				1.27	>.05
<\$30,000	83	34.6	1.86	1.15		
\$30,000 to \$69,999	124	51.7	2.12	1.31		
≥\$70,000	33	13.8	1.88	1.32		
<i>Financial stress, past 6 months</i>	246				-0.53	>.05
Yes	202	82.1	1.97	1.25		
No	44	17.9	1.86	1.21		
<i>National Health Insurance</i>	246				-0.22	>.05
Yes	225	91.5	1.97	1.25		
No	21	8.5	1.9	1.26		
<i>Place Residence</i>	249				-1.74	>.05
Urban	212	85.1	2.01	1.27		
Rural	37	14.9	1.68	1.06		
<i>Born in Taiwan</i>	249				-0.14	>.05
Yes	227	91.2	1.96	1.25		
No	22	8.8	2	1.27		
<i>Previously had an STI test</i>	246				-4.34	<.001
Yes	226	91.9	2.04	1.27		
No	20	8.1	1.3	0.66		
<i>Prior PEP use, past year</i>	247				0.72	>.05
Yes	18	7.3	2.22	1.56		
No	229	92.7	1.95	1.23		
<i>Familiarity with PrEP</i>	249				37.43	<.001
Well-informed	41	16.5	3.29	1.54		
Moderately informed	162	65.1	1.77	1.04		
Unaware/Uninformed	46	18.5	1.46	0.81		
<i>Knowledge about PrEP efficacy</i>	249				-3.58	<.001
Accurate	149	59.8	2.18	1.33		
Inaccurate/Unsure	100	40.2	1.64	1.05		
<i>Aware of a formal PrEP source</i>	246				7.72	<.001

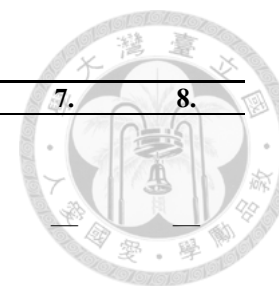


Yes	129	52.4	2.49	1.45		
No	117	47.6	1.41	0.62		
<i>Prior dating app use</i>	248				1.51	>.05
Currently using	184	74.2	2.05	1.26		
Previously used	34	13.7	1.74	1.14		
Never used	30	12.1	1.73	1.26		
<i>Average time on dating apps, weekly</i>	248				0.61	>.05
<3 hours	171	69.0	1.99	1.25		
≥3 hours	47	19.0	2.02	1.24		
Don't use dating apps	30	12.1	1.73	1.26		
<i>Use dating apps to make friends</i>	248				1.02	>.05
Yes	162	65.3	2.02	1.3		
No	86	34.7	1.86	1.15		
<i>Use dating apps for sex</i>	248				2.77	.006
Yes	158	63.7	2.13	1.28		
No	90	36.3	1.69	1.15		
<i>Use dating apps to find dates</i>	248				0.78	>.05
Yes	141	56.9	2.02	1.27		
No	107	43.1	1.9	1.22		
<i>Use dating apps for entertainment</i>	248				0.63	>.05
Yes	131	52.8	2.02	1.28		
No	117	47.2	1.91	1.22		
<i>Use dating apps to connect with SMM</i>	248				2.94	.005
Yes	46	18.5	2.48	1.33		
No	202	81.5	1.85	1.2		
<i>Use a SMM-oriented dating app</i>	248				-2.31	.022
Yes	174	70.2	2.08	1.28		
No	74	29.8	1.7	1.13		
<i>Met a sexual partner via dating apps</i>	244				1.75	>.05
Yes	124	50.8	2.11	1.34		
No	120	49.2	1.83	1.15		
<i>Attention to HIV status on dating apps</i>	245				1.16	>.05
A lot of attention	92	37.6	2.03	1.25		
Some attention	115	46.9	2.04	1.27		
No attention	8	3.3	1.38	0.74		
Don't use dating apps	30	12.2	1.73	1.26		
<i>HIV discourse on dating apps</i>	245				2.49	>.05
High	120	49.0	2.16	1.32		
Low	95	38.8	1.83	1.15		
Don't use	30	12.2	1.73	1.26		
Need Factors	n	%	M	SD	t or F	p-value
<i>Illicit substance use</i>	248				8.85	<.001
Yes, in the past 3 months	35	14.1	2.71	1.53		
Yes, but not past 3 months	45	18.1	2	1.19		
Never	168	67.7	1.78	1.12		
<i>Polysubstance use</i>	248				4.56	.011
Yes, in the past 3 months	15	6.0	2.8	1.47		
Yes, but not past 3 months	18	7.3	2.22	1.35		
Never	215	86.7	1.87	1.19		
<i>Binge drinking, past month</i>	248				1.36	>.05
Yes	68	27.4	1.78	1.22		
No	180	72.6	2.02	1.24		
<i>Chemsex, past six months</i>	248				1.01	<.001
Yes	45	18.1	2.76	1.4		
No	203	81.9	1.79	1.15		
<i>Only male sex partners</i>	249				0.45	>.05

Yes	219	88.0	1.95	1.23		
No	30	12.0	2.07	1.36		
<i>Total anal sex partners, past month</i>	245				15.19	<.001
0	32	13.1	1.88	1.01		
1	107	43.7	1.54	1.02		
≥2	106	43.3	2.43	1.37		
<i>Condomless anal sex, past 6 months</i>	248				4.69	.01
Yes, in the past month	168	67.7	2.01	1.29		
Yes, but not past month	48	19.4	2.21	1.27		
No	32	12.9	1.38	0.75		
<i>STI diagnosis, past 6 months</i>	245				-2.83	.01
Yes	19	7.8	2.95	1.58		
No	226	92.2	1.9	1.19		
<i>HIV Incidence Risk Index for MSM</i>	249				1.01	>.05
≥10 score	225	90.4	1.99	1.27		
<10 score	24	9.6	1.75	1.07		
<i>Sexual violence, lifetime</i>	249				2.46	.017
Yes	40	16.1	2.45	1.4		
No	209	83.9	1.87	1.2		



Table 2. Descriptive Statistics of Variables of Interest, N = 249



	α	Min	Max	N	M	SD	1.	2.	3.	4.	5.	6.	7.	8.
Predisposing Factor														
1. Sexual orientation discrimination	0.86	5	25	248	8.06	4.14	—	—	—	—	—	—	—	—
2. Expectation of rejection	0.89	1	6	249	3.38	1.52	0.42***	—	—	—	—	—	—	—
3. Internalized homophobia	0.93	1	6	246	2.51	1.45	0.34***	0.43***	—	—	—	—	—	—
4. Identity affirmation	0.84	1	6	247	3.97	1.23	-0.05	-0.23***	-0.50***	—	—	—	—	—
Enabling Factors														
5. Family support	0.78	1	6	248	3.68	1.36	-0.04	-0.28***	-0.09	0.44***	—	—	—	—
6. Community connectedness	0.89	1	6	248	3.65	1.00	0.15*	0.17**	0.03	0.19**	0.18**	—	—	—
Need Factors														
7. Sexual satisfaction	0.88	6	30	247	21.90	5.39	-0.13*	-0.01	-0.15*	0.22***	0.10	0.09	—	—
8. Depression	0.93	0	4	247	1.68	1.48	0.25***	0.17**	0.18**	-0.18**	-0.23***	0.05	-0.26***	—
Outcome														
9. PrEP care continuum	—	1	5	249	1.96	1.25	-0.15*	-0.15*	-0.13*	0.13*	0.06	0.18**	-0.05	-0.09

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 3. Predisposing, Enabling, and Need Factors Associated with PrEP Utilization Using Univariate Linear Regressions, N = 249

	n	B	SE	95% CI	
				LL	UL
Predisposing Factors					
<i>Age, ref. ≤30 years</i>	249	—	—	—	—
31 to 40		0.06	0.16	-0.26	0.38
>40		0.35	0.2	-0.04	0.75
<i>Education level, ref. high school or less</i>	249	—	—	—	—
Master's or higher		0.21	0.17	-0.14	0.55
Associate or bachelor's		-0.11	0.16	-0.43	0.21
<i>Current student, ref. yes</i>		-0.2	0.18	-0.55	0.16
<i>Relationship status, ref. single or non-romantic relationship</i>	247	—	—	—	—
Closed romantic relationship		-0.57***	0.17	-0.90	-0.24
Open romantic relationship		0.42***	0.16	0.11	0.73
<i>Sexual orientation, ref. gay</i>	249	-0.27	0.19	-0.65	0.11
<i>Sexual orientation discrimination</i>	248	-0.04*	0.02	-0.08	-0.01
<i>Expectation of rejection</i>	249	-0.13*	0.05	-0.23	-0.02
<i>Internalized homophobia</i>	246	-0.11*	0.05	-0.22	0.00
<i>Identity affirmation</i>	247	0.13*	0.06	0.00	0.25
Enabling Factors					
<i>Employment status, ref. full-time</i>	246	—	—	—	—
Part-time		-0.42*	0.2	-0.81	-0.03
Not employed		-0.07	0.27	-0.6	0.47
<i>Monthly income, NTD, ref. <\$30,000</i>	240	—	—	—	—
\$30,000 to \$69,999		0.26	0.16	-0.06	0.58
≥\$70,000		-0.14	0.24	-0.60	0.33
<i>Financial stress, past 6 months, ref. none</i>	246	0.11	0.21	-0.30	0.51
<i>National Health Insurance, ref. yes</i>	246	0.06	0.28	-0.50	0.63
<i>Previously had an STI test, ref. no</i>	246	0.74*	0.29	0.17	1.3
<i>Prior PEP use, past year, ref. yes</i>	247	0.27	0.31	-0.33	0.87
<i>Familiarity with PrEP, ref. unaware/unfamiliar</i>	249	—	—	—	—
Well-informed		1.59***	0.19	1.22	1.96
Moderately informed		-0.55***	0.16	-0.87	-0.23
<i>Knowledge about PrEP efficacy, ref. unsure/inaccurate</i>		0.54***	0.16	0.23	0.85
<i>Aware of a formal PrEP source, ref. no</i>	246	1.08***	0.14	0.79	1.36
<i>Municipality status, ref. special</i>	249	0.34	0.22	-0.10	0.78
<i>Born in Taiwan, ref. yes</i>	249	0.04	0.28	-0.51	0.59
<i>Prior dating app use, ref. never used</i>	248	—	—	—	—
Currently using		0.31	0.18	-0.04	0.67
Previously used		-0.27	0.23	-0.72	0.18
<i>Average time on dating apps, weekly, ref. never used</i>	248	—	—	—	—
<3 hours		0.09	0.17	-0.25	0.42
≥3 hours		0.07	0.20	-0.33	0.47
<i>Use dating apps to make friends, ref. yes</i>	248	0.16	0.17	-0.16	0.49
<i>Use dating apps for sex, ref. yes</i>	248	0.44**	0.16	0.12	0.76
<i>Use dating apps to find dates, ref. yes</i>	248	-0.12	0.16	-0.44	0.19
<i>Use dating apps for entertainment, ref. yes</i>	248	-0.10	0.16	-0.41	0.21
<i>Use dating apps to connect with SMM, ref. yes</i>	248	0.63**	0.20	0.23	1.02
<i>Use a SMM-oriented dating app, ref. yes</i>	248	0.38*	0.17	0.04	0.72
<i>Met a sexual partner via dating apps, ref. yes</i>	244	0.28	0.16	-0.04	0.59
<i>Attention to HIV status on dating apps</i>	245	—	—	—	—
A lot of attention		0.08	0.17	-0.24	0.41
Some attention		0.12	0.16	-0.20	0.44
No attention		-0.62	0.45	-1.51	0.26
<i>HIV disclosure on dating apps, ref. none/low</i>	245	—	—	—	—
High		0.35*	0.16	0.04	0.66
Low		-0.24	0.16	-0.56	0.08
<i>Family support</i>	248	0.06	0.06	-0.06	0.17
<i>Community connectedness</i>	248	0.23**	0.08	0.07	0.38

Need Factors	n	B	SE	LL	UL
<i>Illicit substance, ref. never</i>	248				
Yes, in the past 3 months		0.89***	0.22	0.46	1.32
Yes, but not in the past 3 months		0.06	0.20	-0.34	0.46
<i>Polysubstance use, ref. never</i>	248	—	—	—	—
Yes, in the past 3 months		0.9**	0.32	0.26	1.54
Yes, but not in the past 3 months		0.29	0.30	-0.30	0.89
<i>Binge drinking, past month, ref. no</i>	248	-0.24	0.18	-0.58	0.11
<i>Chemsex, past 6 months, yes</i>	248	0.96***	0.20	0.57	1.35
<i>Only male sex partners, lifetime, ref. no</i>	249	-0.12	0.24	-0.60	0.36
<i>Total anal sex partners, past month, ref. 0</i>	245	—	—	—	—
1		-0.76***	0.15	-1.07	-0.46
≥2		0.82***	0.15	0.51	1.12
<i>Condomless anal sex, ref. never in the past 6 months</i>	248	—	—	—	—
Yes, in the past month		0.13	0.17	-0.20	0.47
Yes, but not in the past month		0.30	0.20	-0.09	0.70
<i>STI diagnosis, ref. never in past 6 months</i>	245	1.05***	0.29	0.47	1.62
<i>HIV Incidence Risk Index for MSM, ref. <10 score</i>	249	0.24	0.27	-0.29	0.77
<i>Sexual satisfaction</i>	242	-0.01	0.01	-0.04	0.02
<i>Sexual violence, lifetime, ref. no</i>	249	0.58**	0.21	0.16	1.00
<i>Depression, past two weeks</i>	247	-0.07	0.05	-0.18	0.03

* $p < .05$; ** $p < .01$; *** $p < .001$

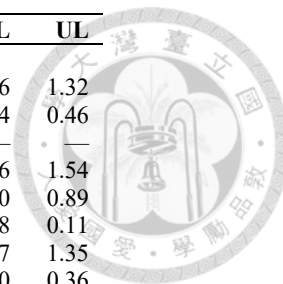
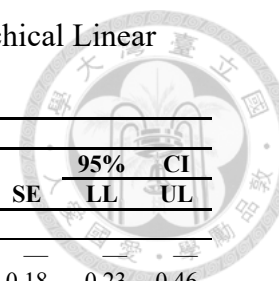


Table 4. Predisposing, Enabling, and Need Factors Associated with PrEP Utilization Using Multivariate Hierarchical Linear Regressions, N = 228



	Model 1		Model 2				Model 3					
	B	SE	95% CI		B	SE	95% CI		B	SE	95% CI	
			LL	UL			LL	UL			LL	UL
Step 1: Predisposing Factors												
<i>Relationship status, ref. single or non-romantic relationship</i>	—	—	—	—	—	—	—	—	—	—	—	—
Open romantic relationship	0.11	0.20	-0.28	0.51	0.11	0.17	-0.23	0.44	0.11	0.18	-0.23	0.46
Closed romantic relationship	-0.58**	0.21	-0.99	-0.16	-0.41*	0.19	-0.78	-0.03	-0.25	0.20	-0.64	0.14
<i>Sexual orientation discrimination</i>	-0.02	0.02	-0.06	0.03	-0.01	0.02	-0.05	0.03	-0.02	0.02	-0.06	0.03
<i>Expectation of rejection</i>	-0.04	0.06	-0.16	0.08	0.01	0.05	-0.09	0.12	0.01	0.06	-0.10	0.12
<i>Internalized homophobia</i>	-0.06	0.07	-0.20	0.08	-0.04	0.06	-0.16	0.07	-0.04	0.06	-0.16	0.07
<i>Identity affirmation</i>	0.03	0.08	-0.12	0.18	-0.02	0.07	-0.15	0.11	-0.05	0.07	-0.18	0.08
Step 2: Enabling Factors												
<i>Part-time employment, ref. full-time</i>	—	—	—	—	-0.16	0.17	-0.49	0.17	-0.13	0.17	-0.46	0.20
<i>Previously had an STI test, ref. never</i>	—	—	—	—	0.44	0.26	-0.07	0.95	0.33	0.26	-0.18	0.84
<i>Familiarity with PrEP, ref. unaware/unfamiliar</i>	—	—	—	—	—	—	—	—	—	—	—	—
Well-informed about PrEP	—	—	—	—	0.86**	0.26	0.34	1.37	0.60*	0.27	0.06	1.14
Moderate PrEP familiarity	—	—	—	—	-0.26	0.19	-0.64	0.12	-0.34	0.19	-0.72	0.05
<i>Knowledge about PrEP efficacy, ref. unsure/inaccurate</i>	—	—	—	—	0.31*	0.15	0.02	0.60	0.29*	0.15	0.00	0.59
<i>Aware of a formal PrEP source, ref. no</i>	—	—	—	—	0.73***	0.15	0.44	1.02	0.77***	0.15	0.48	1.06
<i>Use dating apps for sex, ref. yes</i>	—	—	—	—	0.05	0.16	-0.26	0.36	0.47*	0.18	0.12	0.83
<i>Use dating apps to connect with SMM, ref. yes</i>	—	—	—	—	0.43*	0.18	0.07	0.79	-0.04	0.16	-0.36	0.27
<i>Use a SMM-oriented dating app, ref. yes</i>	—	—	—	—	-0.01	0.17	-0.34	0.33	-0.07	0.17	-0.41	0.26
<i>High HIV disclosure on dating apps, ref. none/low</i>	—	—	—	—	0.28*	0.14	0.01	0.55	0.28*	0.14	0.01	0.56
<i>Community connectedness</i>	—	—	—	—	0.07	0.07	-0.08	0.21	0.05	0.07	-0.10	0.19
Step 3: Need Factors												
<i>Illicit substance, past 3 months, ref. never</i>	—	—	—	—	—	—	—	—	-0.08	0.30	-0.67	0.51
<i>Polysubstance use, past 3 months, ref. never</i>	—	—	—	—	—	—	—	—	0.15	0.37	-0.58	0.87
<i>Chemsex, past 6 months, ref. no</i>	—	—	—	—	—	—	—	—	0.24	0.24	-0.24	0.71
<i>STI diagnosis, past 6 months, ref. no</i>	—	—	—	—	—	—	—	—	0.21	0.27	-0.32	0.74
<i>Total anal sex partners, past month, ref. 0</i>	—	—	—	—	—	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—	—	-0.33	0.22	-0.76	0.10
≥2	—	—	—	—	—	—	—	—	0.12	0.22	-0.32	0.56
<i>Sexual violence, lifetime, ref. never.</i>	—	—	—	—	—	—	—	—	0.09	0.20	-0.29	0.48
R²	0.08		0.41				0.45					
Adjusted R²	0.06		0.37				0.38					
F	3.23***		10.82***				1.88					
ΔR²			0.33				0.04					
ΔF			7.59***				-6.82					

* p < .05; ** p < .01; *** p < .001