Abstract:

Objectives: The effectiveness and efficiency of Pre-exposure Prophylaxis (PrEP) in reducing the transmission of human immunodeficiency virus (HIV) among men who have sex with men (MSM) relies on how widely it is adopted and adhered to, particularly among high-risk groups of MSM. The meta-analysis aims to gather and analyze existing evidence on various factors related to PrEP adherence in MSM, including demographic characteristics, sexual behaviors, substances use, and psychosocial factors.

Methods: The meta-analysis followed the PRISMA guidelines. The search included articles published between January 2018 and December 2022, obtained from databases such as PubMed, ScienceDirect, and Scopus. The studies that were included in the analysis reported the proportion of MSM who demonstrated adherence to PrEP and underwent quality appraisal using Newcastle-Ottawa Scales.

Results: Of the 268 studies initially identified, only 12 met the inclusion criteria and were included in the final meta-analysis. The findings indicated that education (OR = 1.64, 95% CI: 1.12, 2.40), number of sexual partners (OR = 1.16, 95% CI: 1.02, 1.31), engaging in sexual activities with an HIV-positive partner (OR = 1.59, 95% CI: 1.16, 2.26), substance use (OR = 0.83, 95% CI: 0.70, 0.99), and lower levels of depression (OR = 0.55, 95% CI: 0.37, 0.82) were associated with higher rates of PrEP adherence among MSM.

Conclusions: However, further research is necessary to investigate PrEP adherence more comprehensively. The findings of this meta-analysis can be utilized to inform interventions aimed at improving PrEP adherence among MSM and provide directions for future research in this area.

Key words: Pre-exposure prophylaxis (PrEP), Adherence, Gay and Bisexual, Meta-analysis, Systematic review
INTRODUCTION

According to the World Health Organization (WHO) in 2022, approximately 650,000 individuals lost their lives to HIV-related causes, and around 1.5 million people contracted HIV. Unfortunately, there is currently no known cure for HIV infection [1]. The WHO identifies certain groups of individuals engaging in risky behaviors, such as penile-anal sex, unprotected intercourse, having multiple sexual partners, and using alcohol and illicit drugs, as being particularly vulnerable to HIV/AIDS. These groups are referred to as Key Populations (KPs). Despite advancements in reducing AIDS-related deaths, the number of new HIV infections has been increasing, particularly among KPs, including men who have sex with men (MSM), female sex workers (FSWs), and transgender women (TGW) [2,3]. In 2017, the US Public Health Service (USPHS) revised its guidelines, recommending the provision of pre-exposure prophylaxis (PrEP) for MSM who met specific criteria. To be eligible for PrEP, MSM must be aged 18 or older, HIV-negative, and have engaged in anal intercourse in the past 6 months. They should also not be in a mutually monogamous relationship with a recently tested HIV-negative man. Additionally, they must meet at least one of the following criteria: 1) having engaged in condomless anal intercourse in the past 6 months or 2) having been diagnosed with a bacterial sexually transmitted infection (STI) (e.g., gonorrhea, chlamydia, syphilis) within the preceding six months. Notably, the indication referencing being in an ongoing relationship with a partner living with HIV was removed from the list of recommended indications [4].

Pre-exposure prophylaxis (PrEP) has demonstrated remarkable effectiveness in reducing the acquisition of HIV and has led to significant declines in new HIV infections when incorporated into a comprehensive prevention strategy [5]. For gay and bisexual men (GBM), there are two primary recommended dosing approaches. The first is a daily regimen, which involves taking PrEP continuously every day of the week. The second is an event-based regimen, where PrEP is used intermittently specifically before and after engaging in sexual activity. This entails taking two doses of PrEP within 2 to 24 hours before sex, followed by one dose at 24 hours and another at 48 hours after the initial doses. Moreover, a detailed analysis of the data has confirmed that GBM who take PrEP four times per week can achieve a comparable level of HIV risk reduction (96-99%) to those who follow either the daily or event-based regimens [6].
The study of PrEP implementation is a complex task that requires careful evaluation of both the usage of PrEP and individuals’ sexual activities [7]. The effectiveness and efficiency of PrEP in reducing HIV transmission among MSM relies heavily on the adoption and adherence to PrEP by those who are at the highest risk [8]. Unfortunately, PrEP adherence rates are frequently suboptimal, resulting in improper usage, such as forgetting to take the medicine, being too busy, or concerns about potential side effects [9]. Nonetheless, there might be other influential factors affecting PrEP adherence among MSM as well. Currently, there is a lack of comprehensive systematic reviews that consolidate existing knowledge regarding demographic characteristics, sexual behaviors, substance use, and psychosocial factors associated with PrEP adherence specifically among MSM. Therefore, the objectives of this systematic review and meta-analysis are to identify factors that are linked to PrEP adherence among MSM. These factors include demographic characteristics, sexual behaviors, substances use, and psychosocial factors that influence the adherence to PrEP among MSM.

METHOD
Search strategy and data sources
Our systematic review was conducted and reported following the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework [10]. In order to obtain a comprehensive range of relevant literature, three databases were utilized: PubMed, Scopus, and ScienceDirect. These databases were chosen because they cover a wide array of disciplines, including medicine, nursing, health professions, psychology, and sociology. The search strategy utilized a combination of PICO terms to target specific aspects of the study. The Population term focused on MSM, while the Intervention term included relevant factors. The Control term was not applicable in this case, and the Outcome term focused on PrEP adherence. Various combinations of terms, along with the utilization of headings (MeSH), keywords, and phrases, were employed to ensure a comprehensive search. The search was conducted in January 2023.

Eligibility criteria and study selection
We conducted an initial screening of titles and abstracts to determine the eligibility of studies for inclusion in the meta-analysis. Specifically, we sought studies that reported on the adherence of MSM to PrEP. To meet the inclusion criteria for the meta-analysis, studies needed to meet the following criteria: (a) focus on MSM as the target population, (b) assess the behavior to PrEP adherence using methods such as self-report or laboratory testing, (c) provide sufficient data on factors correlated with PrEP adherence, (d) be fully published in peer reviewed journals, (e) employ cohort study designs, (f) be published in English between January 2018 and December 2022, and (g) provide an odds ratio (OR) estimate. We excluded experimental studies, cross-sectional studies, systematic reviews, and meta-analyses from our analysis. The articles were subjected to a review by two reviewers to establish eligibility, and any discrepancies were resolved through team discussion.

Data extraction and quality assessment

Two authors independently extracted data from each included study, including information on first authors’ names, publication years, study locations, samples, types of PrEP utilized, and quality assessment. Any disagreements were resolved through team discussion. The methodological quality of the studies was evaluated using the Newcastle-Ottawa Scale (NOS) [11]. This tool can be used either as a checklist or a scale. Separate NOS scales were developed for cohort studies. The NOS contains eight items, categorized into three dimensions: selection, comparability, and depending on the study type, the outcome. For each item, a series of response options is provided. A star system is used to allow a semi-quantitative assessment of study quality. The NOS ranges between zero to nine stars. The scores are categorized as good (7-9 stars and all three domains complete), fair (4-6 stars and all domains complete), or poor (0-3 stars or not all domains evaluate).

Statistical analysis

We examined the association between demographic characteristics, sexual behaviors, substance use, and psychosocial factors with PrEP adherence by calculating OR with 95% confidence intervals (CI). In the meta-analysis, we employed either fixed-effects or random-effects models to estimate the OR with 95% CI and we utilized the I² statistics to assess heterogeneity across the included studies [12].
If the $I^2$ statistic indicated significant heterogeneity, we opted for the random-effects model. In cases where there was no significant heterogeneity, we utilized the fixed-effects model. To explore potential sources of heterogeneity, subgroup meta-analysis was performed to assess the difference study location. Finally, Egger’s test was adopted to evaluate publication bias. All statistical analyses were performed using STATA 17 software (StataCorp, College Station, TX, USA).

RESULTS

Include studies and studies characteristics

In this systematic review, we initially identified 268 articles through database searches. After assessing the eligibility of 35 full-text articles, we ultimately selected 12 studies for inclusion in both the systematic review and meta-analysis (Figure 1). A summary of the study characteristics of these studies can be found in Table 1. The selected studies were published between 2018 and 2022, and they collectively involved a total of 5,578 participants. All of the studies followed a cohort study design. Among these, five studies were conducted in Eastern countries, while the remaining seven were carried out in Western countries. The age range of the participants across the studies was from 18 to 65 years (mean age = 25.2 years). According to the Newcastle-Ottawa scales, five of the studies included in the analysis were rated as having good quality, while seven were assessed as having fair quality.

Demographic characteristics

As presented in Table 2, the pooled effect results demonstrated a significant association between education and PrEP adherence (OR, 1.64; 95% CI, 1.12 to 2.40; $p = 0.012; I^2 = 73.9\%$). However, no significant associations were found between PrEP adherence and the following factors: age < 25 years (OR, 1.01; 95% CI, 0.43 to 2.41; $p = 0.979; I^2 = 76.6\%$), age > 25 years (OR, 1.07; 95% CI, 0.81 to 1.42; $p = 0.635; I^2 = 77.5\%$), and financial situation (OR, 1.78; 95% CI, 0.91 to 3.49; $p < 0.091; I^2 = 92.8\%$) (Figure S1).

Sexual behaviors
As shown in Table 2, the pooled effect results demonstrated a significant association between PrEP adherence and the number of partners (OR, 1.16; 95% CI, 1.02 to 1.31; \( p = 0.021; I^2 = 38.5\% \)), as well as having sexual encounters with an HIV-positive partner (OR, 1.59; 95% CI, 1.11 to 2.26; \( p = 0.011; I^2 = 0.0\% \)). However, there were no significant associations found between PrEP adherence and the following factors: having regular partners (OR, 0.74; 95% CI, 0.42 to 1.30; \( p = 0.301; I^2 = 76.8\% \)), engaging with casual partners (OR, 1.10; 95% CI, 0.92 to 1.30; \( p = 0.287; I^2 = 0.0\% \)), having sexually transmitted infections (OR, 0.92; 95% CI, 0.68 to 1.23; \( p = 0.564; I^2 = 0.0\% \)), and condom use (OR, 1.02; 95% CI, 0.78 to 1.33; \( p = 0.912; I^2 = 53.8\% \)) (Figure S2-S3).

Substance use

As shown in Table 2, the pooled effect results demonstrated a significant association between substance use and PrEP adherence (OR, 0.83; 95% CI, 0.70 to 0.99; \( p = 0.037; I^2 = 46.1\% \)) (Figure S4).

Psychosocial factors

As shown in Table 2, the pooled effect results indicated a significant association between depression and PrEP adherence (OR, 0.55; 95% CI, 0.37 to 0.82; \( p = 0.003; I^2 = 18.9\% \)). However, there was no significant association between perception of HIV prevention and PrEP adherence (OR, 0.96; 95% CI, 0.88 to 1.06; \( p = 0.457; I^2 = 79\% \)) (Figure S5).

Subgroup analysis

Age > 25 years, education, financial situation, regular partner, and perception of HIV prevention showed a high degree of heterogeneity (\( I^2 > 50\% \)). To investigate the sources of this heterogeneity, we performed a meta-regression analysis. The study location significantly explained the variance in the effects of these factors on PrEP adherence. Subsequently, we conducted a subgroup analysis based on study location (Table 3). The results from this analysis revealed that in the Eastern population, education (OR, 1.79; 95% CI, 1.20 to 2.66; \( p < 0.01; I^2 = 75.1\% \)) and perception of HIV prevention (OR, 0.75; 95% CI, 0.65 to 0.87; \( p < 0.01; I^2 = 0.0\% \)) was associated with PrEP adherence.
On the other hand, in the Western population, financial situation showed an association with PrEP adherence (OR, 2.34; 95% CI, 1.25 to 4.38; \( p < 0.01; I^2 = 82.7\% \)).

**Publication bias**

The findings from the Egger’s test (age > 25; \( p = 0.619 \), education; \( p = 0.377 \), financial situation; \( p = 0.601 \), number of partners; \( p = 0.076 \), regular partner; \( p = 0.769 \), condom use; \( p = 0.476 \), sexually transmitted infections; \( p = 0.574 \), depression; \( p = 0.468 \), perception of HIV prevention; \( p = 0.649 \), substances use; \( p = 0.550 \)) suggest that statistical methods may not effectively identify publication bias due to the limited number of studies, particularly in relation to age < 25, casual partners, and sex with HIV partners.

**DISCUSSION**

This systematic review and meta-analysis investigated factors affecting PrEP adherence among MSM. The analysis of 12 included studies revealed that one demographic characteristic (education) and two sexual behaviors (number of partners and sex with HIV positive partner), along with one psychosocial factor (depression), were associated with PrEP adherence among MSM. Conversely, no significant associations were found between age, financial situation, having regular partners, having casual partners, experiencing sexually transmitted infections, condom use, perception of HIV prevention, and substance use with PrEP adherence. Subgroup analysis based on study location indicated that education and perception of HIV prevention were associated with PrEP adherence in the Eastern population, while financial situation was linked to PrEP adherence in the Western population. Additionally, based on the Egger’s test, there was no evidence of publication bias in the included studies.

Educational attainment was found to be associated with PrEP adherence among MSM, consistent with several previous studies [15, 21]. These studies consistently reported a positive relationship between higher education levels and improved PrEP adherence. Conversely, some studies indicated that individuals with lower education levels, including those with limited HIV knowledge, exhibited poorer PrEP adherence [17, 25]. These findings underscore the potential impact of education...
on PrEP adherence and emphasize the importance of considering educational backgrounds and HIV knowledge in understanding adherence behaviors. This suggests that education may significantly influence attitudes and behaviors related to PrEP among MSM. Therefore, interventions aimed at enhancing PrEP adherence should consider the educational context and target programs to address specific knowledge gaps, thus improving adherence outcomes across diverse populations.

Sexual behaviors, such as the number of partners and having sexual encounters with an HIV-positive partner, were associated with PrEP adherence among MSM. Consistent with previous studies, the number of partners was significantly associated with PrEP adherence among MSM [14,20]. This finding indicates that individuals with multiple sexual partners are more likely to have improved adherence to PrEP. The positive association suggests that those engaging in higher-risk sexual behavior may perceive the importance of PrEP in reducing their risk of HIV transmission, leading to better adherence to the preventive medication. Furthermore, this result aligns with previous studies that have recommended PrEP as a strategy for HIV serodiscordant couples [26,27]. This finding indicates that individuals who are in sexual relationships with HIV-positive partners are more likely to adhere to PrEP. These findings highlight the importance of considering individual sexual behavior and partner characteristics when assessing and promoting PrEP adherence. The associations between the number of partners and sexual encounters with HIV-positive partners emphasize the need for targeted interventions and tailored counselling for individuals engaging in higher-risk sexual behaviors. Healthcare providers should address the specific needs of these individuals, providing them with the necessary support, education, and information to ensure optimal PrEP adherence and reduce the risk of HIV transmission.

Substance use was found to be associated with lower PrEP adherence among MSM, which aligns with the results of several previous studies [21,28]. This suggests that individuals who engage in substance use are less likely to adhere to their PrEP regimens effectively. The negative association between substance use and PrEP adherence raises concerns about the potential impact of substance use on HIV prevention efforts. Substance use may lead to decreased motivation, impaired decision-making, and increased forgetfulness [29-30], hindering individuals’ ability to consistently adhere to their PrEP medication [31]. Moreover, substance use may also be linked to risky sexual behaviors, which could
further increase the risk of HIV transmission among this population. However, it is worth noting that some studies [19,20] have reported no significant association between substance use and PrEP adherence. This contrasting finding suggests that the relationship between substance use and PrEP adherence may not be universally consistent across all populations or settings. Factors such as variations in substance use patterns, cultural norms, and access to healthcare services may contribute to these discrepancies [28,32,33]. These conflicting results highlight the complexity of the relationship between substance use and PrEP adherence. It is essential to consider these factors when interpreting the findings and developing interventions to improve PrEP adherence among MSM. Substance use should be approached with sensitivity and understanding, recognizing that addressing substance use issues may be crucial in promoting optimal PrEP adherence.

Psychosocial factors, such as depression, were found to be associated with PrEP adherence among MSM. Consistent with previous studies, participants who showed depressive symptoms were negatively associated with PrEP adherence [34,35]. This finding suggests that individuals experiencing depression are less likely to adhere to PrEP regimens effectively. The negative association implies that individuals with depression may face unique challenges or barriers that hinder their ability to consistently adhere to PrEP medication. Depression can impact one’s motivation, self-care practices, and overall mental well-being [36,37], subsequently affect adherence behaviors. These findings emphasize the importance of addressing mental health concerns in the context of HIV prevention and care. Healthcare providers and support services should recognize the potential impact of depression on PrEP adherence and tailor interventions accordingly. Integrating mental health support and counseling as part of PrEP programs may prove beneficial in improving adherence outcomes among individuals with depression.

The findings from the subgroup based on study location revealed different factors associated with PrEP adherence in the Eastern and Western populations. In the Eastern population, two factors were found to be associated with PrEP adherence: education and perception of HIV prevention. The pooled effect for education indicates that individuals with higher levels of education in this region were more likely to adhere to PrEP. This finding aligns with previous studies [17,20,24] that have reported a positive association between education and PrEP adherence, suggesting that better-educated individuals
may have a greater understanding of the benefits and importance of PrEP in preventing HIV transmission. In contrast, the perception of HIV prevention was negatively associated with PrEP adherence in the Eastern population. This finding, that individuals with a more positive perception of HIV prevention measures, including PrEP, were less likely to adhere to the medication, may seem counterintuitive and requires careful consideration. There could be a possible explanation for this observation. Individuals who perceive themselves to be at low risk of acquiring HIV may believe that they do not need to adhere to PrEP as rigorously [38,39]. They may feel confident in their ability to avoid HIV transmission through preventive methods, leading to lower adherence to PrEP. In the Western population, the financial situation was significantly associated with PrEP adherence. This indicates that individuals with better financial circumstances in this region were more likely to adhere to PrEP. Financial barriers may influence access to healthcare and preventive services, including PrEP [13,40]. Therefore, individuals with improved financial situations may find it easier to access and afford PrEP medication, leading to better adherence. The differences in the factors associated with PrEP adherence between the Eastern and Western populations highlight the importance of considering regional contexts and cultural factors in HIV prevention efforts. Tailoring interventions to address the specific needs and challenges faced by different populations can enhance PrEP uptake and adherence.

The study had several limitations. Firstly, it relied on data from only three databases, which, although covering a broad range of disciplines, might not have included all relevant studies on the subject. To enhance the comprehensiveness of the literature review and reduce potential bias, future research could broaden the search by incorporating additional databases like Embase, CINAHL, and regional databases. Secondly, certain factors showed high heterogeneity, which could impact the robustness and generalizability of the meta-analysis findings. For improved insights, future studies could conduct sensitivity and subgroup analyses considering various factors, such as study design, participant demographics, and healthcare settings, to explore their contributions to heterogeneity. Thirdly, the study primarily included research from Eastern and Western countries, potentially limiting the generalizability of the findings to the global MSM population. Future research should incorporate studies from diverse regions, including low- and middle-income countries, to gain a more comprehensive understanding of the factors influencing PrEP adherence across varied cultural contexts.
and healthcare systems. Finally, the nature of prospective cohort studies among the included studies may be susceptible to loss to follow-up. Cross-sectional studies are better suited to determining prevalence such as the number of cases in a population at a given point in time and are useful for identifying associations with factors related to PrEP adherence.

CONCLUSIONS

This systematic review and meta-analysis aimed to uncover the factors influencing PrEP adherence in MSM. The study identified several potential factors associated with PrEP adherence among MSM, including education level, the number of sexual partners, engaging in sexual encounters with HIV-positive partners, substance use and experiencing depression. The findings offer valuable insights into the factors affecting PrEP adherence in this population, emphasizing the importance of personalized interventions to address unique challenges and enhance PrEP adherence across diverse populations. Understanding these factors is essential in developing effective strategies to prevent HIV transmission and improve the overall health outcomes of MSM.

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CONFLICT OF INTERESTS

The authors have no conflicts of interest associated with the material presented in this paper.

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REFERENCE


<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Country</th>
<th>Sample</th>
<th>Type of PrEP</th>
<th>Outcome measure</th>
<th>Quality Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eubanks et al. (2022)[14]</td>
<td>West Africa</td>
<td>n = 520 MSM, age ≥18 years; median age 25.6 years.</td>
<td>Daily tablet</td>
<td>TDF/FTC and ED</td>
<td>Good</td>
</tr>
<tr>
<td>Grinsztejn et al. (2018)[16]</td>
<td>Brazil</td>
<td>n = 354 MSM, ages 18 years or older</td>
<td>Daily tablet</td>
<td>TDF/FTC</td>
<td>Fair</td>
</tr>
<tr>
<td>Hojilla et al. (2018)[17]</td>
<td>USA</td>
<td>n = 330 MSM, least 18 years of age, median age 29 years.</td>
<td>Tablet TFV-DP</td>
<td>Laboratory test</td>
<td>Fair</td>
</tr>
<tr>
<td>Liu et al. (2021)[18]</td>
<td>China</td>
<td>n = 496 MSM, ages 18–65 years, median age 28 years.</td>
<td>Daily tablet</td>
<td>Self-report</td>
<td>Good</td>
</tr>
<tr>
<td>Monteiro et al. (2021)[19]</td>
<td>Brazil</td>
<td>n = 338, MSM and TGW, age ≥18 years old; median, age 30 years.</td>
<td>Daily tablet</td>
<td>TDF/FTC</td>
<td>Fair</td>
</tr>
<tr>
<td>Okafor et al. (2020)[20]</td>
<td>USA</td>
<td>n = 226 black MSM, age ≥18 years old, median age 25 years.</td>
<td>Daily tablet</td>
<td>Laboratory test</td>
<td>Good</td>
</tr>
<tr>
<td>Seekaew et al. (2019)[21]</td>
<td>Thailand</td>
<td>n = 564 MSM, ages 18 years or older, median age 28.9 years old</td>
<td>Daily tablet</td>
<td>TDF/FTC</td>
<td>Fair</td>
</tr>
<tr>
<td>Wang et al. (2020)[22]</td>
<td>China</td>
<td>n = 1023, MSM; Aged 18–65 years old, median age 29 years</td>
<td>Daily tablet</td>
<td>TDF/FTC and ED</td>
<td>Fair</td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Sample</td>
<td>Age</td>
<td>Placebo</td>
<td>Study Drug</td>
</tr>
<tr>
<td>------------------</td>
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</tr>
<tr>
<td>Wheeler et al.</td>
<td>USA</td>
<td>n = 226 black MSM, being 18 years and older, median age 26 years.</td>
<td>Daily tablet</td>
<td>FTC/TDF</td>
<td>Good</td>
</tr>
<tr>
<td>Whitfield et al.</td>
<td>USA</td>
<td>n = 226 Black MSM; ages 25 years or older, median age 26 years.</td>
<td>Daily tablet</td>
<td>FTC/TP, TFV-DP</td>
<td>Fair</td>
</tr>
<tr>
<td>Wu et al.</td>
<td>Taiwan</td>
<td>n = 374 MSM; ages 18 or older</td>
<td>Daily tablet</td>
<td>TDF/FTC and ED</td>
<td>Good</td>
</tr>
</tbody>
</table>

**Note:**
- FTC/TDF: tenofovir/disoproxil fumarate
- TFV-DP: tenofovir diphosphate
- ED: event dose
- CAI: condomless anal intercourse
- MSM: men who have sex with men
- TGW: transgender women
Table 2. Pooled effect of factors on PrEP adherence among MSM.

<table>
<thead>
<tr>
<th>factors</th>
<th>No. of studies</th>
<th>OR (95% CI)</th>
<th>Z</th>
<th>p-value</th>
<th>I²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &lt; 25 years</td>
<td>2</td>
<td>1.01 (0.43, 2.41)</td>
<td>0.027</td>
<td>0.979</td>
<td>76.6%</td>
</tr>
<tr>
<td>Age &gt; 25 years</td>
<td>6</td>
<td>1.01 (0.78, 1.32)</td>
<td>0.106</td>
<td>0.915</td>
<td>75.5%</td>
</tr>
<tr>
<td>Education</td>
<td>6</td>
<td>1.64 (1.12, 2.40)</td>
<td>2.522</td>
<td>0.012</td>
<td>73.9%</td>
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<tr>
<td>Financial situation</td>
<td>5</td>
<td>1.78 (0.91, 3.49)</td>
<td>1.690</td>
<td>0.091</td>
<td>92.8%</td>
</tr>
<tr>
<td>Number of partners</td>
<td>6</td>
<td>1.16 (1.02, 1.31)</td>
<td>2.312</td>
<td>0.021</td>
<td>38.5%</td>
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<td>Regular partner</td>
<td>3</td>
<td>0.74 (0.42, 1.30)</td>
<td>-1.035</td>
<td>0.301</td>
<td>76.8%</td>
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<tr>
<td>Casual partners</td>
<td>2</td>
<td>1.10 (0.92, 1.30)</td>
<td>1.065</td>
<td>0.287</td>
<td>0.0%</td>
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<tr>
<td>Sex with HIV partners</td>
<td>2</td>
<td>1.59 (1.11, 2.26)</td>
<td>2.557</td>
<td>0.011</td>
<td>0.0%</td>
</tr>
<tr>
<td>Condom use</td>
<td>7</td>
<td>1.02 (0.78, 1.33)</td>
<td>0.110</td>
<td>0.912</td>
<td>53.8%</td>
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<tr>
<td>Sexually Transmitted Infections</td>
<td>4</td>
<td>0.92 (0.68, 1.23)</td>
<td>-0.576</td>
<td>0.564</td>
<td>0.0%</td>
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<tr>
<td>Depression</td>
<td>4</td>
<td>0.55 (0.37, 0.82)</td>
<td>-2.977</td>
<td>0.003</td>
<td>18.9%</td>
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<tr>
<td>Perception of HIV prevention</td>
<td>2</td>
<td>0.96 (0.88, 1.06)</td>
<td>-0.743</td>
<td>0.457</td>
<td>79.0%</td>
</tr>
<tr>
<td>Substance use</td>
<td>10</td>
<td>0.83 (0.70, 0.99)</td>
<td>-2.083</td>
<td>0.037</td>
<td>46.1%</td>
</tr>
</tbody>
</table>
Table 3. Subgroup analyses of factors and PrEP adherence.

<table>
<thead>
<tr>
<th>factors</th>
<th>Study location</th>
<th>No. of studies</th>
<th>OR (95% CI)</th>
<th>Z</th>
<th>p-value</th>
<th>I²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age&gt;25</td>
<td>Western</td>
<td>4</td>
<td>0.80 (0.37, 1.74)</td>
<td>-0.564</td>
<td>0.573</td>
<td>81.0%</td>
</tr>
<tr>
<td></td>
<td>Eastern</td>
<td>3</td>
<td>1.15 (0.95, 1.39)</td>
<td>1.420</td>
<td>0.156</td>
<td>64.6%</td>
</tr>
<tr>
<td>Education</td>
<td>Western</td>
<td>3</td>
<td>1.48 (0.54, 4.09)</td>
<td>0.761</td>
<td>0.446</td>
<td>73.4%</td>
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<tr>
<td></td>
<td>Eastern</td>
<td>4</td>
<td>1.79 (1.20, 2.66)</td>
<td>2.879</td>
<td>0.004</td>
<td>75.1%</td>
</tr>
<tr>
<td>Financial</td>
<td>Western</td>
<td>3</td>
<td>2.34 (1.25, 4.38)</td>
<td>2.647</td>
<td>0.008</td>
<td>82.7%</td>
</tr>
<tr>
<td></td>
<td>Eastern</td>
<td>2</td>
<td>0.81 (0.49, 1.34)</td>
<td>-0.829</td>
<td>0.407</td>
<td>77.6%</td>
</tr>
<tr>
<td>Regular partner</td>
<td>Western</td>
<td>2</td>
<td>0.65 (0.21, 2.04)</td>
<td>-0.734</td>
<td>0.463</td>
<td>87.6%</td>
</tr>
<tr>
<td></td>
<td>Eastern</td>
<td>1</td>
<td>0.88 (0.65, 1.19)</td>
<td>-0.829</td>
<td>0.407</td>
<td>0.0%</td>
</tr>
<tr>
<td>Perception of HIV prevention</td>
<td>Western</td>
<td>1</td>
<td>1.05 (0.97, 1.14)</td>
<td>1.148</td>
<td>0.251</td>
<td>75.3%</td>
</tr>
<tr>
<td></td>
<td>Eastern</td>
<td>1</td>
<td>0.75 (0.65, 0.87)</td>
<td>-3.903</td>
<td>0.000</td>
<td>0.0%</td>
</tr>
</tbody>
</table>
Figure 1. PRISMA flow diagram.

Identification of studies via databases and registers

268 articles identified from databases searching:
100 articles from PubMed,
99 articles from Scopus,
69 articles from ScienceDirect

106 duplicate articles.

162 Articles screened based on title and abstract.

127 Articles were excluded.

35 Full-text articles assessed for eligibility.

23 Full-text articles excluded, with reasons:
1. No target group
2. Duplicate participant
3. Outcome is not PrEP Adherence
4. The provided information is not complete
5. Experimental and Cross-Sectional Studies

12 Articles included in meta-analysis.