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## Multiple syndemic psychosocial factors are associated with reduced engagement in HIV care among a multinational, online sample of HIV-infected MSM in Latin America

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### ABSTRACT

Latin America has some of the highest levels of antiretroviral therapy (ART) coverage of any developing region in the world. Early initiation and optimal adherence to ART are necessary for improved health outcomes and reduction in onward transmission. Previous work has demonstrated the role of psychosocial problems as barriers to uptake and adherence to ART, and recently, a syndemic framework has been applied to the role of multiple psychosocial syndemic factors and adherence to ART, in the USA. However, to our knowledge, these associations have not been investigated outside of the USA, nor in a multi-country context. To address these gaps, we assessed the association between multiple co-occurring psychosocial factors and engagement in HIV-related medical care and adherence to ART among a large, multinational sample of sexually-active HIV-infected men who have sex with men in Latin America.

Among the 2020 respondents, 80.7% reported currently receiving HIV-related medical care, 72.3% reported currently receiving ART; among those, 62.5% reported 100% adherence. Compared with experiencing no psychosocial health problems, experiencing five or more psychosocial health problems is associated with 42% lower odds of currently receiving HIV-related medical care (adjusted odds ratio, aOR = 0.58, 95% CI 0.36, 0.95) and of currently receiving ART (aOR = 0.58, 95% CI 0.38, 0.91). The number of psychosocial health problems experienced was associated with self-reported ART adherence in a dose-response relationship; compared to those with none of the factors, individuals with one syndemic factor had 23% lower odds (aOR = 0.77, 95% CI 0.60, 0.97) and individuals with five or more syndemic factors had 72% lower odds (aOR = 0.28, 95% CI 0.14, 0.55) of reporting being 100% adherent to ART. Addressing co-occurring psychosocial problems as potential barriers to uptake and adherence of ART in Latin America may improve the effectiveness of secondary prevention interventions.

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HIV/AIDS; men who have sex with men; ART; psychosocial; Latin America

## Introduction

Latin America has some of the highest levels of antiretroviral therapy (ART) coverage of any developing region in the world. As of 2010, seven countries in Latin America has universal (over 80%) ART coverage, including Argentina, Brazil, Chile, and Mexico, and Belize, Costa Rica, Nicaragua, Panama, Paraguay, and Peru are approaching or exceeding 70% coverage (Pan American Health Organization, 2013). However, early initiation and optimal adherence to ART are necessary for both improved health outcomes and reduction in onward transmission to sexual partners (Cohen et al., 2011). Early initiation of ART and thus reduced viral load is

an important component of HIV prevention strategies for ultimately reducing HIV incidence (Das et al., 2010).

Previous work has demonstrated the role of psychosocial forces as barriers to uptake and adherence to ART. In Latin America, where the HIV epidemic in Latin America is highly concentrated in men who have sex with men (MSM), with an estimated HIV prevalence of nearly 15% (Beyrer et al., 2012), these psychosocial factors may be particularly salient, given that high levels of stigma and discrimination toward individuals in same-sex relationships persist (Caceres, Konda, Segura, & Lyerla, 2008). Stigma can be internalized and manifest as individual-level psychosocial factors, including depression and substance use (Diaz et al., 2001; Kingori et al., 2012; Li,

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Lee, Thammawijaya, Jiraphongsa, & Rotheram-Borus, 2009; Logie, Newman, Chakrapani, & Shunmugam, 2012). In Peru and other contexts, alcohol and other substance use disorders have been shown to be associated with decreased ART adherence (Ferro et al., 2015; Gonzalez, Batchelder, Psaros, & Safren, 2011; Parsons, Rosof, & Mustanski, 2008). Depression (Gonzalez et al., 2011) and a history of stressful life events (Mugavero et al., 2009) are also associated with decreased ART adherence in many contexts. High burden of psychosocial factors may undermine secondary prevention efforts by making it more difficult for individuals to initiate and adhere to ART regimens.

Syndemic theory posits that the clustering and interaction of multiple epidemics adversely affect health (Singer et al., 2006). Originally developed by Singer, syndemic theory recognizes the role of adverse social structures, such as poverty or discrimination, in facilitating clustering of multiple co-occurring health conditions (Oldenburg, Perez-Brumer, & Reisner, 2014; Singer, 2004). In the context of HIV among MSM, multiple studies have considered the association between multiple co-occurring psychosocial problems and HIV risk. These studies have consistently demonstrated an association between increasing numbers of psychosocial problems and both increased condomless anal sex and HIV prevalence and acquisition among MSM in diverse settings globally (Biello, Colby, Closson, & Mimiaga, 2014; Mimiaga et al., 2015a,b; Mustanski, Garofalo, Herrick, & Donenberg, 2007; Stall et al., 2003).

Recently, a syndemic framework has been applied to the role of multiple psychosocial syndemic factors and adherence to ART in the USA (Blashill et al., 2014; Friedman et al., 2015), suggesting that multiple psychosocial syndemic factors are associated with reduced adherence to ART and having a detectable viral load. To our knowledge, however, these associations have not been investigated outside of the USA, nor in a multi-country context. Furthermore, little research has assessed the role of psychosocial factors on engagement in HIV-related medical care. To address these gaps, we assessed the association between multiple co-occurring psychosocial factors and engagement in HIV-related medical care and adherence to ART among a large, multinational sample of sexually-active HIV-infected MSM in Latin America. We hypothesized that engagement in HIV-related medical care and adherence to ART would decrease as the number of psychosocial syndemic factors increased in this population.

## Methods

### Participants and procedures

Data for this analysis came from an anonymous online survey of members (18 years of age or older) of a

social/sexual networking site for MSM in Latin America. The survey aimed to collect data on sexual health and psychosocial risk among MSM using the internet for sexual networking. Details of this study have been published elsewhere (Biello et al., 2014). In brief, an email with a link to the survey was sent to nearly 580,000 active members (i.e., had logged on in past 90 days) in Latin America. Approximately 30,400 initiated the survey. For this analysis, we limited the analytic sample to respondents who reported: living in any Spanish- and Portuguese-speaking country in Latin America, male sex at birth, currently identifying as a male, having had sex with another man in the past year, and being HIV infected ( $N = 2020$ ). For participants who did not complete the full survey, data were analyzed for all questions that were answered. As such, the total number of respondents is given for each of the measures reported. The study was approved by the Institutional Review Board at the Fenway Institute at Fenway Health.

### Measures

Respondents completed an anonymous survey to characterize sexual health, including sexual practices, substance use, and relevant psychological concerns. The measures used for this analysis are described below and have been described in detail elsewhere (Biello et al., 2014; Magidson et al., 2015; Mimiaga et al., 2015a).

#### Personal characteristics

Respondents were asked about their age, sexual orientation, education, income/class, and type of living area (urban vs. rural). Additionally, respondents indicated the country in which they currently lived.

#### Syndemic psychosocial variables

Depressive symptoms were assessed using the CES-D 10 – a shortened version of the validated 20-item Center for Epidemiologic Studies Depression Scale (Andresen, Malmgren, Carter, & Patrick, 1994). A score of 10 or greater was categorized as suggestive of clinical depression. Suicidal ideation was determined by an affirmative response to the question, “in the past month, did you think about suicide?” Hazardous alcohol use was determined using the 4-item validated CAGE scale (Ewing, 1984; Fiellin, Reid, & O'Connor, 2000), dichotomized with a score of 2 or greater suggestive of hazardous alcohol use. Hard drug use during sex was determined if respondents reported using any of the following drugs during sex in the past 3 months: stimulants (e.g., crystal meth, speed, crack, and cocaine), ecstasy, gamma hydroxybutyrate, ketamine, or heroin. Childhood or adolescent sexual abuse (CSA) was assessed with a series of

questions regarding unwanted or forced sexual touching or intercourse with a person when 17 years old or younger. Intimate partner violence (IPV) was determined if participants reported having had experienced any violence (i.e., emotional, physical, or sexual) by a male partner in the past 5 years (Greenwood et al., 2002). Finally, sexual compulsivity was assessed using the sexual compulsivity scale, with a score of 24 or greater suggestive of sexual compulsivity (Ballester-Arnal, Gomez-Martinez, Llarío, & Salmeron-Sanchez, 2013; Kalichman & Rompa, 1995).

The syndemic measure was calculated as a count score based on the number of psychosocial health problems each respondent endorsed. The score was calculated as the sum of the seven items. If more than two psychosocial health problem variables (e.g., depression, CSA, and sexual compulsivity) were missing, the syndemic measure was considered missing and not included in analyses. If two or fewer psychosocial health problem variables were missing, the missing items were replaced by the mean of the valid responses, and values summed. The weighted sums were then rounded to the nearest integer to simplify interpretation of the measure and ranged from 0 to 7. These results were compared to the results using only complete data.

### **Engagement in HIV-related medical care**

Respondents were asked to report whether they were currently receiving medical care for HIV, and whether they were currently taking ART to treat HIV. Additionally, respondents who were on ART were asked to report their best estimate of what percentage of their prescribed ART they had taken in the last month. Self-reported ART adherence was dichotomized at 100% vs. <100% in order to account for the effect of overestimation in self-reporting adherence levels.

### **Statistical analysis**

Percentages were calculated for each measure overall and by adherence to ART. In order to examine whether the interconnection of these psychosocial health problems reduces the odds of receipt of HIV medical care, receipt of ART and adherence to ART, we calculated the frequencies and percentages of each outcome by the syndemic count score. Additionally, using generalized estimating equations (GEE) to account for clustering by country, we performed unadjusted and multivariable logistic regression adjusted for personal characteristics (i.e., age, sexual orientation, education, income/class, and type of living area) to examine the associations between the syndemic count score (treated as both nominal and

ordinal to detect a linear trend) and the engagement in HIV care outcomes.

## **Results**

Sample characteristics are described in Table 1. The average age of respondents was 34.9 years (SD = 9.1). Most participants had completed university or post-graduate education (78.4%), considered themselves to be middle class (77.8%), lived in urban areas (97.4%), and identified as being homosexual or gay (91.8%).

Among this sample of HIV-infected, sexually-active MSM, psychosocial health problems were common (Table 1). More than one-third (34.7%) screened in for clinical depression, 12.7% reported thinking about suicide in the past month, and 17.5% reported hazardous alcohol use. Moreover, 10.2% reported any hard drug use in the context of sex in the past 30 days. Over 40% reported experiencing CSA (47.6%) and IPV (40.4%) in the past 5 years. Approximately one-fifth of respondents (19.6%) met the cut-off for sexual compulsivity. Overall, 18.9% of the sample did not have any of the seven psychosocial health problems. Twenty-nine percent had one, 24.5% had two, 13.2% had three, 10.4% had four, 3.2% had five, 0.9% had six, and 0.2% had seven.

Over 80% of the sample reported currently receiving HIV-related medical care (80.7%), 72.3% reported currently receiving ART, and, among those who reported currently receiving ART, 62.5% reported 100% adherence (Table 2).

In unadjusted models and models adjusted for age, sexual orientation, education, income/class, type of living area, and country of residence, compared with experiencing no psychosocial health problems, experiencing five or more psychosocial health problems is associated with 42% lower odds of currently receiving HIV-related medical care (adjusted odds ratio, aOR = 0.58, 95% CI 0.36, 0.95) and of currently receiving ART (aOR = 0.58, 95% CI 0.38, 0.91; Table 3). Additionally, as described in Table 3, a statistical trend was detected. Every unit increase in number of psychosocial health problems is associated with a 9% reduction in odds of receiving HIV-related medical care (aOR = 0.91, 95% CI 0.85, 0.97) and 11% reduction in odds of receiving ART (aOR = 0.89, 95% CI 0.84, 0.93). Findings did not differ meaningfully when only including complete syndemic data.

Moreover, in unadjusted and adjusted models, the number of psychosocial health problems experienced was associated with self-reported ART adherence (Table 3). The additive syndemic measure resulted in lower odds of reporting being 100% adherent to ART.

**Table 1.** Demographic and other factors, overall (among HIV infected) and by adherence to ARTs (among those on ART).

| Risk factors                                       | Non-missing item totals<br>(N = 2020) | Overall     | 100% Adherent (62.1%) | Not 100% adherent (3 7.9%) | p-Value |
|--|---------------------------------------|-------------|-----------------------|----------------------------|---------|
| <b>Personal characteristics</b>                    |                                       |             | Mean (SD)             |                            |         |
| Age  | 2020                                  | 34.9 (9.1)  | 37.3 (9.4)            | 35.5 (8.2)                 | .0002   |
| Country of residence                               | 2020                                  |             | N (%)                 |                            | <.0001  |
| Argentina  |                                       | 275 (13.6)  | 146 (16.4)            | 59 (10.9)                  |         |
| Bolivia  |                                       | 5 (0.3)     | 2 (0.2)               | 1 (0.2)                    |         |
| Brazil   |                                       | 353 (17.5)  | 181 (20.4)            | 56 (10.3)                  |         |
| Chile  |                                       | 215 (10.6)  | 83 (9.4)              | 66 (12.2)                  |         |
| Colombia   |                                       | 255 (12.6)  | 89 (10.0)             | 89 (16.4)                  |         |
| Costa Rica   |                                       | 20 (1.0)    | 9 (1.0)               | 5 (0.9)                    |         |
| Ecuador  |                                       | 27 (1.3)    | 14 (1.6)              | 8 (1.5)                    |         |
| El Salvador  |                                       | 7 (0.3)     | 0 (0.0)               | 6 (1.1)                    |         |
| Guatemala  |                                       | 2 (0.1)     | 1 (0.1)               | 0 (0.0)                    |         |
| Honduras   |                                       | 2 (0.1)     | 0 (0.0)               | 2 (0.4)                    |         |
| Mexico   |                                       | 577 (28.6)  | 259 (29.2)            | 164 (30.3)                 |         |
| Nicaragua  |                                       | 3 (0.2)     | 1 (0.1)               | 0 (0.0)                    |         |
| Panama   |                                       | 23 (1.1)    | 10 (1.1)              | 8 (1.5)                    |         |
| Paraguay   |                                       | 11 (0.5)    | 2 (0.2)               | 3 (0.6)                    |         |
| Peru   |                                       | 73 (3.6)    | 21 (2.4)              | 23 (4.2)                   |         |
| Uruguay  |                                       | 6 (0.3)     | 5 (0.6)               | 0 (0.0)                    |         |
| Venezuela  |                                       | 166 (8.2)   | 65 (7.3)              | 52 (9.6)                   |         |
| Sexual orientation                                 | 2019                                  |             |                       |                            | .655    |
| Heterosexual/straight                              |                                       | 5 (0.2)     | 2 (0.2)               | 1 (0.2)                    |         |
| Bisexual   |                                       | 145 (7.2)   | 61 (6.9)              | 29 (5.4)                   |         |
| Unsure/questioning/other                           |                                       | 16 (0.8)    | 7 (0.8)               | 3 (0.5)                    |         |
| Homosexual/gay                                     |                                       | 1853 (91.8) | 818 (92.1)            | 508 (93.9)                 |         |
| Education  | 2016                                  |             |                       |                            | 0.454   |
| University/Post- Graduate                          |                                       | 1581 (78.4) | 713 (80.4)            | 426 (78.7)                 |         |
| Less than University                               |                                       | 435 (21.6)  | 174 (19.6)            | 115 (21.3)                 |         |
| Income   | 1991                                  |             |                       |                            | 0.235   |
| No income  |                                       | 70 (3.5)    | 21 (2.4)              | 15 (2.8)                   |         |
| Low income/lower class                             |                                       | 176 (8.8)   | 64 (7.3)              | 52 (9.8)                   |         |
| Middle income/middle class                         |                                       | 1549 (77.8) | 687 (78.4)            | 415 (77.9)                 |         |
| High income/upper class                            |                                       | 196 (9.8)   | 104 (11.9)            | 51 (9.6)                   |         |
| Urban/Rural  | 2020                                  |             |                       |                            | 0.854   |
| Urban  |                                       | 1968 (97.4) | 867 (97.6)            | 530 (97.8)                 |         |
| Rural  |                                       | 52 (2.6)    | 21 (2.4)              | 12 (2.2)                   |         |
| <b>Psychosocial conditions</b>                     |                                       |             |                       |                            |         |
| Depression   | 1762                                  | 611 (34.7)  | 249 (31.7)            | 169 (35.6)                 | 0.159   |
| Suicidal ideation (past 30 days)                   | 1752                                  | 223 (12.7)  | 78 (9.9)              | 49 (10.5)                  | 0.768   |
| Hazardous alcohol use                              | 1746                                  | 306 (17.5)  | 114 (14.7)            | 88 (18.8)                  | 0.057   |
| Any hard drug use in context of sex (past 30 days) | 1783                                  | 181 (10.2)  | 67 (8.4)              | 54 (11.3)                  | 0.086   |
| Childhood sexual abuse                             | 1733                                  | 825 (47.6)  | 356 (46.2)            | 247 (52.7)                 | 0.027   |
| Intimate partner violence (past 5 years)           | 1733                                  | 700 (40.4)  | 286 (36.5)            | 209 (45.0)                 | 0.003   |
| Sexually compulsive                                | 1709                                  | 335 (19.6)  | 128 (16.7)            | 90 (19.7)                  | 0.175   |

For example, individuals with one syndemic factor had 23% lower odds of reporting being 100% adherent to ART compared to those with none of the factors (aOR = 0.77, 95% CI 0.60, 0.97), and individuals with five or more syndemic factors had 72% lower odds of reporting being 100% adherent to ART compared to those with

**Table 2.** Frequency and proportion of engagement in HIV care, overall and by number of interconnected psychosocial conditions.

|                                   | Overall     | Number of Psychosocial Health Problems |            |            |            |            |           |
|-----------------------------------|-------------|--|------------|------------|------------|------------|-----------|
|                                   |             | N (%)                                  |            |            |            |            |           |
|                                   |             | 0                                      | 1          | 2          | 3          | 4          | 5+        |
| In HIV-related medical care       |             |  |            |            |            |            |           |
| Yes                               | 1419 (80.7) | 265 (80.1)                             | 427 (84.1) | 351 (82.0) | 181 (77.7) | 143 (78.6) | 52 (68.4) |
| No                                | 339 (19.3)  | 66 (19.9)                              | 81 (15.9)  | 77 (18.0)  | 52 (22.3)  | 39 (21.4)  | 24 (31.6) |
| Currently receiving ART           |             |  |            |            |            |            |           |
| Yes                               | 1275 (72.3) | 239 (71.6)                             | 395 (77.8) | 319 (74.0) | 157 (67.7) | 121 (66.5) | 44 (57.9) |
| No                                | 488 (27.7)  | 95 (28.4)                              | 113 (22.2) | 112 (26.0) | 75 (32.3)  | 61 (33.5)  | 32 (42.1) |
| 100% Adherent to ART <sup>a</sup> |             |  |            |            |            |            |           |
| Yes                               | 794 (62.5)  | 167 (70.2)                             | 242 (61.3) | 211 (66.8) | 89 (56.7)  | 69 (57.0)  | 16 (36.4) |
| No                                | 477 (37.5)  | 71 (29.8)                              | 153 (38.7) | 105 (33.2) | 68 (43.3)  | 52 (43.0)  | 28 (63.6) |

<sup>a</sup>Among those who reported currently receiving ART.



**Table 3.** Association of interconnection of psychosocial conditions and engagement in HIV care.

| Number of psychosocial conditions | HIV-related medical care                  |                                | Currently receiving ART        |                                   | 100% Adherent to ART <sup>a</sup> |   |
|-----------------------------------|---|--------------------------------|--------------------------------|-----------------------------------|-----------------------------------|---|
|                                   | Adjusted odds ratio <sup>b</sup> (95% CI) | Unadjusted odds ratio (95% CI) | Unadjusted odds ratio (95% CI) | Number of psychosocial conditions | Unadjusted odds ratio (95% CI)    | Adjusted odds ratio <sup>b</sup> (95% CI) |
| 0 psychosocial conditions         | 1.0                                       | 1.0                            | 1.0                            | 1.0                               | 1.0                               | 1.0                                       |
| 1/2                               | 1.23 (0.95, 1.61)                         | 1.22 (0.93, 1.60)              | 1.26 (0.99, 1.61)              | 1.27 (0.98, 1.64)                 | <b>0.75 (0.60, 0.92)</b>          | <b>0.77 (0.60, 0.97)</b>                  |
| 3/4                               | 0.89 (0.62, 1.26)                         | 0.88 (0.63, 1.24)              | 0.81 (0.62, 1.06)              | 0.82 (0.63, 1.05)                 | <b>0.56 (0.45, 0.70)</b>          | <b>0.58 (0.47, 0.72)</b>                  |
| 5+ psychosocial conditions        | <b>0.54 (0.33, 0.88)</b>                  | <b>0.58 (0.36, 0.95)</b>       | <b>0.55 (0.33, 0.89)</b>       | <b>0.58 (0.38, 0.91)</b>          | <b>0.24 (0.13, 0.45)</b>          | <b>0.28 (0.14, 0.55)</b>                  |
| Linear trend (0–7)                | <b>0.90 (0.84, 0.97)</b>                  | <b>0.91 (0.85, 0.97)</b>       | <b>0.88 (0.84, 0.93)</b>       | <b>0.89 (0.84, 0.93)</b>          | <b>0.85 (0.80, 0.90)</b>          | <b>0.86 (0.82, 0.91)</b>                  |

Note: Bolded values indicate  $p < 0.05$ .

<sup>a</sup>Among those who reported currently receiving ART.

<sup>b</sup>Adjusted for all personal characteristics listed in Table 1 and for clustering by country of residence (using GEE).

none of the factors (aOR = 0.28, 95% CI 0.14, 0.55; Table 3). Lastly, when treated as continuous, every unit increase in number of psychosocial health problems is associated with a 14% decrease in odds of reporting being 100% adherent to ART (aOR = 0.86, 95% CI 0.82, 0.91; Table 3). Findings did not differ meaningfully when only including complete syndemic data.

## Discussion

In this study, we documented associations between a syndemic of psychosocial factors and engagement in HIV-related medical care, uptake of ART, and adherence to ART. To our knowledge, this is the first study to apply a syndemics framework to ART adherence among MSM outside of the USA, and to engagement in HIV-related medical care in any population. Our findings were consistent with previous work in the USA, which has demonstrated that the odds of non-adherence and detectable viral load increase as the number of psychosocial syndemic factors increases (Blashill et al., 2014; Friedman et al., 2015). Furthermore, previous work has demonstrated an association between psychosocial factors including depression and substance use and decreased adherence to ART, as well as to engagement in care (Ramirez-Avila et al., 2012; Safren et al., 2014). Depressive symptoms may lead to loss of interest, feelings of worthlessness (Gonzalez et al., 2011), and suicidality. These symptoms may make it difficult for individuals to participate in optimal self-care, including attending scheduled appointments and taking ART as prescribed. Depressive symptoms may also lead to increased substance use. Substance users may have more concerns about engaging with providers and may lead more unstable lives, including experiencing food and housing insecurity, which negatively impacts ART adherence and treatment access (Surratt, O'Grady, Levi-Minzi, & Kurtz, 2015). Furthermore, research has shown an association between CSA and adherence to

ART (Meade, Hansen, Kochman, & Sikkema, 2009). CSA may lead to psychosocial distress later in life (Tucci, Kerr-Correa, & Souza-Formigoni, 2010), which may then lead to increased sexual risk-taking and difficulty with adherence. As suggested in our study and others, the co-occurrence of these factors may multiply the negative health effects of these psychosocial conditions, suggesting that secondary HIV prevention efforts aiming to improve outcomes across the HIV care continuum should incorporate elements to address co-occurrence of psychosocial symptoms, including cognitive behavioral therapy (Safren et al., 2009; Safren et al., 2012).

The overall prevalence of each individual psychosocial factor was higher in this sample than was previously reported in the overall study sample (which included over 20,000 HIV-uninfected MSM) (Mimiaga et al., 2015a). Previous work has shown a substantial burden of psychiatric morbidity among HIV-infected individuals in Latin America (Aguilar-Gaxiola et al., 2006; Kamat et al., 2013), as well as a syndemic of psychosocial problems and sexual risk behavior in this population (Mimiaga et al., 2015a). If individuals with comorbid psychiatric disorders are both more likely to engage in sexual risk-taking behavior and less likely to be taking or adherent to ART, they may represent a group that is at particularly high risk of onward transmission (Magidson et al., 2015), further indicating that interventions to address psychiatric and substance use may be particularly important strategies for HIV prevention in Latin America.

The results of this study must be interpreted in the context of several limitations. This study relied on self-reported measures, including self-reported HIV serostatus, engagement in care, and adherence. Participants may overestimate their adherence to ART because of social desirability bias. However, some evidence suggests that self-reported adherence measures are able to detect poor ART adherence (Kabore et al., 2015), and by using a

conservative rule of 100% adherent, we may have been able to detect a significant proportion of those who were truly non-adherent. However, future work should assess the association between psychosocial syndemic factors and ART adherence among MSM in Latin America using objective measures, such as viral load, in order to confirm these findings. In addition, we did not know the timing when individuals were diagnosed with HIV. It is possible that some individuals were recently diagnosed and were not yet eligible for ART, and thus reported not being on ART. Participants were recruited for this study through an online social and sexual networking website for MSM, and therefore are likely not generalizable to all MSM in Latin America. In particular, MSM in this study tended to be of relatively high socioeconomic status and well-educated, and thus this sampling technique may not have reached MSM of lower socioeconomic status, who may face differential barrier to ART uptake and adherence, as well as differential burden of psychosocial syndemic factors. As has been seen in other online surveys, there was attrition over the course of the survey. However, levels of missing data were comparable to those for other online surveys of MSM (Rosenberger et al., 2011; Sullivan et al., 2011). Despite these limitations, this is the first study of the effect of syndemics on engagement in the HIV care continuum at multiple levels in Latin America, and offers important insights into the design of secondary HIV prevention strategies in the Latin American context.

Psychosocial conditions may interact or act additively to augment difficulty with uptake and adherence to ART, which may reduce viral suppression and increase the risk of onward transmission to sexual partners. Although ART coverage in Latin America is generally high, with nearly 75% of the study population currently on ART, addressing psychosocial barriers to uptake and adherence of ART will likely improve the effectiveness of secondary prevention interventions. In the Latin American context, additional work is needed to develop comprehensive interventions for HIV-infected MSM, to help mitigate the effect of the syndemic condition on HIV care continuum outcomes.

## Disclosure statement

No potential conflict of interest was reported by the authors.

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