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Moment-to-moment changes in perceived social support and pain for men living with HIV: An experience sampling study

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Abstract

Research suggests that people living with HIV (PLHIV) experience levels of pain disproportionate to the general population. Pain is a stressor that can negatively impact health-related quality of life. As the number of people aging with HIV increases, we must understand the dynamics of pain experiences among PLHIV and how to effectively harness evidence-based treatments and supportive resources to enhance adaptive coping. We used experience sampling method (ESM; also called ecological momentary assessment) to assess moment-to-moment experiences of pain and social support three times a day for seven days in a sample of 109 men living with HIV. Participants also responded to questionnaires assessing attachment-related insecurity and social support. In hierarchical linear modeling analyses controlling for age, race, sexual orientation, and socioeconomic status, we found that experiences of social support were associated with lower subsequent pain within-persons. On the other hand, experiences of pain were not associated with later experiences of social support. Men with higher levels of attachment-related avoidance reported more pain on average. Attachment-related avoidance also moderated the association between moment-to-moment experiences of felt social support on pain. Results suggest that within-persons, experiences of daily social support reduce experiences of pain. Between-persons, attachment style may influence how individuals make use of social support in coping with experiences of pain. These findings imply a need to assess social well-being at the clinic level and also support tailored biopsychosocial approaches to pain management in HIV care settings.

Keywords

HIV; social support; attachment; daily pain; experience sampling

INTRODUCTION

Pain is a common,[4, 25] yet relatively under-studied experience among people living with HIV (PLHIV). The etiology of pain in PLHIV is likely multi-faceted. HIV-associated conditions such as neuropathy and unsuppressed viral load are related to increased pain.[17] Side effects of antiretroviral medications and co-morbidity contribute to pain. Other

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correlates include psychiatric illness, substance use, psychological distress, traumatic life events, and stigma.[31]

Pain also has negative consequences for PLHIV including impairment in mobility and daily activities,[28] missed healthcare visits,[30] poorer antiretroviral adherence,[39] and reductions in CD4 cell count.[3] Additionally, pain impacts psychological health and substance use among PLHIV.[3, 26, 42] Understanding factors that attenuate or exacerbate pain may inform tailored interventions to improve pain outcomes, reduce comorbidity, and enhance health-related quality of life.

PLHIV may seek social support as one strategy for pain self-management.[27] Social support is a coping resource that can protect people at times of stress,[8, 10] and it is consistently linked with lower morbidity and mortality.[19] Moreover, social support is associated with lower subjective pain intensity.[38] Despite all of the evidence for the positive associations between social support and health, the mechanisms of social support's influence on pain are not fully understood.[15, 41] Social support is an interpersonal process, and previous theoretical and empirical work suggests that individuals differ in how they receive and perceive social support based on their attachment orientation to relationships.[11, 12, 33]

Attachment styles – the internal mental models (or schemas) that develop early in life as a consequence of support-related interactions with caregivers that have enduring influences on one's perception of self in relation to others[6] – affect how people perceive and receive social support.[5] Two dimensions of adult attachment-related insecurity are: attachment-related avoidance (avoidance of emotional closeness with others and preference for over-independence), and attachment-related anxiety (over-reliance on partners and chronic worries about being abandoned).[32] According to an attachment-diathesis model of chronic pain developed for a non-HIV infected population,[23] individuals assess their level of stress associated with pain, their ability to deal with pain, and their available social support resources. These assessments trigger coping responses to adjust to pain, and attachment-related insecurity may moderate these responses. Indeed, both attachment-related insecurity dimensions are associated with higher levels of pain intensity, lower perceived ability to cope with pain, and pain-related disability.[13, 22, 24] While existing literature supports the attachment-diathesis model, no studies have specifically linked attachment-related insecurity to experiences of social support and pain for PLHIV.

Here, we first sought greater depth to understanding the associations between daily social support and pain within PLHIV. Using experience sampling method (also called Ecological Momentary Assessment), we assessed experiences of social support and pain three times a day for seven days in a sample of men living with HIV. Second, we examined between-person effects of attachment-related insecurity and social support on daily pain experiences. Third, we examined moderating effects of attachment-related insecurity and social support on daily associations between social support and pain. That is, we assessed whether some people benefit more from daily social support depending on their level of attachment-related insecurity and available social support resources.

METHODS

Participants and Procedures

Participants included 109 men living with HIV, currently on antiretroviral therapy (ART), and not currently using substances, who were recruited from an HIV primary care clinic in Birmingham, Alabama. All study procedures were approved by the clinic's associated Institutional Review Board at the University of Alabama at Birmingham. Participants were fully informed of all study procedures and provided informed consent prior to participation.

Participants were invited for an in-person study visit. At their visit, participants completed measures of demographic and psychosocial information. They were then provided with a 4G enabled Motorola Droid 4 smart phone to use for the duration of the study. Brief ESM measures were administered via SurveyMonkey,[16] a web-based survey administration tool. Each smart phone was assigned a phone number and university email address.

Participants were encouraged to use the phone to communicate with research staff if they had any questions about procedures. ESM surveys were delivered via link embedded in a calendar reminder that was pre-programmed by research staff using Microsoft Outlook's calendar function. ESM prompts occurred three times per day for seven consecutive days. This frequency of ESM was chosen to maximize the potential for change between prompts while not allowing too much time to pass between surveys. The sampling period of 7 days was chosen to reduce participant burden and enhance compliance. ESM survey times were preset by researchers to be delivered at least 2 hours apart between the hours of 10am and 8pm each day, well within the limits of waking hours. Research staff chose times within those limits at random and changed the time of delivery so the surveys were not delivered at the same time every day. Participants were also informed that ESM surveys would be sent at random time intervals to reduce expectancy of surveys that could have influenced their responses. If participants did not complete a survey within 2 hours, their data for that time period was coded as missing. Participants received a phone call from research staff if they missed multiple consecutive ESM prompts. Participants also received reminders at the end of the day to charge their phone and to plan to take it with them the next day.

ESM was used to obtain an understanding of daily experiences of social support and pain that may be more accurate and less biased than global approximations of these constructs. [35, 40] ESM allows for data collection at the time (or close to the time) of the experiences being assessed, so it permits within-person analyses of co-occurring processes in real time. Questionnaire measures, on the other hand, capture approximations of how individuals tend to think, behave, or feel across situations. Combining both levels of measurement allow for predictions based on state and trait level differences.[35] Accordingly, we will refer to ESM measures in this study as within-person variables, and questionnaire measures as between-person variables.

Questionnaire Measures

Demographic Information.—All participants reported their current age, identified race, and sexual orientation. Participants self-rated their socioeconomic status on the following 5-

point scale: lower, lower middle, middle, upper middle, upper. Demographic information was cross checked with medical record information.

Attachment Styles.—Attachment-related avoidance and attachment-related anxiety were assessed using a brief version of the Experiences in Close Relationships (ECR) measure.[7] The measure included 18 items that assessed the two dimensions of insecure attachment: attachment-related avoidance (e.g., “I don’t feel comfortable opening up to romantic partners.”) and attachment-related anxiety (e.g., “I need a lot of reassurance that I am loved by my partner.”). Participants rated each item on a 7-point Likert scale. Mean scores of the two nine-item subscales were calculated, and both showed very good internal consistency (Cronbach’s alpha for attachment-related avoidance=.90 and attachment-related anxiety=.88).

Social Support.—Social support was assessed using the short form version of the Interpersonal Support Evaluation List (ISEL-SF).[36] The ISEL is a widely used measure of perceived availability of social support resources.[9] The short form assesses four dimensions of social support consistent with the original scale: appraisal – perceived availability of a supportive person to discuss personal issues (e.g., “There is at least one person I know whose advice I really trust.”), tangible assets – perceived availability of material aid (e.g., “If I were sick, I could easily find someone to help me with my daily chores.”), belonging – perceived availability of others for social interaction (e.g., “I often meet or talk with family or friends.”), and self-esteem – perceived availability of others with whom one compares positively (e.g., “Most of my friends are more interesting than I am.”). Participants rated each item using a 4-point scale ranging from 1: *Definitely false*, to 4: *Definitely true* based on how each item applied to them. The ISEL-SF yields a total score, with higher scores indicating greater levels of social support. Mean scores were calculated for the total scale. Internal consistency was very good in the present sample (Cronbach’s alpha = .88).

ESM Measures Administered Three Times a Day for Seven Days

Pain.—Pain was assessed using a numerical rating scale for pain intensity at the time of ESM. Numerical rating scales for pain are widely used in clinical and research settings, and they have good reliability, validity, and sensitivity to changes in pain.[14] Participants were asked to rate their momentary pain (“right now”) at the time of each ESM collection on a scale from 1: *No pain at all*, to 10: *Worst imaginable pain*.

Social Support.—Two dimensions of social support were assessed in ESM: *HIV-related social support* and *felt social support*. Both dimensions were self-reported and therefore reflect participant perceptions of social support they received as well as their affective experiences. The decision to measure these two dimensions of daily social support followed prior research finding that the beneficial effects of social support may be explained by positive perceived feelings associated with the support, rather than received social support itself.[21]

First, participants rated how much *HIV-related social support* they received between ESM occasions. This item was a measure of a specific type of social support participants received. A coverage model (“since your last report”) was used for this item because it assessed discrete events between sampling occasions rather than an ongoing state that could be assessed in the moment. HIV-related social support was assessed using the prompt, “Since your last report, how much did someone give you support related to your immune status?” Participants were informed that the term “immune status” was used instead of HIV throughout ESM surveys to protect participant privacy and confidentiality. Responses ranged from 1: *I received no support at all*, to 5: *I received a huge amount of support*.

Second, participants rated their *felt social support* – their momentary affective experiences related to support and acceptance at the time of ESM. Felt social support was assessed in the moment because it would be more accurate than asking participants to average their affective experiences over the past few hours between sampling occasions. Felt social support was assessed with the prompt, “Please rate how strongly you are feeling each of these emotions right now.” The first item queried how *accepted* participants felt at the moment, and the second item queried how *supported* they felt at the moment. Participants responded using a scale from 1: *Not at all*, to 5: *Very strongly*. A similar format for assessment of momentary affect has been widely used with measures such as the Positive and Negative Affect States (PANAS),[44] and the support and acceptance items were developed specifically for this study. These two affective responses were combined to create a mean score for felt social support.

Data Analysis

Data were cleaned and checked for any computational errors prior to analysis within SPSS, version 23. Within-person changes and between-person differences in pain, social support, and attachment styles were examined using hierarchical linear modeling (HLM) version 6.08.[37] In these analyses, ESM measures were nested within individuals. HLM is robust to missing data at the within-person level by estimating the best fitting model using the available data for each participant.[18] Missing data were assumed to be the result of noncompliance because participants did not report experiences of technical failure that would have impacted ESM completion. The following demographic covariates were chosen following previous research and informed by social determinants of HIV-related health,[1] and were controlled in each model: age, sexual orientation (0=gay or bisexual, 1=heterosexual), socioeconomic status (analyzed continuously from 1–4, because no participants endorsed “5: upper” SES), and race (0=white-non-Hispanic, 1=black). In all analyses, within-person variables were group-centered (the variable mean for each participant across all sampling occasions was subtracted from that participant’s score at each time point) and between-person variables were grand centered (the mean variable score for all participants was subtracted from each participant’s score). We utilized robust estimation of standard errors. Analyses of residual distributions did not suggest a need to transform variables or that our standard errors were biased. Intra-class correlations (ICCs) were calculated by dividing the random intercept variance by the sum of the random intercept variance and residual variance for each outcome to assess the proportion of variance accounted for by within and between-person differences.

Within-Person Associations between Social Support and Pain.—Within-person associations of social support and pain were examined using ESM measures. In each analysis, the two social support variables (HIV-related social support and felt social support) were entered at Level 1 simultaneously. Time-lagged variables were created in order to examine the association of social support at time t and pain at time $t+1$ (*pain later*: pain at the next sampling occasion). In Model 1, pain later was entered as an outcome variable with both ESM social support measures as predictors:

$$\begin{aligned}\text{Level 1: } & \text{Pain later} = \beta_{0i} + \beta_{1i} (\text{HIV-related social support}) + \beta_{2i} (\text{Felt social support}) + e_{it} \\ \text{Level 2: } & \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{age}) + \gamma_{02}(\text{race}) + \gamma_{03}(\text{SES}) + \gamma_{04}(\text{sexual orientation}) + u_{0i} \\ & \beta_{1i} = \gamma_{10} + \gamma_{11}(\text{age}) + \gamma_{12}(\text{race}) + \gamma_{13}(\text{SES}) + \gamma_{14}(\text{sexual orientation}) + u_{1i} \\ & \beta_{2i} = \gamma_{20} + \gamma_{21}(\text{age}) + \gamma_{22}(\text{race}) + \gamma_{23}(\text{SES}) + \gamma_{24}(\text{sexual orientation}) + u_{2i}\end{aligned}$$

In Model 2, we examined the within-person effects of social support on pain later, controlling for concurrent pain:

$$\begin{aligned}\text{Level 1: } & \text{Pain later} = \beta_{0i} + \beta_{1i} (\text{Pain}) + \beta_{2i} (\text{HIV-related social support}) + \beta_{3i} (\text{Felt social support}) + e_{it} \\ \text{Level 2: } & \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{age}) + \gamma_{02}(\text{race}) + \gamma_{03}(\text{SES}) + \gamma_{04}(\text{sexual orientation}) + u_{0i} \\ & \beta_{1i} = \gamma_{10} + \gamma_{11}(\text{age}) + \gamma_{12}(\text{race}) + \gamma_{13}(\text{SES}) + \gamma_{14}(\text{sexual orientation}) + u_{1i} \\ & \beta_{2i} = \gamma_{20} + \gamma_{21}(\text{age}) + \gamma_{22}(\text{race}) + \gamma_{23}(\text{SES}) + \gamma_{24}(\text{sexual orientation}) + u_{2i} \\ & \beta_{3i} = \gamma_{30} + \gamma_{31}(\text{age}) + \gamma_{32}(\text{race}) + \gamma_{33}(\text{SES}) + \gamma_{34}(\text{sexual orientation}) + u_{3i}\end{aligned}$$

We also examined the alternative possibility that pain could predict social support within-persons. Each time-lagged ESM social support variable was entered as an outcome with pain as the predictor. In Model 3 we examined the effects of pain on HIV-related social support later:

$$\begin{aligned}\text{Level 1: } & \text{HIV-related social support later} = \beta_{0i} + \beta_{1i} (\text{Pain}) + e_{it} \\ \text{Level 2: } & \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{age}) + \gamma_{02}(\text{race}) + \gamma_{03}(\text{SES}) + \gamma_{04}(\text{sexual orientation}) + u_{0i} \\ & \beta_{1i} = \gamma_{10} + \gamma_{11}(\text{age}) + \gamma_{12}(\text{race}) + \gamma_{13}(\text{SES}) + \gamma_{14}(\text{sexual orientation}) + u_{1i}\end{aligned}$$

In Model 4, we examined the effects of pain on felt social support later:

$$\begin{aligned}\text{Level 1: } & \text{Felt social support later} = \beta_{0i} + \beta_{1i} (\text{Pain}) + e_{it} \\ \text{Level 2: } & \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{age}) + \gamma_{02}(\text{race}) + \gamma_{03}(\text{SES}) + \gamma_{04}(\text{sexual orientation}) + u_{0i} \\ & \beta_{1i} = \gamma_{10} + \gamma_{11}(\text{age}) + \gamma_{12}(\text{race}) + \gamma_{13}(\text{SES}) + \gamma_{14}(\text{sexual orientation}) + u_{1i}\end{aligned}$$

Between-Person Effects on Pain.—Next, effects of between-person variables (attachment-related avoidance, attachment-related anxiety, and ISEL social support) on pain were assessed. We conducted separate analyses for each between-person variable (Models 5–7). In other words, we ran empty Level 1 models with each variable at Level 2 along with covariates predicting pain:

$$\begin{aligned}\text{Level 1: } & \text{Pain} = \beta_{0i} + e_{it} \\ \text{Level 2: } & \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{age}) + \gamma_{02}(\text{race}) + \gamma_{03}(\text{SES}) + \gamma_{04}(\text{sexual orientation}) + \gamma_{05}(\text{between-person variable}) + u_{0i}\end{aligned}$$

In Model 8, we entered all three between-person variables at Level 2 in the empty Level 1 model predicting pain.

Finally, we examined the moderating effects of between-person variables on the associations between within-person social support and pain. We first entered each moderator (attachment-related avoidance, attachment-related anxiety, ISEL social support) one by one at Level 2 as follows:

$$\begin{aligned} \text{Level 1: } & \text{Pain later} = \beta_{0i} + \beta_{1i} (\text{Pain}) + \beta_{2i} (\text{HIV-related social support}) + \beta_{3i} (\text{Felt social support}) + e_{ii} \\ \text{Level 2: } & \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{age}) + \gamma_{02}(\text{race}) + \gamma_{03}(\text{SES}) + \gamma_{04}(\text{sexual orientation}) + \gamma_{05}(\text{between-person variable}) + u_{0i} \\ & \beta_{1i} = \gamma_{10} + \gamma_{11}(\text{age}) + \gamma_{12}(\text{race}) + \gamma_{13}(\text{SES}) + \gamma_{14}(\text{sexual orientation}) + \gamma_{15}(\text{between-person variable}) + u_{1i} \\ & \beta_{2i} = \gamma_{20} + \gamma_{21}(\text{age}) + \gamma_{22}(\text{race}) + \gamma_{23}(\text{SES}) + \gamma_{24}(\text{sexual orientation}) + \gamma_{25}(\text{between-person variable}) + u_{2i} \\ & \beta_{3i} = \gamma_{30} + \gamma_{31}(\text{age}) + \gamma_{32}(\text{race}) + \gamma_{33}(\text{SES}) + \gamma_{34}(\text{sexual orientation}) + \gamma_{35}(\text{between-person variable}) + u_{3i} \end{aligned}$$

We repeated this model by entering both attachment-related variables together at Level 2 (Model 12).

RESULTS

Description of Sample

A full description of sample demographics is presented in Table 1. Participants included 59 black and 50 white men with a mean age of 40 (SD: 10.5, range: 24–68), who had been on ART for an average of 6.6 years (SD: 4.7, range: 1–19). The majority of the men identified as gay or bisexual (82%). Approximately 54% of the men identified their SES as middle class.

Of the 109 men enrolled in the study, 94 (86%) had complete data for all questionnaire (between-person) variables. A total of 1457 ESM surveys were completed and analyzed out of a possible 1974 (74%). Men completed a mean of 15.87 (Median=17, SD=4.48) ESM prompts total, and there were no differences in completion based on time of day: all medians=6 across first (M: 5.40, SD: 1.62), second (M: 5.19, SD: 1.75), and third (M: 5.28, SD: 1.70) ESM of the day. Preliminary analyses of ICCs suggested that the 87% of the variance in daily pain was accounted for by between-person differences. For the social support outcomes, 78% of the variance in felt social support was accounted for by between-person differences, and 70% of the variance in HIV-related social support was accounted for by between-person differences.

Within-Person Associations between Social Support and Pain

There were significant within-person associations between social support and pain later, as can be seen in Table 2, Model 1. Both social support variables were significantly and negatively associated with pain later. Within-persons, receiving more HIV-related social support predicted less pain at the next sampling occasion (γ_{10} coefficient (se) = $-0.06(.02)$, $t = -2.56$, $p = .01$). Felt social support was also associated with less pain later (γ_{20} coefficient (se) = $-0.09(.03)$, $t = -2.51$, $p = .01$), and this relationship was moderated by sexual

orientation such that gay and bisexual-identified men benefitted more from felt social support in terms of pain reduction (γ_{24} coefficient(se) = $-0.30(.09)$, $t = -3.04$, $p = .004$).

The relationships between social support and pain later remained significant when controlling for pain reported at the previous time point (Table 2, Model 2). HIV-related social support was significantly associated with less pain later, when controlling for pain previously (γ_{20} coefficient (se) = $-0.07 (.03)$, $t = -2.46$, $p = .02$). Likewise, felt social support was associated with less pain later when controlling for current pain (γ_{30} coefficient (se) = $-0.08 (.04)$, $t = -2.09$, $p = .04$). None of the covariates moderated the within-person associations of social support and pain later controlling for current pain.

Next, we examined the alternative hypothesis that pain predicted social support at later time points (Models 3 & 4). However, the relationship between pain and HIV-related social support at the next time point was not supported ($\gamma_{10} = -0.01$, $p = .25$). Pain was also not significantly associated with felt social support later ($\gamma_{10} = 0.01$, $p = .32$). Given that within-persons, social support predicted pain rather than vice versa, we proceeded with analyses examining the effects of between-person variables on pain as the outcome.

Between-Person Effects on Pain

Main effects of between-person variables on daily pain are presented in Table 3. First we examined the association between attachment-related avoidance and pain (Model 5). Attachment-related avoidance was significantly associated with greater pain on average (γ_{05} coefficient (se) = $0.37 (.14)$, $t = 2.63$, $p = .01$), and none of the demographic covariates were significantly associated with pain. Attachment-related anxiety was not significantly associated with pain (Model 6; $\gamma_{05} = 0.22$, $p = .120$). Age was a significant covariate in this model of the effect of attachment-related anxiety on pain (γ_{01} coefficient (se) = $0.34(.02)$, $t = 2.04$, $p = .04$), such that reported pain increased by 0.34 on average with each year increase in age. To examine between-person effects of social support on pain, the ISEL total scale score was entered at Level 2 (Model 7). ISEL social support was not significantly associated with daily pain on average ($\gamma_{05} = -0.87$, $p = .057$).

When all three between-person variables were entered together at Level 2 (Model 8): $\beta_{0i} = \gamma_{00} + \gamma_{01}(\text{age}) + \gamma_{02}(\text{race}) + \gamma_{03}(\text{SES}) + \gamma_{04}(\text{sexual orientation}) + \gamma_{05}(\text{Attachment-related Avoidance}) + \gamma_{06}(\text{Attachment-related Anxiety}) + \gamma_{07}(\text{ISEL Social Support}) + u_{0i}$

Attachment-related avoidance was again significantly related to pain (γ_{05} coefficient (se) = $0.43(.15)$, $t = 2.79$, $p = .007$). For each unit increase in attachment-related avoidance, pain increased by 0.43 on average. Attachment-related anxiety and ISEL social support were not associated with pain in this model ($\gamma_{06} = -0.11$, $p = .409$; $\gamma_{07} = -0.35$, $p = .475$, respectively).

Moderation Effects of Between-person Variables on Within-person Associations between Social Support and Pain

Cross-level interaction effects of each between-person variable on the association between within-person social support and pain are presented in Table 4 (Models 9–11). Attachment-related avoidance (Model 9) was again associated with greater pain later (γ_{05} coefficient (se)

= 0.37(.15), $t = 2.63$, $p = .011$). Attachment-related avoidance also moderated the effect of felt social support on pain later, such that participants higher on attachment-related avoidance appeared to benefit more from felt social support on average (γ_{35} coefficient (se) = -0.05 (.02), $t = -2.00$, $p = .048$). Even at high levels of felt social support, pain among men with high attachment-related avoidance was greater compared to those with low attachment-related avoidance as depicted in Figure 1. Attachment-related anxiety did not moderate the effect of either within-person association between social support and pain (model 10); nor did ISEL social support (Model 11).

In the final model, we entered both attachment variables together at Level 2. Again, attachment-related avoidance predicted greater pain later when controlling for current pain (γ_{05} coefficient (se) = 0.37(.15), $t = 2.49$, $p = .015$). Attachment-related anxiety moderated the effect of current pain on pain later, such that those with higher attachment-related anxiety showed a stronger association between successive measures of pain (γ_{16} coefficient (se) = 0.09(.04), $t = 2.17$, $p = .033$). Neither attachment variable moderated the effect of HIV-related social support on pain later. Only attachment-related avoidance moderated the effect of felt social support on pain later (γ_{35} coefficient (se) = -0.04(.02), $t = -2.09$, $p = .039$).

DISCUSSION

In the present study, a three times per day intensive ESM approach was used to examine the effects of moment-to-moment social support on experiences of pain during the daily lives of men living with HIV. We found that experiences of HIV-related social support as well as felt social support were associated with reductions in concurrent and time-lagged pain within-persons. With regard to daily pain, men benefitted from both receipt of HIV-related social support as well as perceived feelings of support and acceptance. Experienced pain however, did not significantly affect moment-to-moment experiences of HIV-related social support or felt social support. We also did not find a significant effect of between-person social support on pain, suggesting that daily experiences of social support reduced pain regardless of perceived available social support resources.

Additionally, we assessed between-person effects of attachment-related insecurity on daily pain. We found that attachment-related avoidance had a significant main effect on pain. Specifically men with more attachment-related avoidance reported greater levels of pain on average. That effect remained significant even when accounting for attachment-related anxiety. Neither dimension of attachment-related insecurity moderated the effect of HIV-related social support on pain. Compared to received social support in the context of romantic relationships,[11] HIV-related social support may be less ambiguous and therefore have benefits in spite of one's attachment orientation. On the other hand, attachment-related avoidance moderated the within-person association between felt social support and pain. Men with higher levels of attachment-related avoidance appeared to benefit more from felt social support. Yet the reduction in momentary pain would not meet the level of pain among men with low attachment-related avoidance regardless of felt social support.

Prior research suggests that people with greater attachment-related avoidance tend to overestimate their ability to cope independently with pain until they reach a point of becoming overwhelmed by the pain stressor and need to seek out coping resources.[2] While the attachment-diathesis model of chronic pain was developed for non-HIV populations with chronic pain, we anticipated it would still apply to this investigation of acute (daily) pain experiences. Indeed, attachment-related insecurity may broadly interfere with appraisal of pain and social support. In this study, men with higher attachment-related avoidance may need and benefit more from experiences of felt social support, yet the support they perceive may not be sufficient in reducing their pain or distress to a baseline level. Overall, attachment-related insecurity (particularly avoidance) appeared to predispose individuals to greater pain and moderated the effectiveness of daily felt social support on pain.

Individual demographic characteristics that were included as covariates also played a role in these analyses. For instance, gay and bisexual men appeared to benefit more from felt social support relative to heterosexual-identified men. Age was associated with greater pain on average, and race and SES influenced initial levels of social support within-persons. Pain and social support do not look the same for all individuals and it is important to assume an intersectional approach[43] to future research on the psychosocial mechanisms of pain in PLHIV.

These findings have implications for prevention and management of pain among PLHIV. At the healthcare provider level, pain should be widely assessed and discussed with PLHIV. Assessment could be enhanced by asking how patients cope with pain when it occurs and whether those coping strategies are effective. Healthcare providers have an opportunity to provide both HIV-related social support and to help patients feel supported in addressing their health concerns.[20] PLHIV may feel open to discussing physical discomfort in a medical setting, which could open an opportunity to model supportive behavior. We did not assess sources of social support in this study, but future research could determine whether the source of social support (e.g., healthcare provider, family member, romantic partner, friend) further modifies pain.

Our findings also suggest that approaches to pain management are needed that account for individual and interpersonal factors. For instance, a 12-session pain self-management intervention, Skills TO Manage Pain (STOMP)[29] combines individual skill development with group sessions to bolster peer support around the experience of living with pain and HIV. Our findings support the integration of social support with pain management skills to optimize intervention effects. Content on seeking social support effectively could be integrated in individual or group pain interventions. Furthermore, content specific to interpersonal relationship enhancement and emotion regulation may be included in interventions to address attachment-related insecurity that may interfere with the use of available social support in the context of pain. If feasible, interventionists may consider including a family member, partner, or other supportive figure in sessions to facilitate communication about pain and how to provide support. Overall, there is very little research on evidence-based behavioral pain interventions for populations affected by HIV. Feasibility is supported [27] and larger scale studies are needed to test the efficacy and effectiveness for behavioral pain interventions tailored for PLHIV. Providers must also consider if individuals

do not have successes in managing pain, interpersonal psychotherapy may be indicated to address attachment-related insecurity that could interfere with appraisal of pain and coping.

The results of this study should be interpreted in light of some limitations. The sample included only men, and thus results may not generalize to the daily experiences of social support and pain among women, transgender individuals, or gender non-conforming individuals. Moreover, this sample was recruited from a university-based HIV care clinic and may not represent the experiences of those who receive medical treatment in other settings, or who are not currently connected to HIV care. Future research should make use of larger samples inclusive of all genders, as well as different geographical and cultural backgrounds to further examine the generalizability of these findings. This investigation also did not include current substance users. Some research suggests that pain experiences are more severe among people with problematic substance use, while others find no differences in pain severity between substance users and non-users.[34, 42] Future investigations should include substance users to determine the role of social support and attachment in the context of substance use and pain.[20] Additionally, while we had a relatively large sample for an ESM design, we did have some missing data due to participant noncompliance. Future studies will need to consider ways to enhance compliance in their study designs. Our measures of pain and social support in ESM were brief (one-item in the case of HIV-related social support) in order to reduce participant burden which may have limited broader understanding of these constructs. Additional forms of received social support could be assessed in future studies to determine whether the focus of received social support changes its beneficial effects. Overall, ESM is a useful tool for studying daily life experiences and future research can help describe the nuances of daily pain among PLHIV, including more specifics about how PLHIV cope with pain.

This study also has several major strengths and implications that are worth noting, including its use of ESM to assess experiences of social support and pain as they occur in the daily lives of men living with HIV. In other words, we measured in-the-moment experiences of pain right after potential experiences of social support had occurred, limiting potential biases by exclusively using global measures of these experiences. Our results suggest that daily measures of perceived social support are better predictors of momentary pain than a questionnaire measure of perceived social support. A global assessment of perceived social support may not be the most effective tool to assess the influence of social support on pain among men. The ESM approach combined with time-lagged analyses offered a richer understanding of the relationships between social support and pain, and allowed for inferences about the directionality of relationships among the constructs measured. Additionally, cross-level interactions allowed for exploration of the nuanced ways within- and between-person variables interact to affect moment-to-moment experiences of pain in this sample of men living with HIV.

CONCLUSIONS

Given the high prevalence of pain experienced by PLHIV, we used an intensive ESM approach to understand the relationships between moment-to-moment experiences of social support and pain in a sample of men living with HIV. We found that perceived HIV-specific

social support and feelings of support and acceptance were associated with less pain within individuals. Additionally, we accounted for between-person attachment-related insecurity and perceived social support. Attachment-related avoidance was associated with greater pain on average, and it also moderated the effect of momentary felt social support on pain. These findings support that individual and interpersonal variables are both important to account for in assessment and intervention for pain in men living with HIV. More rigorous research is needed to support wider assessment of pain in PLHIV and to evaluate tailored interventions for pain management. Interpersonal approaches to treatment may be needed to augment intervention effectiveness.

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Figure 1. Moderation effect of attachment-related avoidance on the relationship between felt social support and pain later, when HIV-related support, current pain, and covariates are included in model.

Table 1.

Demographic information about sample (N= 109) and description of study variables.

Variable	Mean $\pm$ SD Or n (%)	Range
Age (M $\pm$ SD, range)	40.0 $\pm$ 10.5	24–68
Time since starting ART (years)	6.6 $\pm$ 4.7	1–19
Race		
African American/Black	59 (54%)	---
White, non-Hispanic	50 (46%)	---
Sexual Orientation		
Gay/Bisexual	89 (82%)	---
Heterosexual/Straight	20 (18%)	---
SES Level	2.76 $\pm$ 0.89	1–4
Lower	12 (11%)	---
Lower Middle	23 (21%)	---
Middle	53 (49%)	---
Upper Middle	21 (19%)	---
Study Variables	M $\pm$ SD	Range
Questionnaire Measures		
Attachment Avoidance	2.9 $\pm$ 1.4	1–6.3
Attachment Anxiety	3.6 $\pm$ 1.5	1–7
ISEL - Total	3.3 $\pm$ 0.5	1.4–4
ESM Measures		
Pain	2.0 $\pm$ 1.8	1–8.6
HIV-related social support	2.1 $\pm$ 1.3	1–5
Felt social support	3.8 $\pm$ 1.1	1.4–5

Note: ISEL: Interpersonal Support Evaluation List; ESM: experience sampling method. ESM measures are reported based on aggregate values.

Table 2.

Multilevel associations between ESM social support and pain.

	Model 1: Pain later			Model 2: Pain later			Model 3: HIV-related social support later			Model 4: Felt social support later		
Level 1: Within-person	Coefficient (se)	t	p	Coefficient (se)	t	p	Coefficient (se)	t	p	Coefficient (se)	t	p
Intercept	2.11 (0.20)	10.55	<.001	2.11 (0.20)	10.56	<.001	2.20 (0.13)	17.55	<.001	3.91 (0.08)	46.20	<.001
HIV-related Social Support	-0.06 (0.02)	-2.56	.013	-0.07 (0.03)	-2.46	.016	---	---	---	---	---	---
Felt Social Support	-0.09 (0.03)	-2.52	.014	-0.08 (0.04)	-2.09	.040	---	---	---	---	---	---
Pain Now	---	---	---	0.21 (0.05)	4.11	<.001	-0.05 (0.04)	-1.16	.249	0.01 (0.01)	1.01	.316
Level 2: Covariates^c												
Age	0.03 (0.02)	1.63	.106	0.03 (0.02)	1.63	.106	0.01 (0.01)	0.93	.354	0.01 (0.01)	1.95	.054
Race ^a	0.27 (0.41)	0.65	.519	0.27 (0.41)	0.65	.517	0.71 (0.27)	2.67	.009	0.31 (0.17)	1.86	.066
SES	-0.46 (0.35)	-1.31	.195	-0.46 (0.35)	-1.31	.195	0.06 (0.16)	0.38	.704	0.43 (0.09)	4.65	<.001
Sexual Orientation ^b	0.87 (0.69)	1.25	.214	0.87 (0.69)	1.25	.214	0.22 (0.36)	0.61	.544	-0.39 (0.26)	-1.49	.139

^aDichotomous variable (0=white, non-Hispanic)^bDichotomous variable (0=gay/bisexual)^cValues reported at the intercept

Table 3.

Main effects of between-person psychosocial variables on ESM pain, when variables entered one by one (Models 5–7) and simultaneously (Model 8).

	Model 5			Model 6			Model 7			Model 8		
Level 2: Between-person variables	Coefficient (se)	t	p	Coefficient (se)	t	p	Coefficient (se)	t	p	Coefficient (se)	t	p
Intercept	2.12 (0.19)	11.04	<.001	2.13 (0.20)	10.79	<.001	2.20 (0.20)	11.24	<.001	2.19 (0.19)	11.54	<.001
Attachment-related Avoidance	0.37 (0.14)	2.63	.010	---	---	---	---	---	---	0.43 (0.15)	2.79	.007
Attachment-related Anxiety	---	---	---	0.22 (0.14)	1.57	.120	---	---	---	-0.11 (0.13)	-0.83	.409
ISEL Social Support	---	---	---	---	---	---	-0.87 (0.45)	-1.92	.057	-0.35 (0.49)	-0.72	.475
Level 2 Covariates												
Age	0.03 (0.02)	1.95	.054	0.04 (0.02)	2.04	.044	0.04 (0.02)	2.11	.037	0.03 (0.02)	2.11	.037
Race ^a	0.30 (0.41)	0.73	.466	0.32 (0.42)	0.75	.454	0.47 (0.44)	1.07	.290	0.43 (0.42)	1.02	.312
SES	-0.32 (0.33)	-0.97	.336	-0.38 (0.34)	-1.10	.277	-0.16 (0.34)	-0.48	.632	-0.19 (0.33)	-0.57	.571
Sexual Orientation ^b	0.83 (0.64)	1.30	.197	0.91 (0.68)	1.34	.185	1.03 (0.68)	1.52	.133	0.99 (0.64)	1.54	.127

^aDichotomous variable (0=white, non-Hispanic)

^bDichotomous variable (0=gay/bisexual)

Table 4.

Moderation effects of between-person psychosocial variables on time-lagged ESM pain, when variables entered one by one (Models 9–11).

	Model 9: Attachment-related avoidance			Model 10: Attachment-related anxiety			Model 11: ISEL social support		
Level 1: Within-person Main effects	Coefficient (se)	t	p	Coefficient (se)	t	p	Coefficient (se)	t	p
Intercept	2.10 (0.19)	10.95	<.001	2.11 (0.20)	10.67	<.001	2.18 (0.20)	11.12	<.001
HIV-related Social Support	-0.06 (0.03)	-2.09	.040	-0.07 (0.03)	-2.18	.032	-0.05 (0.02)	-2.33	.022
Felt Social Support	-0.07 (0.04)	-1.88	.063	-0.09 (0.04)	-2.11	.037	-0.05 (0.04)	-1.45	.150
Pain	0.21 (0.04)	3.53	.001	0.20 (0.05)	3.79	<.001	0.20 (0.05)	4.04	<.001
Level 2: Between-person Interaction effects									
Between-person Variable x HIV-related Social Support	0.00 (0.00)	-0.00	.998	-0.01 (0.02)	-0.62	.540	-0.01 (0.04)	-0.30	.769
Between-person Variable x Felt Social Support	-0.05 (0.02)	-2.00	.048	-0.00 (0.03)	-0.15	.886	0.06 (0.09)	0.73	.468
Between-person Variable x Pain	-0.03 (0.05)	-0.57	.568	0.06 (0.04)	1.56	.121	0.09 (0.10)	0.89	.377
Level 2 Covariates^c									
Age	0.03 (0.02)	1.89	.061	0.04 (0.02)	2.00	.048	0.04 (0.02)	2.10	.039
Race ^a	0.27 (0.41)	0.66	.510	0.28 (0.42)	0.67	.505	0.43 (0.44)	0.98	.330
SES	-0.33 (0.35)	-0.94	.352	-0.36 (0.37)	-0.98	.329	-0.15 (0.36)	-0.43	.669
Sexual Orientation ^b	0.85 (0.64)	1.31	.193	0.93 (0.69)	1.35	.180	1.04 (0.68)	1.53	.129

^aDichotomous variable (0=white, non-Hispanic)

^bDichotomous variable (0=gay/bisexual)

^cValues reported at the intercept