Intensity of Social Support Matters: A Latent Class Analysis to Identify Levels of Social Support Associated with Optimal Health Outcomes Among Women Living with HIV

Aruna Chandran[1], **Fiona Bhondoekhan**[1], **Tracey E. Wilson**[2], **Joel Milam**[3], **Mardge H. Cohen**[4], **Adaora A. Adimora**[5], **Adebola Adedimeji**[6], **Jennifer Cocohoba**[7], **Carrigan Parish**[8], **Marcia Holstad**[9], **Seble Kassaye**[10], **Mirjam-Colette Kempf**[11]

[1]Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, 615 N. Wolfe Street, Suite W6501, Baltimore, MD 21205, USA

[2]Department of Community Health Sciences, School of Public Health, SUNY Downstate Health Sciences University, Brooklyn, NY, USA

[3]Department of Preventive Medicine, University of Southern California, Los Angeles, CA, USA

[4]Cook County Health and Hospital System, Chicago, IL, USA

[5]Department of Medicine, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

[6]Department of Epidemiology & Population Health, Albert Einstein College of Medicine, Bronx, NY, USA

[7]Department of Clinical Pharmacy, University of California, San Francisco, San Francisco, CA, USA

[8]Department of Sociomedical Sciences, Mailman School of Public Health, Columbia University, New York, NY, USA

[9]Nell Hodgson Woodruff School of Nursing, Atlanta, GA, USA

[10]Department of Medicine/Infectious Diseases, Georgetown University, Washington, DC, USA

[11]Schools of Nursing, Public Health and Medicine, University of Alabama at Birmingham, Birmingham, AL, USA

Abstract

Social support is associated with improved HIV care and quality of life. We utilized latent class analysis to identify three classes of baseline emotional and tangible perceived social

✉Aruna Chandran, achandr3@jhu.edu.

support, termed "Strong", "Wavering" and "Weak". "Weak" vs. "Strong" perceived social support was associated over time with an 8% decreased risk of optimal antiretroviral therapy (ART) adherence for emotional and 6% decreased risk for tangible perceived social support. Importantly, "Wavering" vs "Strong" social support also showed a decreased risk of ART adherence of 6% for emotional and 3% for tangible support. "Strong" vs. "Weak" perceived support had a similar association with undetectable viral load, but the association for "Strong" vs. "Wavering" support was not statistically significant. Intensity of social support is associated with HIV care outcomes, and strong social support may be needed for some individuals. It is important to quantify the level or intensity of social support that is needed to optimize HIV outcomes.

Resumen

El apoyo social está asociado con una mejor atención y calidad de vida del virus de inmunodeficiencia humana (VIH). Utilizamos el análisis de clase latente para identificar tres clases de apoyo social percibido emocional y tangible de referencia, denominado "fuerte", "vacilante" y "débil". El apoyo social percibido "débil" versus el "fuerte" se asoció con el tiempo con una disminución del 8% en el riesgo de una adherencia óptima al terapia antirretroviral (TAR) para el apoyo emocional y del 6% en el riesgo de un apoyo social percibido tangible. Es importante destacar que el apoyo social "vacilante" frente a "fuerte" también mostró una disminución del riesgo de adherencia al TAR del 6% para el apoyo emocional y del 3% para el apoyo tangible. El apoyo percibido "fuerte" frente a "débil" tuvo una asociación similar con una carga viral indetectable, pero la asociación entre el apoyo "fuerte" y el apoyo "vacilante" no fue estadísticamente significativa. La intensidad del apoyo social está asociada con los resultados de la atención del VIH, y algunas personas pueden necesitar un fuerte apoyo social. Es importante cuantificar el nivel o la intensidad del apoyo social que se necesita para optimizar los resultados del VIH.

Keywords

Introduction

Several decades of research have documented the positive impact of perceived social support on physical as well as mental health outcomes [1–3]. Among people living with HIV (PLWH), social support is associated with improved HIV-care and quality of life [4–7]. Within the Women's Interagency HIV Study (WIHS), the largest natural history cohort of women living with HIV, increased social support was prospectively associated with antiretrovial therapy (ART) adherence, a key component of HIV disease management [8].

Social support is "...the perception or experience that one is loved and cared for by others, esteemed and valued, and part of a social network of mutual assistance and obligations" [9, 10]. There are multiple mechanisms by which social support may augment health, including increasing coping mechanisms, self-compassion as well as savoring or the ability to reminisce on or anticipate positive experiences [11–15]. In addition, research is ongoing to better understand the specific features of social support that are most acceptable and

impactful [13, 16–18]. Some studies have suggested the promotion of support groups for individuals with chronic illnesses, while others have noted participant preferences for individual coaches or companions [19–23].

Another unanswered question regarding designing interventions to augment social support is what level of support is needed to achieve optimal outcomes. Hakulinen et al. showed that the association of social support and health outcomes is bidirectional through the adult life course, such that social support augmented physical and mental well-being and that improved physical and mental health was important for building future social support [24]. Spohr et al. explored the question of how social support quality and quantity affect health risk behaviors in drug-involved offenders, and found that while social support quality was associated with decreased risk behaviors, there was a weak association between the amount of social support received and increased risk behaviors [25].

While patient preference is certainly an important component of deciding on the intensity of social support that should be provided, it is crucial to understand how different levels of perceived social support influence particular health outcomes [26, 27]. Santos et al. showed a higher prevalence of mental health challenges among Brazilian mothers reporting "low" (vs. "high") perceived social support; they differentiated levels of social support using Latent Class Analysis (LCA) [27]. LCA is a tool used to discriminate between subgroups within a population that cluster with regards to their probabilities of responding in certain ways to a set of questions [28].

Given the lack of clarity in the literature as to what is the appropriate level or intensity of social support needed for women to achieve optimal HIV health outcomes, in this study, we apply LCA to explore if women living with HIV (WLHW) in the Women's Inter-Agency HIV Study (WIHS) cluster in terms of the intensity or level of their perceived social support using data collected in the WIHS from 2013–2019. We then examined whether different levels of social support are differentially associated with optimal ART adherence and undetectable viral load. ART adherence and subsequent viral load suppression are critical both for individual HIV outcomes/health as well as to diminish community-level HIV transmission [29].

Methods

This study sample consists of WLWH who were enrolled at one of 10 sites in the WIHS across the United States (Bronx/Manhattan, New York; Brooklyn, New York; Washington, D.C.; San Francisco/Bay Area, California; Chicago, Illinois; Chapel Hill, North Carolina; Atlanta, Georgia; Miami, Florida; Birmingham, Alabama/Jackson, Mississippi). The WIHS is a multi-center cohort study that has observed WLWH and women at risk for HIV since the mid-1990s [30]. Eligible individuals for this analysis were those who answered at least one of the social support questions at or after the time in which those questions were introduced (October 2013). WIHS participants provided written informed consent and were compensated for their participation in the study. The WIHS protocol has been approved by the Institutional Review Board at each study site's institution and by the WIHS executive committee.

Exposure

Participants in the WIHS were asked a series of 15 questions related to social support during every biannual visit since October 2013. The first 12 questions are from the Medical Outcomes Study's Modified Social Support Survey (MSSS) [31]. The last three questions were specifically created for the WIHS cohort. All questions regarding perceived presence of social support were asked on a Likert Scale, with 1 being "none of the time", 2 being "a little of the time", 3 being "some of the time", 4 being "most of the time", and 5 being "all of the time". A previously conducted Exploratory Factor Analysis (EFA) of these questions in this cohort of women revealed that 14 out of the 15 questions loaded into two distinct factors [(termed "emotional" (8 questions) and "tangible" (6 questions) support] with high factor loadings (> 0.713 per item) and Cronbach's alpha scores (0.97 for emotional support, 0.95 for tangible support) [8]. Emotional social support represents the perception of having people to talk to or get advice from, and tangible social support represents the perception of having people to help with activities of daily living or chores. Those 14 questions were used in this analysis, eliminating the question "Do you have someone to care for children/others in your care" which potentially would only apply to a subset of women.

In this study, 1712 WLWH answered the MSSS survey for their first time (identified as their "baseline" for this study) between Fall 2013 and Fall 2016. Five women did not answer 3 or more of the 14 social support questions at that visit; therefore 1707 women, representing all four enrollment waves in the WIHS, that completed 12 or more social support questions at baseline were retained in the baseline perceived social support analysis. The EFA of the social support questions was repeated in this group, and again the questions loaded into two distinct factors of "emotional" and "tangible" support, with Cronbach's alpha values of 0.963 for emotional and 0.938 for tangible support. We also conducted a Confirmatory Factor Analysis using the constructs separately, and the model showed strong fit statistics with a Root Mean Squared Error of Approximation of 0.04 and a Comparative Fit Index of 0.890. Given these results, we continued to analyze the two constructs separately for this study.

Outcome

The first outcome for this study was ART adherence, assessed at annual visits between Fall 2013 and Fall 2019. Adherence was measured by self-report of how often the women took their HIV medication as prescribed over the past 6 months (1: 100% of the time, 2: 95–99% of the time, 3: 75–94% of the time, 4: < 75% of the time, and 5: I haven't taken any of my prescribed medications). We created a binary variable where 95% or higher was considered optimal adherence [32]. For this analysis, all measures of adherence that occurred starting from the visit following the baseline assessment of social support were used.

The second outcome for this study was viral load, also assessed at annual visits routinely in the WIHS. HIV RNA levels were assessed using a nucleic acid sequence–based amplification (COBAS/TaqMan) method, which has a lower limit of detection of 20 copies/mL. In keeping with the national as well as international goals of Undetectable = Untransmittable (U = U), we created a binary variable of achievement of an undetectable viral load *vs.* detectable level of viral RNA [33, 34]. For this analysis, all measures of viral

load that occurred starting from the visit following the baseline assessment of social support were used.

Covariates

Sociodemographic characteristics included in this analysis were based on covariates previously identified as important in the literature with age at baseline as a time-fixed covariate, and annual household income, employment status, housing stability, insurance status, depressive symptoms, alcohol abuse and illicit drug use as time-varying covariates. We also included baseline optimal ART adherence and baseline viral load as a time-fixed covariate in each respective analysis. We aligned covariate categorization with the prior analysis of perceived social support in the WIHS [8]. We categorized age as < 40 years, 40– < 50 years, and ≥ 50 years. Household income was categorized as < $24,000 per year, ≥ $24,000 per year, and unknown/not reported. Employment status was dichotomized as currently employed *vs.* not currently employed. Housing status was categorized as "stable" if the participant reported living in their own house/apartment, parent's house, or someone else's house/apartment, and "unstable" if they reported living in a shelter, jail, residential treatment center, on the street, or "other" place. Insurance status was divided into any *vs.* no coverage. Recognizing that depression is an important confounding variable associated with both perceived social support and HIV outcomes, we included a dichotomous variable of a score of ≥ 16 on the Center for Epidemiological Studies Depression (CES-D) Scale indicating presence of depressive symptoms [35]. Alcohol abuse was dichotomized as consumption of > 7 drinks per week *vs.* ≤ 7 drinks per week [36]. Illicit drug use was defined as use of injected or non-injected use of recreational drugs since the last visit, including includes crack, cocaine, heroin, methamphetamines, amphetamines, and illicit methadone [37]. We do not include race or ethnicity in our model; guided by the work of scholars such as Nancy Krieger, we believe there is no proven underlying sole effect of race on health outcomes and instead that the social construct of "race" represents a loose proxy for underlying root causes of health disparities [38]. However, we did conduct a sensitivity analysis of our models using a categorical variable of race/ethnicity (Non-Hispanic White, Non-Hispanic Black, Hispanic), and found no differences in our estimates or confidence intervals.

Statistical Analysis

Without any a priori assumptions regarding how responses to each question would align with the Likert Scale, we separately conducted LCAs of baseline emotional and tangible social support. We selected the optimal number of classes after comparing the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), and the Vuong-Lo-Mendell-Rubin Bootstrapped Likelihood Ratio Test. For both emotional and tangible social support, 3 (compared with 2,4 and 5 classes) was the optimal number of classes; the entropy for the three-class model for emotional social support was 0.968 and for tangible social support was 0.943.

We categorized the women into three classes of perceived emotional and tangible social support separately at baseline based on their posterior probabilities of answering 5 ("all of the time") vs. 4 ("most of the time") vs. 1, 2 or 3 ("none of the time", "a little of the

time", "some of the time") on the individual social support questions. In LCA, the posterior probabilities reflect the likelihood of a membership in a particular class given a specific response option to a question. All of the questions within each sub-scale aligned with these class categorizations, which is supported by the strong loadings that each question had with its respective sub-scale; the posterior probabilities of each response option for each question are given in the Supplementary Tables 1 and 2. In generalized estimating equation robust modified poisson models with log links, independent correlation structures, exposure time as the offset, and classes of emotional and tangible social support as exposures, the relative risk of ART adherence or undetectable viral load by social support classes were explored controlling for the above-mentioned covariates [39]. All EFA and LCA analyses were conducted in MPlus 8 and regression models for the association between social support classes and ART adherence were performed in Stata Version 16.

Results

There were 1,707 WLWH who reported perceived social support and thus were included in the LCA (Table 1). At baseline, 43% (737) were 50 years of age or older and 37% (624) were 40– < 50 years of age. The majority (72%, 1234) identified as Black or African American, and 14% (241) self-reported Hispanic/Latina ethnicity. Approximately one-third were enrolled in each of the first (1994–95; 31%, 534) and fourth (2013–15; 34%, 586) enrollment waves of the WIHS. Over 75% (1233) reported an income of < $24,000 annually. Fewer than a third (552, 32%) were employed, and 30% (529) reported presence of depressive symptoms. Nearly all (1620, 95% and 1,631, 96%) reported having insurance coverage and being stably housed. Just over 10% (12%, 27) reported abusing alcohol, and 23% (391) reported use of illicit drugs. A total of 1,540 were included in the ART adherence model; adherence of 95% was reported by 84% (1290) of women at baseline. 1,654 women were included in the undetectable viral load models, with 1,095 (66%) women having undetectable viral load at baseline.

In both types of perceived social support, the LCA showed three subclasses of individuals. For emotional social support, 44.8% (765) of individuals were likely to respond "All of the time" on all of the questions, and were termed having "Strong" perceived social support. A total of 490 individuals (28.7%) were likely to respond "Most of the time" to all questions, and were termed having "Wavering" perceived social support. The remaining 452 (26.5%) were likely to respond "Some of the time", "A little of the time", or "None of the time" to all questions and were termed having "Weak" perceived social support. The probabilities of the specified response option(s) within each class for emotional social support are shown in Fig. 1. The "Strong" social support class had probabilities of 89–97% of responding "All of the time", the "Wavering" class had probabilities of 66–78% of responding "Most of the time", and the "Weak" class had probabilities of 85–96% of responding "None of the time" to "Some of the time". The same classes were identified with tangible social support, with 46.3% (791) having "Strong" perceived social support, 21.9% (374) having "Wavering" perceived social support, and 31.8% (542) having "Weak" perceived social support. For tangible social support (Fig. 2), the "Strong" social support class had probabilities of 84– 95% of responding "All of the time", the "Wavering" class had probabilities of 60–83%

of responding "Most of the time", and the "Weak" class had probabilities of 84–95% of responding "None of the time" to "Some of the time."

Compared to women with Strong perceived emotional support, those with Weak perceived emotional support had an 8% decreased risk of ART adherence (aRR 0.92, 95% Confidence Interval (CI) 0.89, 0.96) (Table 2). Those with Wavering perceived emotional support had a 6% decreased risk of adherence (aRR: 0.95, 95% CI 0.89, 0.96). Similarly, compared to women with Strong perceived tangible support, those with Weak perceived tangible support had an 6% decreased risk of ART adherence (aRR: 0.94, 95% CI 0.91, 0.97), and those with Wavering perceived tangible support also appeared to have a decreased risk of ART adherence (aRR: 0.97, 95% CI 0.94, 0.99).

For undetectable viral load, the associations with levels of perceived social support were not as strong but in the same direction. Compared to women with Strong perceived emotional support, those with Weak perceived emotional support had a 6% decreased risk of having an undetectable viral load (aRR 0.94, 95% Confidence Interval (CI) 0.89, 0.99) (Table 2). With perceived tangible social support, women with Weak vs. Strong support had a 6% decreased risk of having an undetectable viral load (aRR: 0.94, 95% CI 0.89, 0.98). For Wavering vs. Strong perceived social support, the associations were not significant (aRR 0.98, 95% CI 0.93, 1.02, for emotional support, and aRR 0.98, 95% CI 0.93, 1.02, for tangible support).

Discussion

Using LCA to delineate different baseline levels of perceived social support, we showed an 8% and 6% decreased risk of optimal ART adherence with weak vs. strong emotional and tangible social support among WLWH in the WIHS cohort, respectively. Weak vs. strong emotional and tangible social support resulted in a 6% decreased risk of having undetectable viral load. This supports findings from other studies; for example, Santos et al. showed greater prevalence of mental health disorders among mothers with low vs. high levels of perceived social support [27]. Our study, however, suggests an additional unique finding, which is that moderately high perceived social support still results in decreased risk of optimal ART adherence (6% and 3% with decreased adherence with "Wavering" vs. "Strong" emotional and tangible support, respectively). Intuitively, as well as in some prior studies, individuals reporting social support "most of the time" may be combined with those reporting social support "all of the time", with the assumption that the two categories are for all intents and purposes equal [27]. With our more objective outcome of undetectable viral load, there was a 6% decreased risk of having an optimal viral load for "Strong" vs. "Weak" emotional and tangible social support, but there was not a significant difference between "Strong" vs. "Wavering" social support. Our findings suggest the need to explore further whether there is a difference between individual perceived social support "all of the time" vs. "most of the time."

These findings deserve further exploration with individuals who have a broader and more diverse social support experience in order to better inform interventions designed to promote social support among individuals with chronic illnesses. In prior efforts to develop social support interventions, investigators have suggested the need to better understand

and consider appropriate support intensity; in a meta-analysis of psychosocial support interventions for WLWH, Beres et al. discussed the need to better delineate the length and intensity of interventions being evaluated [40–42]. As more and more models are testing the utility of using peers as clinic or community based support for HIV testing, linkage and retention, better quantification of the level or intensity of support that will be most effective is crucial [43, 44].

Our study has several limitations. First, we assessed perceived social support as a baseline exposure and compared it with subsequent HIV care outcome ascertainment. Given chronic illnesses such as HIV/AIDS requiring complex and long-term care, it might be helpful for some intervention strategies to explore if there is a bidirectional relationship between social support and HIV care outcomes. In addition, we noted very little variation in perceived social support over multiple ascertainments in our population; however, it would be interesting to assess classes of social support as measured over a longer period of time in a future study. Second, the WIHS cohort is unique in that the WIHS sites may in and of themselves be a source of support to these women, many of whom have maintained relationships with their sites for several decades. Thus they may have a stronger perceived social support than the general population. It will be important to explore the importance of social support level or intensity among other key populations. Third, the posterior probabilities of being in the Wavering class were lower than the other classes in our population, ranging from 60–83%. Researchers have suggested a cut-off of 70% for assignment to a particular class [45]; we elected to keep all questions as representative of class membership given the relatively high fit statistics and entropy of our models. However, further research is needed to establish the true nature of "Wavering" social support.

Our study suggests differential effects of levels of perceived social support on ART adherence and undetectable viral load among WLWH; although the magnitude of the differences were small, we do believe this warrants further investigation. We encourage future studies to further delineate the appropriate duration and intensity of social support that may be needed to improve HIV care. Interventions to promote social support may need to differentiate the levels of social support that are being provided (i.e., telephone-based peer support vs. more intense mentoring programs), and fully evaluate the differential effects of levels of social support intensity. Promotion of interventions that provide the necessary level of social support to individuals living with HIV may be an important component to improving HIV care.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Funding

References

1. Harandi TF, Taghinasab MM, Nayeri TD. The correlation of social support with mental health: a meta-analysis. Electron Phys. 2017;9(9):5212–22.

2. Lee S, Chung JE, Park N. Network environments and well-being: an examination of personal network structure, social capital, and perceived social support. Health Commun. 2018;33(1):22–31. [PubMed: 27858469]

3. Uchino BN, Bowen K, Kent de Grey RG, Mikel J, Fisher EB. Social support and physical health: models, mechanisms, and opportunities. In: Fisher E, editor. Principles and concepts of behavioral medicine. New York, NY: Springer; 2018. p. 341–72.

4. Lambert CC, Westfall A, Modi R, Amico RK, Golin C, Keruly J. HIV-related stigma, depression, and social support are associated with health-related quality of life among patients newly entering HIV Care. AIDS Care. 2020;32(6):681–8. [PubMed: 31167537]

5. Kalichman SC, DiMarco M, Austin J, Luke W, DiFonzo K. Stress, social support, and HIV-status disclosure to family and friends among HIV-positive men and women. J Behav Med. 2003;26(4):315–32. [PubMed: 12921006]

6. Friedman MR, Coulter RW, Silvestre AJ, Stall R, Teplin L, Shoptaw S, et al. Someone to count on: social support as an effect modifier of viral load suppression in a prospective cohort study. AIDS Care. 2017;29(4):469–80. [PubMed: 27456040]

7. Mi T, Li X, Zhou G, Qiao S, Shen Z, Zhou Y. HIV disclosure to family members and medication adherence: role of social support and self-efficacy. AIDS Behav. 2020;24(1):45–54. [PubMed: 30863978]

8. Chandran A, Benning L, Musci RJ, Wilson TE, Milam J, Adedimeji A, et al. The longitudinal association between social support on HIV medication adherence and healthcare utilization in the women's interagency HIV study. AIDS Behav. 2019;23(8):2014–24. [PubMed: 30311104]

9. Wills TA. Social support and interpersonal relationships. In: Clark MS, editor. Prosocial behavior. Thousand Oaks, CA: SAGE; 1991. p. 265–89.

10. Taylor SE. Social support: a review. In: Friedman MS, editor. The handbook of health psychology. New York, NY: Oxford University Press; 2011. p. 189–214.

11. Wilson JM, Weiss A, Shook NJ. Mindfulness, self-compassion, and savoring: factors that explain the relation between perceived social support and well-being. Personal Individ Differ. 2020;152:1–9.

12. Feeney BC, Collins NL. New look at social support: a theoretical perspective on thriving through relationships. Personal Soc Psychol Rev. 2015;19(2):113–47.

13. Pillemer SC, Holtzer R. The differential relationships of dimensions of perceived social support with cognitive function among older adults. Aging Ment Health. 2016;20(7):727–35. [PubMed: 25902848]

14. Drogomyretska K, Fox R, Colbert D. Brief Report: stress and perceived social support in parents of children with ASD. J Autism and Dev Disord. 2020;50:4176. [PubMed: 32200467]

15. Simoni JM, Frick PA, Huang B. A longitudinal evaluation of a social support model of medication adherence among HIV-positive men and women on antiretroviral therapy. Health Psychol. 2006;25(1):74–81. [PubMed: 16448300]

16. Rogers E, Polonijo AN, Carpiano RM. Getting by with a little help from friends and colleagues: testing how residents' social support networks affect loneliness and burnout. Can Fam Physician. 2016;62(11):e677–83. [PubMed: 28661887]

17. Lee CY, Goldstein SE. Loneliness, stress, and social support in young adulthood: does the source of support matter? J Youth Adolesc. 2016;45(3):568–80. [PubMed: 26602564]

18. Bekele T, Rourke SB, Tucker R, Greene S, Sobota M, Koornstra J, et al. Direct and indirect effects of perceived social support on health-related quality of life in persons living with HIV/AIDS. AIDS Care. 2013;25(3):337–46. [PubMed: 22774876]

19. Wright KB. Communication in health-related online social support groups/communities: a review of research on predictors of participation, applications of social support theory, and health outcomes. Rev Commun Res. 2016;4:65–87.

20. Ogbe E, Harmon S, Van den Bergh R, Degomme O. A systematic review of intimate partner violence interventions focused on improving social support and/ mental health outcomes of survivors. PLoS ONE 2020;15(6):e0235177. [PubMed: 32584910]

21. Young SD, Koussa M, Lee SJ, Perez H, Gill N, Gelberg L, et al. Feasibility of a social media/ online community support group intervention among chronic pain patients on opioid therapy. J Addict Dis. 2018;37(1–2):96–101. [PubMed: 30614403]

22. Lee EJ, Cho E. When using facebook to avoid isolation reduces perceived social support. Cyberpsychol Behav Soc Netw. 2018;21(1):32–9. [PubMed: 28650208]

23. Bloom RD, Reblin M, Chou WS, Beck SL, Wilson A, Ellington L. Online social support for cancer caregivers: alignment between requests and offers on CaringBridge. J Psychosoc Oncol. 2021. 10.1080/07347332.2020.1806174.

24. Hakulinen C, Pulkki-Raback L, Jokela M, Ferrie JE, Aalto AM, Virtanen M, et al. Structural and functional aspects of social support as predictors of mental and physical health trajectories: Whitehall II cohort study. J Epidemiol Community Health. 2016;70(7):710–5. [PubMed: 26767407]

25. Spohr SA, Suzuki S, Marshall B, Taxman FS, Walters ST. Social support quality and availability affects risk behaviors in offenders. Health Justice. 2016;4:2. [PubMed: 27054059]

26. Lloyd GR, Hoffman SA, Welch WA, Blanch-Hartigan D, Gavin KL, Cottrell A, et al. Breast cancer survivors' preferences for social support features in technology-supported physical activity interventions: findings from a mixed methods evaluation. Transl Behav Med. 2020;10(2):423–34. [PubMed: 30445595]

27. Santos LM, Amorim LD, Santos DN, Barreto ML. Measuring the level of social support using latent class analysis. Soc Sci Res. 2015;50:139–46. [PubMed: 25592926]

28. Collins LM, Lanza ST. Latent class and latent transition analysis: with applications in the social, behavioral and health sciences. New York, NY: John Wiley & Sons, Inc.; 2009. p. 330.

29. Schaecher KL. The importance of treatment adherence in HIV. Am J Manag Care. 2013;19(12 Suppl):s231–7. [PubMed: 24495293]

30. Adimora AA, Ramirez C, Benning L, Greenblatt RM, Kempf MC, Tien PC, et al. Cohort profile: the women's interagency HIV study (WIHS). Int J Epidemiol. 2018;47(2):393–4. [PubMed: 29688497]

31. Sherbourne CD, Stewart AL. The MOS social support survey. Soc Sci Med. 1991;32(6):705–14. [PubMed: 2035047]

32. Altice F, Evuarherhe O, Shina S, Carter G, Beaubrun AC. Adherence to HIV treatment regimens: systematic literature review and meta-analysis. Patient Prefer Adherence. 2019;13:475–90. [PubMed: 31040651]

33. Calabrese SK, Mayer KH. Providers should discuss U=U with all patients living with HIV. Lancet HIV. 2019;6(4):e211–3. [PubMed: 30772420]

34. Okoli C, Van de Velde N, Richman B, Allan B, Castellanos E, Young B, et al. Undetectable equals untransmittable (U = U): awareness and associations with health outcomes among people living with HIV in 25 countries. Sex Transm Infect. 2020. 10.1136/sextrans-2020-054551.

35. Radloff L. The CES-D scale: a self-reported depression scale for research in the general population. Appl Psychol Meas. 1977;1(3):385–401.

36. Linden-Carmichael AN, Vasilenko SA, Lanza ST, Maggs JL. High-intensity drinking versus heavy episodic drinking: prevalence rates and relative odds of alcohol use disorder across adulthood. Alcohol Clin Exp Res. 2017;41(10):1754–9. [PubMed: 28800154]

37. Mack KA, Jones CM, Ballesteros MF. Illicit drug use, illicit drug use disorders, and drug overdose deaths in metropolitan and nonmetropolitan areas—United States. MMWR Surveill Summ. 2017;66(19):1–12.

38. Krieger N. Stormy weather: race, gene expression, and the science of health disparities. Am J Public Health. 2005;95(12):2155–60. [PubMed: 16257941]

39. Chen W, Qian L, Shi J, Franklin M. Comparing performance between log-binomial and robust Poisson regression models for estimating risk ratios under model misspecification. BMC Med Res Methodol. 2018;18(1):63–75. [PubMed: 29929477]

40. Hansell PS, Hughes CB, Caliandro G, Russo P, Budin WC, Hartman B, et al. The effect of a social support boosting intervention on stress, coping, and social support in caregivers of children with HIV/AIDS. Nurs Res. 1998;47(2):79–86. [PubMed: 9536191]

41. Simoni JM, Pantalone DW, Plummer MD, Huang B. A randomized controlled trial of a peer support intervention targeting antiretroviral medication adherence and depressive symptomatology in HIV-positive men and women. Health Psychol. 2007;26(4):488–95. [PubMed: 17605569]

42. Beres LK, Narasimhan M, Robinson J, Welbourn A, Kennedy CE. Non-specialist psychosocial support interventions for women living with HIV: a systematic review. AIDS Care. 2017;29(9):1079–87. [PubMed: 28438030]

43. Genberg BL, Shangani S, Sabatino K, Rachlis B, Wachira J, Braitstein P, et al. Improving engagement in the HIV care cascade: a systematic review of interventions involving people living with HIV/AIDS as peers. AIDS Behav. 2016;20(10):2452–63. [PubMed: 26837630]

44. Macdonald V, Verster A, Baggaley R. A call for differentiated approaches to delivering HIV services to key populations. J Int AIDS Soc. 2017;20(Suppl 4):21658. [PubMed: 28770592]

45. Nagin DS. Group-based modeling of development. Cambridge, MA: Harvard University Press; 2005. p. 214.
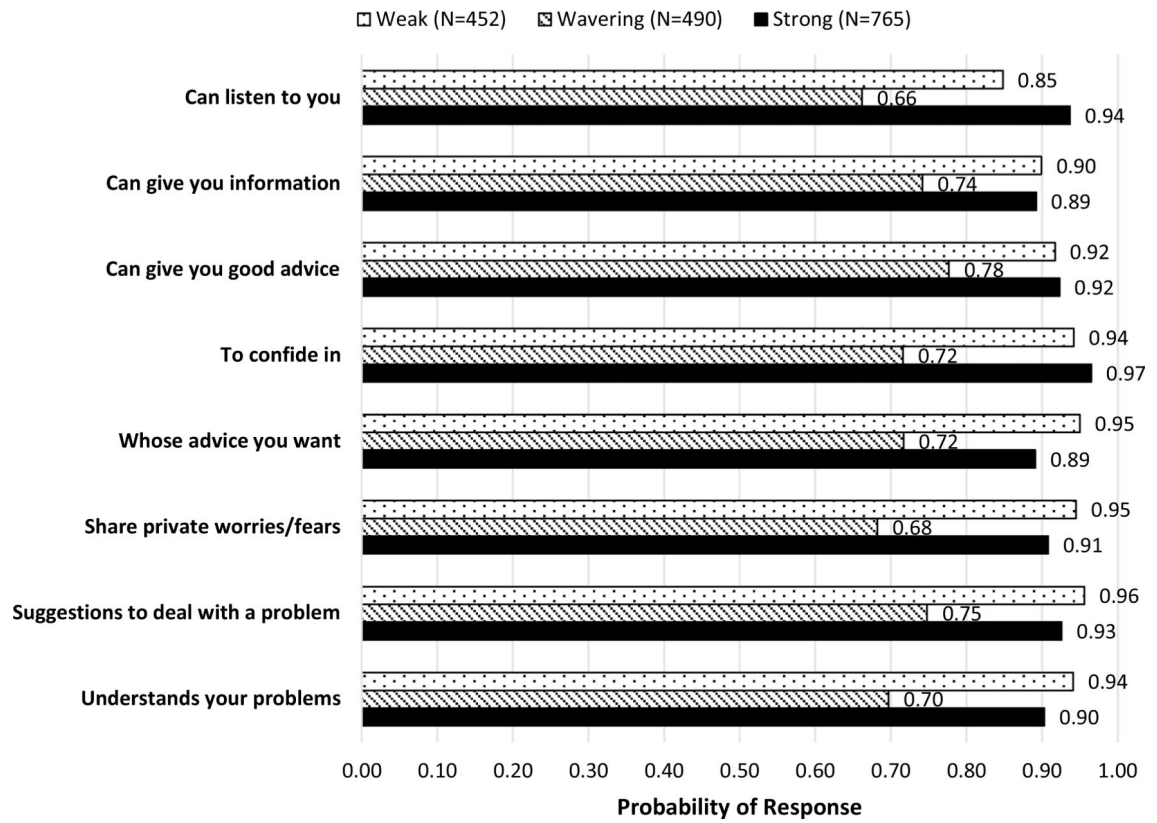
Fig. 1.
Posterior Probabilities of Response Categories "Strong, All of the time", "Wavering, Most of the time" and "Weak, None to Some of the time" for Classes of Perceived Emotional Social Support
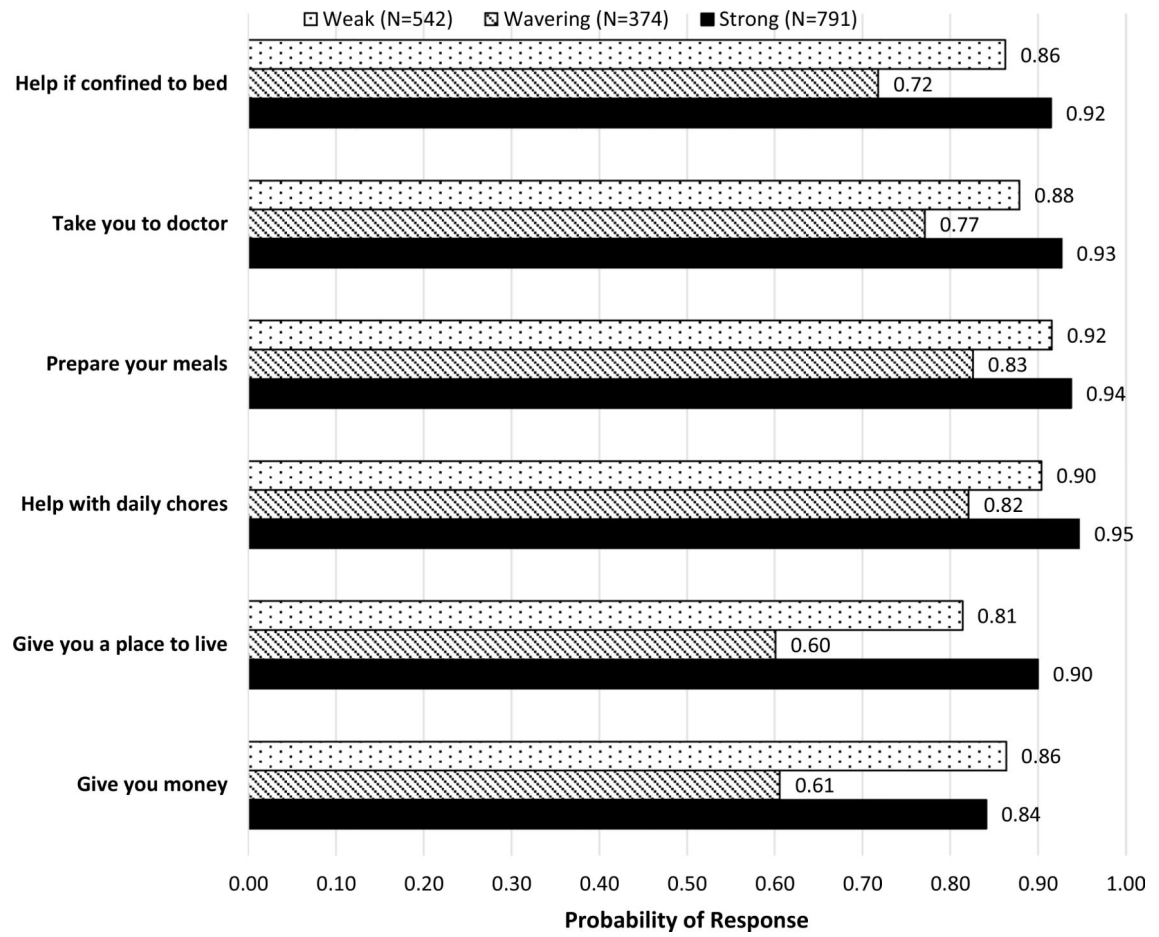
Fig. 2.
Posterior Probabilities of Response Categories "Strong, All of the time", "Wavering, Most of the time" and "Weak, None to Some of the time" for Classes of Perceived Tangible Social Support

Table 1

Baseline characteristics of women living with HIV enrolled in the WIHS included in this analysis (N = 1,707)

Characteristic	Number	Percent
Age < 40 years	346	20.3
40—< 50 years	624	36.6
50 years	737	43.2
Race/Ethnicity[*] NH-Black/African American	1234	72.3
NH-White/Other	232	13.6
Hispanic/Latina	241	14.1
Enrollment Wave Wave 1 (1994–95)	534	31.3
Wave 2 (2001–02)	368	21.6
Wave 3 (2011–12)	219	12.8
Wave 4(2013–15)	586	34.3
Income (N = 1,640) < $24,000 per year	1233	75.2
$24,000 per year	407	24.8
Employment (N = 1,704) Employed	552	32.4
Not employed	1152	67.6
Depressive Symptoms (N = 1,690) 15 CESD Score	1171	69.3
16 CESD Score	519	30.7
Insurance Status (N = 1,705) Currently insured	1620	95.0
Currently not insured	85	5.0
Residential Stability (N = 1,705) Stable	1631	95.7
Unstable	74	4.3
Alcohol Abuse (N = 1,706) Yes	207	12.1
No	1,499	87.9
Illicit Drug Use (N = 1,705) Yes	391	22.9
No	1,314	77.1
Adherence (N = 1,540) 95%	1290	83.8
< 95%	250	16.2
Viral Load (N = 1,654) Undetectable (> 20 copies/mL)	1095	66.2
Detectable (20 copies/mL)	559	33.8

[*]*NH* Non-Hispanic

Table 2

Adjusted relative risk of optimal art adherence and undetect- able viral load with varying levels of perceived social support

	Adjusted relative risk	95% Confidence interval
Optimal Adherence		
Emotional Social Support		
Strong	Ref	–
Wavering	**0.94**	**0.89, 0.96**
Weak	**0.92**	**0.89, 0.96**
Tangible Social Support		
Strong	Ref	–
Wavering	**0.97**	**0.94, 0.99**
Weak	**0.94**	**0.91, 0.97**
Undetectable Viral Load		
Emotional Social Support		
Strong	Ref	–
Wavering	0.98	0.93, 1.02
Weak	**0.94**	**0.89, 0.99**
Tangible Social Support		
Strong	Ref	–
Wavering	0.98	0.93, 1.02
Weak	**0.94**	**0.89, 0.98**

Bold denotes statistical significance, $p < 0.05$

*
Adjusted for age, baseline optimal ART adherence/viral load, employment, income, depressive symptoms, insurance status, residential stability, alcohol abuse, and illicit drug use