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The Longitudinal Association between Social Support on HIV Medication Adherence and Healthcare Utilization in the Women's Interagency HIV Study

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Abstract

Social support is associated with HIV-related health outcomes. However, few studies have explored this longitudinally. We assessed psychometric properties of the Medical Outcomes Study's Social Support Survey among women in the Women's Interagency HIV Study, and explored the longitudinal effects of social support on HIV medication adherence (HIV-positive women) and healthcare utilization (HIV-positive and negative women). The 15 questions loaded into two factors, with Cronbach's Alpha > 0.95. Over 3 years, perceived emotional support was associated with optimal medication adherence (OR 1.19, 95% CI 1.10–1.28) and healthcare utilization (OR 1.16, 95% CI 1.05–1.27), and tangible social support with adherence only (OR 1.18, 95% CI 1.08–1.27) when controlling for covariates, including core sociodemographic characteristics and depressive symptoms. Interventions to further understand the drivers of sub-types of social support as well as enhance sustained social support may assist with optimizing care of women with and at risk for HIV.

Keywords Social support · HIV · Adherence · Healthcare utilization · WIHS

Resumen

El apoyo social está asociado con los resultados de salud relacionados con el VIH. Sin embargo, pocos estudios han explorado esto longitudinalmente. Evaluamos las propiedades psicométricas de la Encuesta de Apoyo Social del Estudio de Resultados Médicos entre las mujeres en el Estudio Interinstitucional del VIH de Mujeres, y exploramos los efectos longitudinales del apoyo social sobre la adherencia a los medicamentos contra el VIH (mujeres VIH positivas) y la utilización de la atención médica (mujeres VIH positivas y negativas). Las 15 preguntas se cargaron en dos factores, con el Alfa de Cronbach > 0.95. Durante tres años, el apoyo emocional percibido se asoció con una adherencia óptima a la medicación (Proporcion de probabilidades (OR) 1.19, Intervalo de confianza (CI) 95%: 1.10–1.28) y la utilización de la atención médica (OR 1.16, CI 95%: 1.05–1.27) y apoyo social tangible con adherencia solamente (OR 1,18, CI del 95%: 1,08–1,27) al controlar las covariables, incluidas las características sociodemográficas principales y los síntomas depresivos. Las intervenciones para comprender mejor los impulsores de los subtipos de apoyo social, así como para mejorar el apoyo social sostenido, pueden ayudar a optimizar la atención de las mujeres con y en riesgo de contraer el VIH.

Introduction

The availability of and ability to access social support is integrally related to health. Social support has been described by House et al. as a multidimensional construct including belonging to a social network, perceived satisfaction with support, emotional support (empathy, caring and trust), and instrumental support (sharing of tasks) [1]. Those with high quality social relationships have decreased risk of

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mortality and other negative health outcomes as compared with those who have low quantity or quality of social relationships [2–5]. Feeling considered as a valued and integral part of relationships improves health outcomes and results in increased treatment self-efficacy [6–9]. Among HIV-positive persons, increased levels of individual social support/cohesion are associated with augmented medical care adherence, improved quality of life, and increased knowledge about HIV care/treatment [9–12]. Among HIV-negative individuals, specifically those of lower socioeconomic status, social support has been associated with higher academic performance, decreased biological inflammatory stress response, and improved general health status [13–15]. However, social support is not always positive; particularly among women, some studies show that being enmeshed in social relationships in which perceived stigma regarding HIV status or turbulence in relationships with individuals that are normally a source of support leaves women feeling less interested in caring for themselves and may serve as barriers to HIV care even in the presence of traditionally-defined social support [16, 17]. Among HIV-negative women specifically of lower socioeconomic status, some studies have suggested that social support can have negative effects on health and well-being, due to factors such as social relationships creating excess drain of limited resources or stress or discomfort resulting from reliance on a source of social support [18–20]. Delineating the types of social support that could be positive for HIV health and general health particularly among vulnerable women of low socioeconomic status could offer a unique opportunity for intervention through promotion or leveraging of sources of social support to improve health and well-being among women.

The majority of studies regarding social support and health outcomes, including those related to HIV, utilize a cross-sectional approach to measuring social support, in which a single survey is used to measure social support that is then compared to health outcomes and demographic covariates measured at or around that time. In other areas, such as economic deprivation, longitudinal assessments of sustained versus varied hardship have given unique insights beyond traditional single-point measurements [21]. To our knowledge, there are few (if any) studies that attempt to associate serial measures of social support with health outcomes measured over time among HIV-positive or vulnerable HIV-negative individuals. Retention in HIV care, adherence to antiretroviral treatments (ART) and healthcare utilization among HIV-positive women is complex, requiring patients to remain engaged in care despite potential individual and structural barriers over long periods of time [22, 23]. Healthcare utilization among women of lower socioeconomic status has consistently been shown to be low, often due to barriers in healthcare access as well as quality; however, effective health prevention and promotion is

augmented through sustained contact with the medical care system [24–26].

The Women's Interagency HIV Study (WIHS) is a multicenter longitudinal cohort study comprised of both HIV-infected women and at-risk HIV-uninfected women. A detailed interviewer-administered questionnaire related to social support has been administered to all participants every 6 months since October 2013 [27]. A study by Turan et al. administered the social support measure utilized in the current study in a sub-sample of WIHS participants; in this analysis, social support was found to have high internal consistency and to predict medication adherence [28].

In this study, we first assess the psychometric properties of the social support scale assessed in the WIHS cohort. We then utilize this information to augment the current knowledge of the association between social support and HIV medication adherence by examining the longitudinal association between social support and ART adherence in HIV-positive women to assess how variations in social support over time might affect adherence. Finally, we utilize our larger sample of vulnerable lower socioeconomic status women (both HIV-positive and negative) to examine how longitudinal social support affects healthcare utilization among our cohort.

Methods

Study Sample

This study sample consists of both HIV-positive and HIV-negative women in the WIHS cohort who were enrolled during the 1994–1995, 2001–2002, or 2011–2012 enrollment phases at one of five sites across the United States (San Francisco/Bay Area, California; Bronx/Manhattan, New York; Brooklyn, New York; Washington, D.C.; Chicago, Illinois) [27, 29]. Eligible individuals for this analysis were those who had at least two visits between October 2013 and September 2016 and who answered at least one of the social support questions at each visit. 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.

Measures

Participants in the WIHS were asked a series of 15 questions related to tangible and emotional support during every biannual visit since October 2013. The first 12 questions were from the Medical Outcomes Study's Modified Social Support Survey (MSSS) [30]. The last three questions were uniquely created for the WIHS cohort; the list of questions

on the questionnaire is shown in the table detailing the results of the factor analysis (Table 2). Responses regarding perceived availability of support range from 1 (none of the time) to 5 (all of the time).

The key outcomes for this study were ART adherence and healthcare utilization. Adherence was measured by self-report of how often HIV-positive patients 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). To be consistent with the literature, we created a binary variable where 95% or higher was considered optimal adherence [28, 31].

Healthcare utilization was assessed by correlating how often women self-reported seeing their primary care provider with the current guidelines according to HIV status. For HIV-positive women, optimal utilization was having seen a provider in the past 6 months (Yes or No), while for HIV-negative women, optimal utilization was defined as having seen a provider in the past 12 months (Yes or No). Current recommendations include a preventive visit once a year for HIV-negative women, and a regular HIV care visit once in 6 months for HIV-positive women [32, 33]. Of note, women with certain co-morbid health conditions may be recommended to have more frequent visits to a healthcare provider; for the purposes of this analysis, we did not differentiate among our HIV-negative population. In measuring healthcare utilization, women were asked if they had seen a regular healthcare provider at each visit in the October 2013–September 2016 time frame, but this question was omitted from the data collection forms in the 5-year period prior to October 2013. Therefore, in order to assess optimal healthcare utilization at the October 2013 visit by HIV-negative women, the likelihood of having seen a healthcare provider at the prior visit (March 2013) was imputed. A generalized estimating equation logistic regression model for healthcare utilization was created with data from the October 2013–September 2016 time frame to estimate coefficients for each of the model covariates. Information on those predictors from the year prior to October 2013 along with the estimated coefficients were used to compute the estimated probability of reporting having seen a healthcare provider in the 6 months prior to the visit that occurred in March 2013. If the estimated probability was > 0.75, an imputed value of "yes" for having seen a healthcare provider was used for that visit. This increased the proportion of HIV-negative women with an optimal healthcare utilization measure at baseline (October 2013) from 74 to 84%, which is consistent with values for optimal healthcare utilization for the remaining visits (March 2014–September 2016).

Sociodemographic characteristics included in this analysis based on covariates previously identified as important in the literature were age and race/ethnicity as time-fixed

baseline covariates, and marital status, average number of adults/children in the household in the past year, employment status, annual household income, housing stability, and insurance status as time-varying covariates. We categorized age as < 40 years, 40 to < 50 years, and ≥ 50 years. Race/ethnicity was divided into non-Hispanic Black, Hispanic/Latina, and non-Hispanic White/Other (which includes those self-designated as Asian/Pacific Islander, American Indian/Alaskan Native, or other). 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. Marital status was divided as married/living with a partner, not married or living with a partner and unknown. 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. In addition, recognizing that depression is an important confounding variable associated with both perceived social support and HIV care/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 [28, 34, 35].

Data Analysis

Exploratory factor analysis with orthogonal rotation was used to explore the underlying structure of the 15 social support variables to reduce correlated variables into a smaller number of latent constructs using responses from the baseline visit. The factor analysis was conducted separately in the HIV-positive cohort for the adherence outcome and then in the combined cohort of HIV-positive and negative women for the healthcare utilization outcome. The number of factors used was chosen based on observation of the Scree plot of Eigenvalues. Internal consistency of the variables in measuring each factor was assessed using Cronbach's alpha. Discriminant validity of the two factors in measuring different aspects of social support was assessed using Pearson's correlation coefficient. Time-varying emotional and tangible social support factors were then inserted in a random effects longitudinal model to explore the relationship between social support and ART adherence and healthcare utilization controlling for the following covariates: age group, race/ethnicity, income, unstable housing, insurance status, employment, marital status, numbers of adults/children in the household, and depressive symptoms. Potential multicollinearity between the covariates was tested using the Variance Inflation Factor, and all values were above the tolerance threshold. Analyses were conducted using Stata

Version 15 (StataCorp, L.L.C., College Station, TX) and SAS Version 9.4 (SAS Institute, Inc., Cary, NC).

Results

A total of 6021 WIHS study visits by 1115 HIV-positive women were included in the adherence outcome analysis; an additional 2603 WIHS study visits by 485 HIV-negative women were added to the healthcare utilization analysis (Table 1). The median age of the population was approximately 50 years, with ~67% of women being non-Hispanic Black. Over two-thirds of women reported an annual household income of < $24,000. The majority (96%) were in a stable housing situation. Nearly one-third reported being married or living with a partner while another one-third (29%) had never been married. Approximately one-quarter had more than one adult living in their household in the past year. In the CES-D scale of depressive symptoms, about one-quarter scored 16 or more indicating depressive symptoms; 29% of HIV-positive women compared with 18% of HIV-negative women reported having seen a mental health provider in the past 6 months. In terms of other differences in demographics, all of which were significant ($p < 0.01$) except unstable residence and CES-D score, a smaller proportion of HIV-positive women reported being employed (33% vs. 43%). HIV-negative women were less likely to have health insurance coverage (88% vs. 97% reporting having any insurance), and were more likely to have one or more children in their household (41% vs. 33%). HIV-positive women were more likely to have regular visits with a healthcare professional; when measured against current guidelines, 92% of positive women had seen a healthcare professional in the past 6 months, while 84% of HIV-negative women had seen a healthcare professional in the past year. Among HIV-positive women, 90% reported being on ART, with 74% reporting optimal adherence.

Social Support Scale

Participants were asked a series of 15 questions related to social support; the first 12 were from the MSSS, followed by three WIHS-specific questions. The first of the WIHS-specific questions asks if the individual has "Someone to care for your children/grandchildren/others in your care, even for a short time if you were unable". At the first visit, 429 of 1,115 HIV-positive women and 153 of the 485 HIV-negative women stated that this question does not apply to them. Based on an a priori assumption that women with dependents may have a different need for and perception of social support than those without dependents, we conducted the exploratory factor analysis without this variable.

The factor analysis was conducted using responses to the social support questions from the first (baseline) visit in October 2013. The first 12 questions loaded into two distinct factors (termed "emotional" (questions 1-8) and "tangible" (questions 9-12) support), which is consistent with the psychometric properties found by the RAND corporation in the Medical Outcomes Study [36]. The final two WIHS-specific questions (questions 14 and 15) also loaded with tangible social support (Table 2). The internal consistency within each factor was strong, with a Cronbach's alpha for emotional and tangible social support questions of 0.97 and 0.95, respectively, in the full population and 0.97 and 0.95, respectively, in the HIV-positive group. After log-transforming the baseline factors to convert to a normal distribution, we confirmed discriminant validity in that the two factors were not strongly related ($r = 0.0875$). The factor values inserted as a continuous variable in subsequent regression models ranged from approximately -0.5 to 2.5 for both emotional and tangible social support.

To assess whether there were differences in perceived social support among women with and without dependents in our population, we used Item Response Theory divided into the two groups. The one question that was significantly different between the two groups was "Someone to help you if you were confined to bed" ($p = 0.0072$). Given this difference, we conducted the remainder of the analyses both in the full group as well as stratified by the presence or absence of dependents.

Random Effects Models

HIV Medication Adherence

In our longitudinal assessment over a 3-year period among HIV-positive women, each unit increase in perceived emotional social support resulted in a 1.19-fold increased odds of optimal ART adherence (95% CI 1.10–1.28) at each visit, and each unit increase in tangible social support resulted in a 1.18-fold increased odds of ART adherence (95% CI 1.08–1.27) at each visit (Table 3). Being non-Hispanic White/Other was associated with a 2.12-fold increased odds of adherence (95% CI 1.45–3.12) compared with being non-Hispanic Black, and being Hispanic/Latina had a 1.41-fold increased odds of adherence (95% CI 1.05–1.89) compared with being non-Hispanic Black. Neither income level, employment nor marital status were associated with adherence. However, those who reported having more than one adult in the household over the past year or did not answer that question had a decreased odds of optimal adherence. Presence of depressive symptoms as represented by a CES-D score ≥ 16 was not significantly associated with ART adherence when controlling for perceived social support and the other covariates, although

Table 1 Descriptive/demographic characteristics of the study sample

Characteristics at baseline visit	HIV-positive women (N = 1,115)	HIV-negative women (N = 485)	P value
Median age in years (IQR)	50 (44–055)	48 (41–55)	<0.001
Race/ethnicity, N (%)			
Black, non-Hispanic	742 (67%)	328 (68%)	<0.001
Hispanic/Latina	205 (18%)	96 (20%)	
Non-Hispanic White & Other	168 (15%)	61 (13%)	
Annual household income, N (%)			
<$24,000	768 (69%)	309 (64%)	<0.001
≥$24,000	301 (27%)	149 (31%)	
Unknown	46 (4%)	27 (6%)	
Employed, N (%)	365 (33%)	209 (43%)	<0.001
Unstable housing, N (%)	41 (4%)	20 (4%)	0.245
Marital Status, N (%)			
Married/Living with partner	329 (30%)	149 (31%)	<0.001
Widowed	94 (8%)	22 (5%)	
Divorced/Separated	181 (16%)	77 (16%)	
Never married	319 (29%)	138 (28%)	
Other	157 (14%)	76 (16%)	
Unknown	35 (3%)	23 (5%)	
Live Alone, N (%)			
Yes	268 (24%)	81 (17%)	<0.001
No	788 (71%)	378 (78%)	
Unknown	59 (5%)	26 (5%)	
Average number adults in household (past year)			
Median (IQR)	1 (0–1)	1 (0–2)	<0.001
None, N (%)	356 (32%)	123 (25%)	
One, N (%)	437 (39%)	196 (40%)	
More than one, N (%)	263 (24%)	140 (29%)	
Unknown	59 (5%)	26 (5%)	
Average number children in household (past year)			
Median (IQR)	0 (0–1)	0 (0–1)	<0.001
None	692 (62%)	259 (53%)	
One or more, N(%)	364 (33%)	200 (41%)	
Unknown	59 (5%)	26 (5%)	
Medical insurance (not mutually exclusive), N (%)			
Any	1084 (97%)	425 (88%)	<0.001
Medicaid	732 (66%)	279 (58%)	
Medicare	256 (23%)	69 (14%)	
Private	234 (21%)	107 (22%)	
Other	437 (39%)	198 (41%)	
AIDS Drug Assistance Program (ADAP), New York residents only	187 (17%)	N/A	
CES-D Depression Score			
Median (IQR)	7 (3–16)	6 (3–15)	0.066
≥ 16, N (%)	289 (26%)	118 (24%)	
Seen a mental health provider in the past 6 months, N (%)	318 (29%)	89 (18%)	<0.001
Seen healthcare provider within recommended window, N (%)	1023 (92%)	407 (84%)	<0.001
Regular HIV care, N (%)			
Ever	1090 (98%)		
Past 6 months	979 (88%)		
Uses ART, N (%)	999 (90%)		

Table 1 (continued)

Characteristics at baseline visit	HIV-positive women (N = 1,115)	HIV-negative women (N = 485)	P value
ART adherence, N (%)			
Not on ART	116 (10%)		
100%	515 (46%)		
95–99%	308 (28%)		
75–94%	119 (11%)		
<75%	48 (4%)		
0%	9 (1%)		

Table 2 Rotated factor loadings of the WIHS social support scale, absolute loadings < 0.3 suppressed

Question: How often are each of the following kinds of support available to you when you need it?	HIV-positive Women		All Women	
	Factor 1	Factor 2	Factor 1	Factor 2
1: Someone you can count on to listen to you when you need to talk	0.7418		0.7578	
2: Someone to give you information to help you understand a situation	0.7676		0.7925	
3: Someone to give you good advice about a crisis	0.8341		0.8324	
4: Someone to confide in or talk to about yourself or your problems	0.8386		0.8474	
5: Someone whose advice you really want	0.8151		0.8089	
6: Someone to share your most private worries and fears with	0.7986		0.7931	
7: Someone to turn to for suggestions about how to deal with a personal problem	0.8408		0.8413	
8: Someone who understands your problems	0.8321		0.8241	
9: Someone to help you if you were confined to bed		0.7596		0.7635
10: Someone to take you to the doctor or somewhere you had to go if you needed it		0.8140		0.8038
11: Someone to prepare your meals if you were unable to do it yourself		0.8684		0.8753
12: Someone to help with daily chores like grocery shopping if you were sick		0.8471		0.8599
13: Someone to care for your children/grandchildren/others in your care, even for a short time if you were unable	N/A			
14: Someone to give you a place to live if you needed it even if for a short time		0.7484		0.7398
15: Someone to give you money for things you really needed like food and clothing		0.7131		0.7187
Cronbach's Alpha	0.97	0.95	0.97	0.95

the trend is that depression is negatively associated with adherence (OR 0.84, 95% CI 0.69–1.02).

We stratified the analysis by those women who indicated that the question "Someone to care for your children/grandchildren/others in your care, even for a short time if you were unable" did not apply to them as those "not having dependents" vs. those who answered the question on the scale of 1–5 as having dependents (data not shown). Increases in emotional social support was associated with a 1.14-fold increased odds of optimal adherence (95% CI 1.03–1.26) in women with dependents, and with a 1.24-fold increased adherence (95% CI 1.12–1.38) in women without dependents. In terms of tangible social support, the odds ratios were 1.15 (95% CI 1.04–1.27) and 1.18 (95% CI 1.06–1.32) in women with and without dependents, respectively. The effects of the remaining factors in the model were also very similar in the two strata with the estimates from the overall model.

Healthcare Utilization

Over a 3-year period including all women, increases in emotional social support resulted in a 1.16-fold increased odds of optimal healthcare utilization (95% CI 1.05–1.27). Increase in tangible social support was not significantly associated with healthcare utilization (OR 1.05, 95% CI 0.96–1.16) (Table 4). Being aged 50 or above was associated with a 1.53-fold increased odds of utilization (95% CI 1.18–1.98), and being non-Hispanic White/Other had a 1.53-fold increased odds of utilization (95% CI 1.08–2.17) compared with being non-Hispanic Black. As with adherence in HIV-positive women, presence of depressive symptoms

Table 3 Multivariate model of the effect of perceived longitudinal social support on ART adherence in the WIHS

Variables	HIV-positive women	
	Odds ratio*	95% Confidence interval
Emotional social support	**1.19**	**1.10–1.28**
Tangible social support	**1.18**	**1.08–1.27**
Time, per 6 month visit interval	**1.05**	**1.02–1.08**
Age (yrs)		
< 40	**0.58**	**0.42–0.81**
40 to < 50	Ref	–
50+	1.17	0.92–1.50
Race/ethnicity		
Black, NH	Ref	–
Latina/Hispanic	**1.41**	**1.05–1.88**
Non-Hispanic White & other	**2.12**	**1.45–3.12**
Depression	0.84	0.69–1.02
Income		
≤ $24,000	Ref	–
> $24,000	0.87	0.69–1.09
Unknown/not reported	0.9	0.43–1.86
Unstable housing	0.84	0.55–1.30
Insurance	**1.8**	**1.06–3.05**
Employment	1.17	0.94–1.45
Marital status		
Not married or living with partner	Ref	–
Married or living with partner	1.12	0.88–1.42
Unknown	1.13	0.50–2.56
Number of adults in household		
0	Ref	–
1	0.88	0.70–1.11
> 1	**0.73**	**0.55–0.95**
Unknown	**0.64**	**0.44–0.94**
Number of children in household		
None	Ref	–
1 or more	0.96	0.75–1.22

Bold values indicate statistically significant results

*A random-effects multivariate longitudinal model adjusting for all listed covariates

Table 4 Multivariate model of the effect of perceived longitudinal social support on healthcare utilization among HIV-positive and HIV-negative women in the WIHS

Variables	Odds ratio	95% Confidence interval
Emotional social support	**1.16**	**1.05–1.27**
Tangible social support	1.05	0.96–1.16
Time, per 6 month visit interval	1.02	0.98–1.07
HIV infection	**1.76**	**1.40–2.20**
Age (yrs)		
< 40	0.76	0.58–1.01
40–< 50	Ref	–
50+	**1.53**	**1.18–1.98**
Race/ethnicity	Ref	–
Black, NH	1.29	0.98–1.71
Latina/Hispanic	**1.53**	**1.08–2.17**
Non-Hispanic White & other		
Depression	1.01	0.81–1.25
Income		
≤ $24,000	Ref	–
> $24,000	0.97	0.76–1.24
Unknown/not reported	0.72	0.34–1.51
Unstable housing	0.71	0.40–1.26
Insurance	**6.68**	**4.86–9.16**
Employment	**0.64**	**0.51–0.81**
Marital status		
Not married or living with partner	Ref	–
Married or living with partner	1.24	0.98–1.58
Unknown	1.46	0.55–3.90
Number of adults in household		
0	Ref	–
1	0.90	0.70–1.17
> 1	0.91	0.68–1.22
Unknown	0.86	0.52–1.42
Number of children in household		
None	Ref	–
1 or more	0.94	0.75–1.18

Bold values indicate statistically significant results

*A random-effects multivariate longitudinal model adjusting for all listed covariates

as represented by a CES-D score ≥ 16 was not significantly associated with healthcare utilization among all women when controlling for perceived social support and other covariates. Not unexpectedly, having health insurance was strongly associated with optimal healthcare utilization (OR 6.68, 95% CI 4.86–9.16); this was particularly true among HIV-negative women, who had an 8.24 increased odds of healthcare utilization (95% CI 5.45–12.47) if they had insurance. Being employed was negatively associated with utilization. When stratifying by HIV status, this association was not true for HIV-positive women (OR 0.84, 95%

CI 0.63–1.12) but was strongly associated in HIV-negative women (OR 0.46, 95% CI 0.31–0.67). Income, housing stability, marital status, and numbers of adults or children in the household were not significantly associated with healthcare utilization.

Once again we stratified the analysis by those who indicated having dependents vs. those who did not. The effect of emotional support on optimal healthcare utilization was different in the two strata; emotional social support was associated with a 1.26-fold increased odds of optimal healthcare

utilization (95% CI 1.13–1.41) in women with dependents, but with a non-significant 1.07-fold increase in healthcare utilization (95% CI 0.96–1.19) in women without dependents. In terms of tangible social support, the odds ratios were very similar as in the unstratified analysis, 1.05 (95% CI 0.93–1.18) and 1.05 (95% CI 0.94–1.18) in women with and without dependents, respectively. The effects of the remaining factors in the model were very similar in the two strata with the estimates from the overall model.

Discussion

Our study shows a statistically significant association between longitudinal perceived social support and increased ART adherence in a cohort of HIV-positive women. For healthcare utilization, the association was significant for emotional support (but not tangible support) in our full cohort of women of lower socioeconomic status. This positive effect of social support is consistent with what has been shown in the literature, with HIV and other chronic disease outcomes, as well as with living in a low socioeconomic status environment [2, 3, 5, 9, 11, 14]. Our findings support previously stated suggestions that addressing the need for social support is critical to optimizing health outcomes in HIV-positive individuals as well as vulnerable women at-risk for HIV and other negative health outcomes. Interestingly, the effect of perceived emotional support on adherence was augmented in HIV-positive women who reported not having any dependents. In contrast, perceived emotional social support was associated with healthcare utilization specifically among women (both HIV-positive and negative) with dependents. Prior work in the WIHS cohorts showed that having children was negatively associated with adherence (OR 0.92, p = 0.03) [37]. Our study findings support this prior work showing that having dependents to care for poses a challenge for day-to-day HIV care which must be addressed for HIV-positive women. Our findings also suggest that when including HIV-negative women in the cohort, having dependents counting on you for care increases attendance at routine health visits specifically among women with perceived emotional social support but not among those without. Further research is required to corroborate this finding and then potentially to understand how to augment sustained emotional social support among vulnerable women with dependents so that they can best be supported to optimize their healthcare.

Psychometric evaluation of the social support scale used in this study, which included three WIHS-specific questions that had not been previously evaluated, confirmed two latent classes of social support, which is consistent both with social support theory as well as with previous psychometric work done on a longer version of the original MOS scale. Our first class we termed "emotional support", representing the perception of having people to talk to or get advice from. The second we termed "tangible support", representing the perception of having people to help with activities of daily living or chores. Our evaluation showed that this scale has strong internal consistency and discriminant validity in our population. Importantly, there was not a significant difference in these results in individuals who reported having dependents versus those who did not.

Presence of HIV infection was significantly associated with healthcare utilization; this is not surprising, as HIV-positive individuals have strong reasons for ongoing regular engagement with a healthcare provider. Although participants do not receive care through the WIHS itself, they receive study related outreach and testing related to their HIV clinical care. The question that arises in this population is whether they have a sustained source of social support through their WIHS care network. The model of HIV care in the vast majority of centers across the United States, driven in large part through the Ryan White Program, is one in which an individual is cared for by an HIV expert along with a care coordinator responsible for identifying and coordinating access to a variety of ancillary services and psychosocial support. Among HIV-negative women in our cohort, having tangible social support was significantly associated with improved healthcare utilization (OR 1.17; 95% CI 1.03–1.33). This suggests that implementation of a structural intervention to provide or augment tangible social support should be considered for vulnerable HIV-negative individuals, including in the healthcare environment. Studies have evaluated the use of clinic-based patient navigators to enhance HIV care retention; further research in these areas should include an assessment of the independent effects of the role such programs play in enhancing an individual's perception of social support [38].

For the at-risk HIV-negative women in this cohort, employment was strongly negatively associated with healthcare utilization. Individuals with the organizational capacity to keep up with preventive healthcare appointments may also be those more likely to be employed, but in this case we observed the opposite. It may be that these lower income higher-risk women lack flexibility in their jobs to keep healthcare appointments, or that the HIV-negative women in the WIHS cohort utilize the WIHS visits as opportunities to receive blood work and PAP smears in lieu of seeing their primary care physician. Given the importance of preventive care particularly in this group of women, this finding highlights the need for finding creative ways to offer preventive and screening services to vulnerable populations.

Our study has several limitations. First, we believe that there is a strong inter-dependence of social support and HIV-related outcomes with mental health issues. We controlled for depressive symptoms in our analysis at a

crude level using the CES-D scale, but encourage further exploration of this relationship in a much more detailed fashion in future studies. Second, we were limited to having 3 years of social support measurement in our longitudinal analysis. These findings indicate that social support has a sustained influence on HIV-related outcomes. Future studies with longer-periods of social support and outcome assessments would be informative, particularly given that there is potential for change in one's perceived social support over time as relationships and family needs change. Finally, assessment of sub-classes of individuals who differ in their levels of social support over time was beyond the scope of this analysis, but would also be critical in our understanding of the variability of social support over time and its impact on HIV outcomes.

We encourage exploration of targeted interventions that assess and fulfill the need for social support particularly in vulnerable populations. We also recommend further research to develop a more nuanced understanding of subgroups of individuals most susceptible to lacking social support, and how interventions can be tailored to fill this gap. In this exploration, involvement of the target community as well as the clinics providing care to those individuals would be critical in understanding how to fill this need. Recognizing the importance of sustained social support in optimizing HIV prevention and outcomes is critical for future interventions targeted towards optimizing the care of HIV-positive as well as vulnerable negative individuals.

Compliance with Ethical Standards

Conflicts of interest None of the authors have any conflicts of interest to report.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The WIHS protocol was approved by the Institutional Review Board at each study site's institution and by the WIHS executive committee.

Informed Consent Informed consent was obtained from all individual participants included in the study. Individuals were compensated for their participation in the study.

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