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ORIGINAL PAPER

The Effects of Housing Status on Health-Related Outcomes in People living with HIV: A Systematic Review of the Literature

Chad A. Leaver · Gordon Bargh · James R. Dunn · Stephen W. Hwang

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Abstract
Introduction HIV infection is increasingly characterized as a chronic condition that can be managed through adherence to a healthy lifestyle, complex drug regimens, and regular treatment and monitoring. The location, quality, and/or affordability of a person's housing can be a significant determinant of his or her ability to meet these requirements. The objective of this systematic review is to inform program and policy development and future research by examining the available empirical evidence on the effects of housing status on health-related outcomes in people living with HIV/AIDS.
Methods Electronic databases were searched from dates of inception through November 2005. A total of 29 studies met inclusion criteria for this review. Seventeen studies received a "good" or "fair" quality rating based on defined criteria.
Results A significant positive association between increased housing stability and better health-related outcomes was noted in all studies examining housing status with outcomes of medication adherence (n = 9), utilization of health and social services (n = 5), and studies examining health status (n = 2) and HIV risk behaviours (n = 1).
Conclusions Healthcare, support workers and public health policy should recognize the important impact of affordable and sustainable housing on the health of persons living with HIV.

Keywords HIV/AIDS · Systematic review · Housing · Social epidemiology · Policy

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Introduction

As a result of the effectiveness of combination anti-retroviral therapy (ART) in the last decade, HIV is increasingly characterized as a chronic long-term condition, resulting in significant changes in patterns of morbidity and mortality. People with access to this treatment and ongoing care are now living with HIV/AIDS with an increased prevalence of disability and non-HIV associated illnesses (Crystal, Fleishman, Hays, Shapiro, & Bozzette, 2000; Rusch et al. 2004, Morris, Masur, & Huang, 2006). As with other chronic and disabling conditions, living with HIV demands that patients comply with complex drug regimens; sustain adequate rest, maintain ample nutrition; and receive regular treatment and monitoring by health care and social support professionals. Many people living with HIV report that the location, quality and/or affordability of their housing can be a significant factor in their ability meet these needs

(Anderson & Weatherburn, 2004). The potential mismatch between sustained stable housing and patients' needs is made more difficult by the fact that living with HIV often places a significant strain on individual resources and reduces patients' capacity to maintain employment and socially integrated lifestyles (Braveman, Levin, Kielhofner, & Finlayson, 2006); particularly for people with co-morbidities (Conover, Arno, Weaver, Ang, & Ettner, 2006). Pathways between housing and health have been previously reviewed, addressing connections between biological, physical, social, economic or cultural characteristics of housing (Fuller-Thompson, Hulchanski, & Hwang, 2000). A growing body of evidence suggests that housing status (being homeless vs. housed) and housing security and stability are significantly associated with HIV related risk-taking behaviours (Aidala, Cross, Stall, Harre, & Sumartojo, 2005); seroconversion (Weber et al., 2001); and are important factors in individual access to health care and social service systems, initiation and adherence to antiretroviral treatment, reduced viral loads and ultimately mortality (Anderson & Weatherburn, 2004; Godin, Cote, Naccache, Lambert, & Trottier, 2005; Smith et al., 2000). These studies consistently indicate the financial or economic vulnerability of living with HIV across the social spectrum and the importance of early and consistent access to primary care and treatment options. To our knowledge, no reviews have been conducted that examine the relationship between housing and health-related outcomes in the context of HIV and AIDS.

The objective of this systematic review is to inform program and policy development and future research by examining the available empirical evidence on the effects of housing status on health-related outcomes in people living with HIV/AIDS. Health-related outcomes in this instance are inclusive of physical health outcomes, health outcomes that are socially determined (social determinants of health); and health behavioural outcomes with established relationships to the health of the individual.

Methods

Literature Search and Selection Criteria

A search was conducted of the Medline, PsychInfo, HealthStar, Ebase, OVID, Sociological and Social Sciences Abstracts databases from their respective inception dates through November 2005 for articles that included both terms describing housing (housing, dwelling, homeless, homelessness, living accommodations) and terms describing persons living with HIV/AIDS (HIV, AIDS, PHA, PWHA, PLWA). A total of 3,246 articles were retrieved. Two investigators (GB, CAL) independently reviewed the title and abstract of each article to determine eligibility for inclusion in this systematic review (Fig. 1).

Inclusion criteria were: (1) English-language article published in a peer-reviewed journal, (2) study population consisting of HIV positive persons, and (3) analysis of empiric data with at least one measure of housing status as an independent variable and at least one quantitative health outcome as a dependent variable. Housing status was broadly defined to include any measure of homelessness, marginal housing, stable housing, or quality of housing. Health-related outcomes were also broadly defined as measures of physiological or clinical measures of health outcomes (CD4 count, viral load, morbidity), social determinants of health, often described as health mediating variables—such as access to treatment and care, health and social service utilization, adherence to treatment, quality of life and health status (including physical and mental health). Health-related outcomes also includes behavioural health outcomes, namely HIV risk-behaviours. Case studies and qualitative studies were excluded.

Two investigators (GB, CAL) prepared independent lists of retrieved articles that appeared to meet study inclusion criteria based on title and abstract; and then conferred to compare their selections. The full study was obtained and reviewed in detail if both investigators agreed that the article met inclusion criteria, or if they were still uncertain that the article met inclusion criteria after conferring.

After review of the full paper, investigators (GB, CAL) then met to reach consensus on which articles met all inclusion criteria. In cases of disagreement or uncertainty, a final decision was made in consultation with two other investigators (JRD, SWH). Data were abstracted from each included article by one investigator (CAL) and reviewed by at least one other investigator. All four investigators reviewed final selections. Two investigators (GB, CAL) hand-searched the bibliographies of included articles to identify any additional potentially relevant articles.

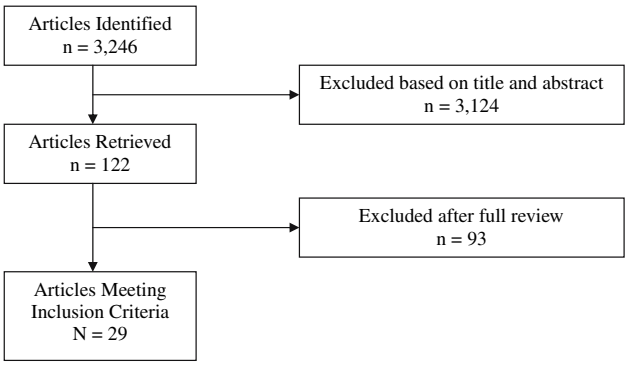

Fig. 1 Critical appraisal process

Critical Appraisal Process

We initially identified 122 articles that appeared to potentially meet selection criteria based on title and abstract (Fig. 1). Ninety-three of these articles were excluded after full review. The most common reasons for exclusion were study samples that included both HIV positive and HIV negative persons; lack of quantitative data on health-related outcomes; and absence of an analysis of the relationship between housing status and a health-related outcome.

A total of 29 articles met the inclusion criteria and underwent data abstraction and critical appraisal (See Appendix 1 for Systematic Review rating guidelines). Studies were rated "good" if they used a longitudinal or cross-sectional design, stated clear definitions of housing status, used reliable measures of health outcomes, and utilized appropriate analytic methods with adjustment for confounding. Studies with clear definitions of housing status rated as "good" defined stability with reference to aspects of dwelling context as either personal or asset, or both. For instance, a clear definition of stable housing for a study rated "good" would be defined in the study as: living in a house or apartment—rented or owned by the participant (personal asset); and unstable housing would be defined in the study as living in a short-term occupancy hotel, residence, or motel, having moved more than once in the last year, or having received housing assistance (context). A clear definition of unstable housing or homelessness may also be defined in studies as living in a hospice, shelter, on the street, or a car. Further, a clear definition may also provide actual quality of housing or structural dimensions of the dwelling relevant to the care and mobility of people living with HIV/AIDS, such as living in a walk-up apartment building (excessive stairs) or adequate amenities of the dwelling for privacy, rest or medication storage (crowding, ventilation or refrigeration). Studies were rated "fair" if the definition of housing status was defined as "stable" "unstable" or "homeless" but did not provide definitions of stability/instability in terms of either dwelling context or personal asset; and some confounders were left uncontrolled in the analysis presented. Meaning that in studies reporting statistical analysis of the association between housing status and one or more health-related outcome, adjustment for a comprehensive set of confounders (age, sex, income, etc.,) was presented in the analytical procedures and results sections of the paper for studies rated "good". Studies presenting bivariate analysis of association only—with no adjustment for confounding, or potential confounders were left uncontrolled were considered "fair" or "poor". Further, studies were rated "poor" if the housing status classification was vague or non-descript as to stability/instability or dwelling context, asset or quality.

Results

Of the 29 studies that met inclusion criteria, nine were rated as good quality, eight as fair quality; and 12 as poor quality. Studies were classified according to the types of health-related outcomes that were analyzed. A total of 16 studies examined access and/or utilization of health care, HIV treatment, and/or social services; 12 studies examined adherence to highly active anti-retroviral treatment (HAART); and five studies examined health status outcomes, such as co-infection and one study examined HIV-risk behaviours; three studies overlapped two these areas; and one study overlapped three of these areas of inquiry. No appropriate articles examining Quality of Life (QOL) variables or validated scales were identified among articles included in this review. The majority of studies were conducted in the United States ($n = 22$); with the remaining studies from the European Union ($n = 4$), Canada ($n = 1$), Australia ($n = 1$), and Cote d'Ivoire ($n = 1$). In most cases, the study population consisted of convenience samples of HIV positive patients who were in contact with the health care system.

Table 1 summarizes the results of the 17 studies that received a quality rating of good or fair; findings from these studies are summarized below. Table 2 provides detailed study information and findings from these 17 studies by analysis outcome.

Table 1 Summary of studies examining the association between housing status and health-related outcomes in people living with HIV

Association between housing status and health-related outcome	Type of health-related outcome		
	Utilization of health care and social services	Adherence to anti-retroviral therapy	Health status and HIV risk behaviours
Significant positive association*	9	5	3
No significant association	0	0	1
Significant negative association**	0	0	1

Numbers indicate the number of good and fair quality studies with that overall result

* Defined as an association between increased housing stability and *better* health-related outcomes

** Defined as an association between increased housing stability and *worse* health-related outcomes

Table 2 Detailed abstraction from studies rated (a) "good" and (b) "fair"

Study details Author, date, analysis	Sample characteristics	Housing status classification	Analysis outcome linked to housing	Results	Strengths/weaknesses Comment
(a) Studies rated "good"					
Aidala et al. (2005) *Cross-sectional and Longitudinal Analysis* (N = 2,149) Location: USA	HIV positive persons with no or inadequate housing compared to persons with HIV who were stably housed. This multi-site study is broadly representative of individuals receiving publicly funded HIV services in the USA 66% Male 34% Female African American: 60.1% White: 20.1% Hispanic: 11.8% Other: 8.1%	(i) Homeless: sleeping on the street, park, abandoned building, car, or public space, shelter or single room occupancy hotel, (ii) Unstable/Inadequate: temp/trans housing, jail, treatment, friends/someone else's home, (iii) Stably Housed: secure perm housing, apt, group quarters	Health Status, as defined by HIV risk behaviours: (i) Drug use: Hard drug use, needle use; and needle sharing. (ii) Sex risk behaviours: unprotected sex* and sex exchanges for money, drugs or a place to stay at any time *Unprotected sex did not determine serostatus of sexual partners, thus encompassing a broad range of sex behaviours between varied partner types	Housing status significantly linked in univariate and adjusted multivariate models (cross-sectional and longitudinal) with increased odds of HIV risk behaviours: Drug use (hard drug use, needle use and sharing) and Sexual risk behaviours (unprotected sex and sex in exchange for money, drugs or housing/a place to stay). Improved housing status also significantly linked to reduction in drug use and unprotected sex, but not sex exchange behaviours, however for those whose housing status worsened, increase in sex exchanged behaviours was five times higher for those whose situation stayed the same	*S*: National level—Longitudinal study design specifically aimed to examine the relationship between housing and health status outcomes as measured by drug use and sexual risk taking behaviours. Well-defined parameters of housing status and improvement of status across time *W*: Substantial loss to follow-up in dataset require longitudinal results be viewed as exploratory. Potential for reporting bias of sample to underestimate risk behaviours to ensure access to housing, support and resources *C*: Excellent study, though cannot establish a causal relationship between housing status and HIV transmission risks
Berg et al. (2004) *Longitudinal Analysis* (N = 113) Location: USA, NY	Cohort participants from longstanding (HERO) study in methadone maintenance program (former IVDUs) 57% Male 43% Female Hispanic: 66% African American: 22% White: 12% IVDU: 100%	(i) Long term housing—living in current residence > 3 years; (ii) housing status—living in own apartment, living in other apartment, temp housing (hotel, motel, shelter, with someone, w/o shelter)	Adherence to ART *Adherence Measure:* electronic monitoring. Medication Event Monitoring System (MEMS). Developed average adherence rate for all meds in the regimen	Better adherence associated with long-term housing (75 vs. 42%, p = 0.03) In multivariate linear regression, participants with a lack of long-term housing were 16 × more likely to report poor adherence to ART regimens (controlling for age, sex, depression) : (Beta: 16.0, 95% CI: 5.3–26.7) 81% Lived in their own apartment 45% Lived in current residence for longer than 3 years	*S*: Longitudinal study design. Total of 7-data collection point visits at 4-week intervals (6 m). Median length of follow-up: 180-days. Comprehensive follow-up periods given study objectives; and objective measure of adherence *W*: Sampled from existing "longstanding" cohort study group of Opiate users *C*: Perhaps explains the high proportion of sample with housing stability history (81%)—45% lived in housing for 3+ years. Less stably housed are less likely to be retained in cohort study

Table 2 continued

Study details Author, date, analysis	Sample characteristics	Housing status classification	Analysis outcome linked to housing	Results	Strengths/weaknesses Comment
Bica et al. (2003) *Cross-sectional Analysis* ($N = 642$) Location: USA, MA/RI	HIV positive adults in Nutrition for Healthy Living Cohort Study. Unit of observation: Study Visit ($n = 2{,}013$ across 642 participants) between Feb. 1995 and Apr. 1999 75.1% Male 24.9% Female White: 64.3% Non-White: 35.7% Gay: 60.7% IVDU ever: 31.5% IVDU current: 3.7%	(i) Insecure housing—currently living in a shelter, rooming or boarding house, residential alcohol or drug treatment facility, or street; (ii) secure housing—living in own/parent's/friend's home	Health Care, Treatment and Social Service Utilization Examined use of Complementary Alternative Medicine (CAM)/Therapy	10% of visits (unit of analysis) were missing information on housing ($n = 2{,}000$) Housing insecurity associated with less use of ingested CAM. Multivariate: PR 0.75; 95% CI: 0.61–0.92; ($p = 0.007$) Use of ingested CAM highest for high-school educated gay males with secure housing and lowest for less educated non-gay males with insecure housing (68.5%, 95% CI 65–72%; and 27%, 95% CI: 21–34%). Trend toward a positive association between HAART use CAM use ($p = 0.057$)	*S:* Excellent clinical measures. One of few studies examining CAM use among patients on HAART (to date). Sample size *W*: Study sample derived from cohort study designed to examine nutritional problems of HIV infected individuals. Analysis does not enlighten direction of causation *C*: Focus on ingested CAM therapies as these have more likelihood of interacting (pharmacologic parameters) with HAART
Carballo et al. (2004) *Cross-sectional Analysis* ($N = 235$) Location: Spain	Random selection and voluntary participation of HIV positive patients from three hospitals in Spain 71.5% Male 28.5% Female *Race not reported* IVDU: 65.1% Heterosexual: 22.1% Homosexual: 11.9%	Home stability—(i) stable = living in stable housing with family, partner, etc, or (ii) unstable = living in non-permanent housing, such as social institutions, hostels, etc	Adherence to ART (QOL) *Measure of Adherence* Self-report (detailed)	Good adherence among subjects with stable housing: Univariate-(OR: 3.02, 95% CI: 1.47–6.24). In multivariate, good adherence among subject with stable housing: (OR: 2.96, 95% CI: 1.39–6.32)	*S*: Sample selection (random); sample size and strength of analysis of data provides comprehensive cross-sectional assessment of predictors of "good" adherence. Three hospitals in samples had similar adherence results *W*: Measure of adherence (self-report) subject to bias
Conover and Whetten-Goldstein (2002) *Cross-sectional Analysis* ($N = 377$) Location: USA, NC	HIV positive patients eligible for Medicaid (public insurance for low-income) from three academic medical centres. Data collected: October 1997–August 1999 61.1% Male 38.9% Female African American: 69.9% White: 27.7% Hispanic: 1.8% MSM: 30.1% Heterosexual: 41.6% IVDU: 11.8% MSM/IVDU: 2.1%	Housing assistance/services (undefined). Housing services itemized and amalgamated with "basic necessities" (incl. emergency food, nutritional assistance, and housing assistance)	Health Status and Health Care, Treatment and Social Service Utilization	Receipt of housing assistance significantly associated with increased likelihood of reporting receipt of any primary care services ($p < 0.05$); and increases likelihood of receiving adequate primary care in full-multivariate model ($p < 0.001$) 25.5% sample receiving housing assistance. A total of 37.9% report needing service. (32.9% patients need housing assistance but do not receive it). No relationship between receipt of housing assistance and health status Significant multivariate association with receipt of housing assistance to increased likelihood of receiving primary care ($p < 0.10$)	*S*: Methods of collecting clinical indicators for health status (retro and prospective chart review) *W*: Small sample sizes within-group analyses. Noted that sample is un-representative of Medicaid or CARE ACT recipients. Weak definition of housing assistance (provision of housing, link to monetary assistance or placement assistance is unclear)

Table 2 continued

Study details Author, date, analysis	Sample characteristics	Housing status classification	Analysis outcome linked to housing	Results	Strengths/weaknesses Comment
Lieb et al. (2002) *Cross-sectional Analysis* (N = 360) Location: USA, FL	Urban public health HIV clinics at four Florida sites 70.8% Male 29.2% Female African American: 65% White: 32.5% Hispanic: 2.5% MSM: 28.3% Heterosexual: 27.5% IVDU: 27.5% MSM/IVDU: 5.8%	Homelessness = homeless at some point during abstraction period (i.e., the 12 months before the case reference date)	Health Care, Treatment and Social Service Utilization Adherence to ART *Adherence Measure:* 1. Participants were classified as: (i) received HAART without interruption (ii) received HAART—discontinued therapy due to side effects (iii) Did not receive HAART 2. Documented adherence problem (from medical chart extraction)	Homeless were more likely to have poor adherence (70 vs. 56%) and not be receiving HAART (52 vs. 20%) equating to an increased risk of mortality (10-fold: OR: 9.98, 95 % CI: 2.34–42.5) in multivariate—but homelessness still an independent predictor of mortality even after adjustment for above Non-adherent respondents had a 2-fold increased risk of mortality; and not receiving HAART 2.8 increase	*S*: Detailed random patient record abstraction study *W*: Study design and inferences from chart-abstraction subject to bias. Study does not examine dimensions of housing beyond homelessness
Masson et al. (2004) *Longitudinal Analysis* (N = 190) Location: USA	HIV positive and substance users, recruited from a Public Hospital 73% Male 27% Female African American: 43% White: 42% Hispanic: 7% Heterosexual: 52% Homosexual: 31% Bisexual 17% IVDU: 75%	(i) Rent/own house/apt (ii) house/apt of friend/ relative (iii) halfway house, residence, or therapeutic community (iv) room, hotel, motel (v) institution (jail, hospital) (vi) homeless (living in a shelter, car, outdoors); NOTE: unstable housing = at least (ii) (iii) (iv)	Health Care, Treatment and Social Service Utilization	27% of sample homeless; 54% residing in unstable housing conditions, leaving 19% of sample stably housed Predisposing, enabling and need for ER Use (homeless respondents had 92% ($p < 0.01$) more ER use; and 113% ($p < 0.001$) inpatient admissions than housed participants)	*S*: Study design. Use of standard scales to assess health status and mental health. Comprehensive measure of housing status and stability *W*: Sampling bias may well drive results on health service utilization as those accessing services at point of study intake (outpatient services and ER) in a public hospital

Table 2 continued

Study details Author, date, analysis	Sample characteristics	Housing status classification	Analysis outcome linked to housing	Results	Strengths/weaknesses Comment
Smith et al. (2000) *Cross-sectional Analysis* (N = 1,445) Location: USA, NY	New York State Medicaid recipients from existing cohort study—baseline data only. 81% resided in Metropolitan NY. Data collected from: Apr 1996 to March 1997) African American: 52.9% Hispanic: 28.7% White: 16.6%	(i) Homeless (living on the street at time of interview, or in shelter or other "temporary place".) (ii) Doubled-up (currently living in someone else's house/apt) (iii) Stably Housed (currently living in a place of their own)	Health Care, Treatment and Social Service Utilization *Multiple Outcomes:* 1. # ambulatory visits past 3mos; 2.# ER visits; 3.# inpatient visits; 4. # months seeing physician regularly for HIV treatment/ monitoring; 5. on ARV 6. on antibiotics to prevent pneumonia	Stably housed had been diagnosed with HIV for a longer period of time (p = 0.05); and had a longer average of time in regular care (p = 0.01); more likely to see a physician regularly for HIV monitoring and treatment compared to doubled-up or homeless (96.8 vs. 92.5 and 87.8: p = 0.0001) In multivariate: Being homeless or living doubled up associated with increased number of outpatient visits (p = 0.001, p = 0.022, respectively). Living doubled up associated with increased # ER visits (p = 0.47) Compared to stable/doubled up—homeless significantly more outpatient visits (p = 0.02); and less likely to be seeing same physician for care (p = 0.007)	*S*: Focus on housing in main analyses. Comprehensive data set with predictor variables spanning background, resource related and medical need *W*: Context age of data bias to present (Data collected 10 years ago), self-report bias *C*: Sample may be under representative of the HIV-infected Medicaid population who use the health care system infrequently or not at all, a group likely to have significant housing problems
Stewart et al. (2005) *Multi-level Analysis* (N = 401) Location: USA, AL	HIV positive persons across the state of Alabama 66% Male 34% Female *Ethnocultural Identity:* African American: 65.7% Hispanic: 8.5% Haitian: 5.8% *Risk Group:* Not Reported	Housing Stability. Persons were considered to have housing stability if they (i) lived in their own home or apartment; or (ii) the participant was not currently in need of housing assistance	Health Status: Physical and Mental Health *Multiple Outcomes:* (i) Hospital use (ii) Non-hospital use (iii) Disease burden	83% of sample resided in stable housing. Stable housing was significantly associated with better physical health as indicated by clinical measures of CD4 and physical health functioning. Housing stability was not significantly associated with mental health functioning Demonstrated effect of stability of housing status as a context that significantly impacts the influence of individual (level-1) predictors (clinical CD4 and T-cell count)	*S*: Multi-level modelling approach *W*: Large percentage of missing data significantly associated with housing stability (those in unstable conditions had more missing data) *C*: Missing data on housing stability—may be an indicator of homelessness

Table 2 continued

Study details Author, date, analysis	Sample characteristics	Housing status classification	Analysis outcome linked to housing	Results	Strengths/weaknesses Comment
(b) Studies rated "fair"					
Arno et al. (1996) *Cross-sectional Analysis* (N = 1,848) Location: USA	HIV positive patients receiving treatment at provider sites, stratified by illness stage, ethnicity, exposure route and insurance status 81% Male 19% Female White: 42% African American: 29% Hispanic: 27% Gay/Bi Male: 55% Male IVDU: 15% Female IVDU: 11%	(i) Doubled up (hosted) w/. friend or relative (ii) single room occupancy/ welfare hotel (iii) AIDS housing (iv) shelters (v) street/public space (Homeless)	Health Care, Treatment and Social Service Utilization (i) ER visit (ii) # ER visits (iii) Hospitalization (iv) # Ambulatory visits (v) # hospital days (vi) Ave length of stay	9% (n = 171) of sample unstably housed in past 3 mos. Women (14.1%, 47 / vs. 8.5%, 124 men) more likely to experience unstable housing ($p < 0.005$). African American and Hispanic (14% 73, 9.7%. 47) more likely that White to experience unstable housing ($p < 0.005$). IVDU (female: 24% 29 and male: 20%, 54) most likely to be unstably housed ($p < 0.005$). Mean functional status lower for unstably housed ($p < 0.005$). Unstably housed more likely to have ER visit (51 vs. 35%); and visited ER more frequently ($p < 0.05$); and more ambulatory visits when controlling for insurance and functional status ($p < 0.03$)	*S*: Composite scales of functional impairment as control for health status: 1. Limited in range of physical and daily living activities; 2. nature/severity of pain. The effect of functional status on health care utilization consistently significant for all levels of outcome variables *W*: Health care utilization measured by self-report; the survey involved only those HIV persons receiving medical care
Bonuck and Arno (1997) *Cross-sectional Analysis* (N = 749) Location: USA, NY	HIV positive patients from five NYC hospitals. Systematic random sample of discharges between June 1 and August 31, 1991 71% Male 29% Female *Ethnocultural Identity:* Hispanic: 45% African American: 36% White: 18% IVDU: 47% MSM: 24% Heterosexual: 18%	(i) Stability or absence of housing prior to admission (ii) unstable—transient/ doubled-up, previous stable housing jeopardized by hospitalization and/or HIV disclosure (iii) housing-related discharge barriers: lack of housing; housing appropriateness for patient upon discharge	Health Care, Treatment and Social Service Utilization Examined variations in average length of stay	Examined housing and social barriers to discharge from inpatient clinics. Unstable housing patients have longer stay (25 vs. 19 days). 2/3 of sample with unstable housing were at risk of loosing housing In multivariate: unstable housing status was significantly associated with length of stay (OR: 1.80, 95% CI: 1.0–3.1)	*S*: Housing status primary focus of the study. Multivariate analyses controlling for morbidity related variables and housing barriers *W*: Possible coding bias in retrospective data collection design. Up to 20 (< 3%) repeat admissions may have been included in data *C*: No assessment of quality or dimensions of housing among those who are stably housed

Table 2 continued

Study details Author, date, analysis	Sample characteristics	Housing status classification	Analysis outcome linked to housing	Results	Strengths/weaknesses Comment
Braitstein et al. (2005) *Cross-sectional Analysis* (N = 484) Location: Canada, BC	HIV positive Cohort population selected from the provincial Drug Treatment Program, distributing anti-retroviral medication at no cost 93.5% Male 6.4 % Female 73% Caucasian 27% Non-Caucasian MSM: 63% IVDU: 19% Blood products: 3%	Stable vs. unstable (Undefined classification)	Health Status (Co-infection with hepatitis C)	Among respondents, individuals with hepatitis C were less likely to have stable housing ($p < 0.001$) Having Stable housing was independently predictive of HIV–HCV co-infection compared to individuals mono-infected with HIV (OR: 0.16, 95% CI: 0.04–0.59)	*S*: Good clinical sample and derivation of analysis indicators *W*: Study does not provide more sophisticated analysis modelling that examines housing and quality of life and depression on health outcomes of mono- and hepatitis C co-infected persons
Hall et al. (2004) *Cross-sectional Analysis* (N = 249) Location: USA, CA	HIV positive and HPV co-infection study 82% Male 18% Female African American: 43% White: 41% Hispanic: 16% Heterosexual: 37% Bisexual: 35% Homosexual: 28% Ever IVDU: 64%	Marginal housing: homeless shelters, free lunch programs, single room occupancy residential hotels	Health Status Adherence to ART and Health Care Treatment and Social Service Utilization *Measure of Adherence:* Unannounced pill-count	24% at follow-up had spent night on the street or in a shelter in the past 30 days At follow-up, being homeless over 1 year at baseline, demonstrated a significant univariate association with HCV infection ($p < 0.020$)—co-infected Homeless over 1 year significantly associated with HCV co-infection (62 vs. 38%)	*S*: HCV antibody or viral RNA testing *W*: Analysis not focused on housing in relation to outcome variables *C*: Study indicates collection of adherence to ART, but article does not report univariate or multivariate models, analyses or tabled results. Marginalized housing as barrier to care—though this effect is difficult to isolate
Johnson et al. (2003) *Cross-sectional Analysis* (N = 2,765) Location: USA	Participants in cognitive-behavioural risk reduction intervention w/ coping skills and adherence modules 74.3% Male 24.4% Female 1.3% Transgender African American: 49% White: 26% Hispanic: 18% Heterosexual: 43% Homosexual: 43% Bisexual: 11%	History of homelessness or living in a shelter	Adherence to ART *Adherence measure*: self-report (noted by pills skipped in previous 3-days). Assessed by > / < 90% adherence	31.75% of persons on ART reported less than 90% adherence in the previous 3 days History of homelessness ($p < 0.001$) or living in a shelter ($p < 0.001$) demonstrates significant univariate association to poor-adherence Significant multivariate association to poor adherence (OR: 1.38, 95% CI: 1.02–1.85 /$p < 0.035$)	*S*: Comprehensive consideration of independent covariates examined in analysis with standard measure of social support, depression and other psychosocial indicators. Analysis is framed using Social Action Theory (SAT) *W*: Self-report measure of adherence possibly under-estimated

Table 2 continued

Study details Author, date, analysis	Sample characteristics	Housing status classification	Analysis outcome linked to housing	Results	Strengths/weaknesses Comment
Msellati et al. (2003) *Cross-sectional Analysis* (N = 711) Location: Cote d'Ivoire	HIV-positive patients seeking care. Recruited from five referral centres focused on HIV Care plus three additional health structures in charge of HIV care 51% Male 49% Female	Poor housing conditions (absence of refrigerator in household, absence of ventilation in patient's bedroom) "Living in collective housing"—indicator of poverty	Health Care, Treatment and Social Service Utilization *Multiple Outcomes:* Treatment with ART and access to Drug Access Initiative Program	In multivariate: Living in poor housing conditions: 1. No refrigerator in household: (OR: 1.7, 95% CI: 1.2–2.3) 2. Absence of ventilation in bedroom (OR: 1.5, 95% CI: 1.1–2.0); and being male, no insurance, and low education level associated with not being treated with ART and having no access to "Drug Access Initiative" program—the majority of whom (67.9%) had CD4 cell counts $\geq$ 500×10^6 cells/l; consider privacy concerns, drug cost, info dissemination	*S*: Only international study emerging from review. Living conditions/housing strong focus of research inquiry and significant in multivariate *W*: Study design. Sampling (1/3 potential subjects were not offered participation) *C*: Housing conditions classify amenities in the African context. Connection to treatment related to eligibility and outreach of previous programs
Spire et al. (2002) *Longitudinal Analysis* (N = 445) Location: France	French APROCO cohort, enrolled from 47 French hospitals delivering specialized HIV/AIDS Care 78.2% Male 21.8% Female Homosexual: 45% Heterosexual: 29% IVDU: 14%	Housing conditions: stable, stable but poor housing, unstable (all undefined by specific parameters)	Adherence to ART *Measure of Adherence*: two measures of self-report. 1. Pill count taken 4 days prior to interview. 2. Self-qualitative assessment: totally/partially/ or interrupted treatment in past 4 days For non-adherers: Quant/Qual question examined reasons for non-adherence	26.7% non-adherent in the 4 days prior to their M4 interview. (81.5% of whom skipped doses vs. totally interrupting treatment 18.5% Decrease in viral load titres between M4 and M0 greater among adherent patients Non-adherence @m4 associated with poor (31.2%) and unstable housing (41.9%) compared to those with stable housing (17.9%): ($p < 0.01$). Multivariate: housing status highest predictor: Unstable (OR: 2.70, 95% CI: 1.20–6.08); Stable but Poor housing: (OR: 1.71, 95% CI: 1.01–2.92) @M4 consistent	*S*: Study design, and detailed multivariate analysis, commencing at first prescription of HAART *W*: Undefined parameters of housing stability/instability. Only self-report measure of adherence, no clinical indicators. 4 m follow-up period too short to take into account consequences of drug toxicity which is understood to affect continued adherence *C*: A number of predictors indicate short-term adherence, including self-identified non-adherents to medications in general

Table 2 continued

Study details Author, date, analysis	Sample characteristics	Housing status classification	Analysis outcome linked to housing	Results	Strengths/weaknesses Comment
Wiessman et al. (1996) *Cross-sectional Analysis* (N = 305) Location: USA, MA	HIV positive patients receiving care 92.8% Male 7.2% Female White: 66.2% African American: 18.9% Hispanic: 8.5% Haitian: 5.8% Gay/Bisexual: 69.3%Heterosexual: 30.7% IVDU: 23.6%	Homelessness (yes/no) = whether they had a place of their own to live during the last 4 months	Health Care, Treatment and Social Service Utilization *Multiple Outcomes:* (i) Hospital use (ii) Non-hospital use (iii) Disease burden	Homelessness as high predictor of hospitalization (OR: 3.3). AIDS may compound this relation Non respondents (40% of eligible persons) more likely ($p < 0.05$) to be homeless and probably were sicker because 10% of non respondents died before they could be enrolled	*S*: Longitudinal (4 m) study design; health care use: for all study sites, based on hospital records or when determined by self-report (non-study sites) verified by hospital records. Non hospital services considered and examined in secondary analysis but more reliant on self-reports *W*: Housing status variable does not assess the stability of housing for those who did have their own place to live in past 4 mos—only yes/no homeless. Did not control for sample setting potential/known selection effects

Notes: All studies were comprised of clinical samples where HIV-status was either tested or confirmed with client's clinical records except for Waldrop-Valverde and Valverde (2005), which comprised a community sample of HIV-positive intravenous drug users, where HIV-status was not tested or clinically confirmed. Sample characteristics indicate gender, ethnocultural identity and HIV-risk group category where sample proportions were indicated in article. *Notable abbreviations:* MSM = men who have sex with men; IVDU (Intravenous drug user)

Measures of Housing Status

Various measures were used to describe the housing status of study populations. Housing stability was in some cases considered a function of housing type (owning or renting one's own place vs. motel/hotel or shelter) as the frequency of a change in residence, receipt of housing assistance, or in the case of the study from Cote d'Ivoire, as access to basic household amenities (refrigerator and adequate ventilation). Homelessness was largely defined as living in a shelter, single-room occupancy residential hotel, or a public place (i.e., car, street), although some studies determined homelessness based on the frequency of attendance at a free meal program, or simply not living in a place of one's own.

Health Care, Treatment and Social Service Utilization

Unstable housing was significantly associated with health care and/or social service utilization in all nine of the good or fair rated studies examining these outcome measures. The health care services examined varied widely between studies, primarily including aspects of access and utilization of hospital-based emergent and in-patient care, community-based ambulatory care and/or access to HIV antiretroviral therapy.

The receipt of some form of housing assistance was found to be significantly associated with routine use of primary health care services. In a study of 377 HIV patients eligible for Medicaid coverage in North Carolina, receipt of housing assistance was significantly associated with attending at least one primary care visit every 6 months (Conover & Whetten-Goldstein, 2002). Several studies indicated that persons with HIV/AIDS who lived in unstable living arrangements or who were homeless were more likely to demonstrate frequent use of hospital-based emergency or inpatient services (Masson, Sorensen, Phibbs, & Okin, 2004; Smith et al., 2000; Weissman et al., 1996) and more ambulatory care services (Arno et al., 1996) than HIV-positive persons who were stably housed. Unstable housing was also associated with prolonged hospitalization. Bonuck and colleagues found that unstable housing (OR = 1.8, 95% CI = 1.0–3.1) and housing-related discharge barriers (homelessness, non-hygienic, unsafe or ill-equipped for homecare), were significantly associated (OR = 2.1, 95% CI: 1.1–4.0) with longer than average length of hospitalization among 749 HIV patients who received care at five New York City hospitals (Bonuck & Arno, 1997).

Two studies examined the relationship between housing status and access to anti-retroviral treatment. Among 711 HIV-positive patients in Cote d'Ivoire, participants with poor housing conditions were significantly less likely to be involved in a United Nations-sponsored HIV drug program; and more likely to not be receiving anti-retroviral therapy due to the absence of a refrigerator in the household (OR = 1.7, 95% CI = 1.2–2.3) (Msellati et al., 2003). In addition, a Florida study of four public health clinics noted that homeless clients were more likely to not be receiving HAART compared to housed clients (52 vs. 20%), equating to a 10-fold increased risk of mortality (OR: 9.98, 95% CI: 2.34–42.5) in multivariate analysis (Lieb et al., 2002).

In another study by Bica and colleagues, HIV positive persons residing in unstable housing were significantly less likely than those in stable housing to use oral complimentary alternative therapies such as dietary and single nutrient supplements (prevalence ratio = 0.75, 95% CI: 0.61–0.92, $p = 0.007$) (Bica et al., 2003).

One study found no statistical association between measures of housing stability and healthcare service utilization, including treatment for Hepatitis C Virus co-infection (Hall, Charlebois, Hahn, Moss, & Bangsberg, 2004); another study found no difference in adherence to medical appointments among homeless and house persons (Israelski et al., 2001).

Adherence to Anti-retroviral Treatment

Housing instability was a significant predictor of non-adherence to HAART in all five studies rated as good or fair that examined this outcome. Studies varied in their adherence reporting methods, with two of these five studies collecting more than one measure of adherence.

Unstable housing status or poor housing conditions were the strongest predictors of non-adherence: (OR: 2.76, 95% CI: 1.30–5.85; and OR: 1.88, 95% CI: 1.15–3.08, respectively) among a study sample of 445 HIV-positive patients from 47 specialized HIV care facilities in France (Spire et al., 2002). In a 6-month longitudinal study of adherence in a sample of former injection drug users in a methadone maintenance program in New York City, residence in long-term housing vs. short-term occupancy shelters or hostels was significantly associated with better adherence to HAART (75 vs. 42%, $p = 0.03$) (Berg et al., 2004). In the same study, controlling for age, sex and depression, participants living in long-term housing were sixteen times more likely (Beta: 16.0, 95% CI: 5.3–26.7) to report good adherence to HAART regimens than participants with unstable, or short-term housing, such as shelters or motels or hostels (Berg et al., 2004). Better adherence (OR: 2.96, 95% CI: 1.39, 6.32) was also found for people living in stable housing—defined as living with a partner, friend or relation in a home or apartment compared to those living in unstable housing (Carballo et al., 2004). Increased likelihood of poor adherence was noted by Johnson and colleagues for HIV positive persons who have had a history of homelessness (unstable housing) (OR: 1.38, 95% CI: 1.02–1.85/$p < 0.035$) (Johnson

et al., 2003). Lieb and colleagues study, noted above, of four public health clinics in Florida reported that housed clients were more likely to adhere to HAART than homeless clients (70 vs. 56%) (Lieb et al., 2002).

Health Status of Persons Living with HIV/AIDS

A total of five studies examined the impact of housing on health status outcomes among persons living with HIV/AIDS, three of these studies examined housing status and co-infection with either Hepatitis C or tuberculosis (TB). A San Francisco cohort study of people living with HIV who were marginally housed noted that being homeless over 1-year at baseline vs. never homeless demonstrated a significant univariate association with Hepatitis-C (HCV) co-infection (62 vs. 38%, respectively: $p < 0.020$) (Hall et al., 2004). A Canadian study in the province of British Columbia similarly demonstrated that participants in stable housing were less likely to be co-infected with Hepatitis C (OR: 0.16, 95% CI: 0.04–0.59) (Braistein et al., 2005). Conover and colleagues, examining 377 HIV positive patients eligible for public health insurance (Medicaid) from three US-based medical centres demonstrated no relationship between receipt of housing assistance and health status outcomes (CD4 and viral load) (Conover & Whetten-Goldstein, 2002). A multilevel analysis of HIV positive persons in Alabama found that stable housing was significantly associated with better physical health functioning as measured by CD4 and T-cell counts, but was not associated with better mental health functioning (Stewart, Cianfrini, & Walker, 2005).

HIV Risk Behaviours of Persons Living with HIV/AIDS

One study included in this review examined the association between housing status and HIV risk behaviours. Aidala and colleagues (2005) report on a National US longitudinal study specifically designed to examine the relationship between housing and HIV risk-behaviour outcomes of drug use and sex risk-taking behaviours among people living with HIV. In this study, housing status was significantly associated in univariate and adjusted multivariate models (cross-sectional and longitudinal) with increased odds of HIV risk behaviours of drug use (hard drug use, needle use and sharing) and sexual risk behaviours (unprotected sex and sex in exchange for money, drugs or housing/a place to stay). In propensity weighted and adjusted models homeless participants at baseline were over three and a half times as likely (OR: 3.58, 95% CI: 2.31–5.53) to recently have used hard drugs (heroin, cocaine, crack, methamphetamine or combinations of these substances) as persons with stable housing (Aidala et al., 2005). Persons unstably housed, were twice as likely in this regard compared to those who were stably housed. Improved housing status was also significantly linked to a reduction in drug use and unprotected sex at last intercourse, but not with sex exchange behaviours (Aidala et al., 2005). However, for those whose housing status worsened across the study period, increase in sex exchange behaviours was five times higher (OR: 5.11, 95% CI: 1.05–24.8) compared to persons whose housing situation stayed the same (Aidala et al., 2005).

Discussion

This review of the literature demonstrates the importance of housing status and stability on access to and utilization of health and social services; access and adherence to HIV treatment regimens; and to health status and HIV risk-behaviour outcomes of people living with HIV. The studies included in this review used extremely diverse indicators of housing stability and/or quality and widely differing health outcome measures. This extreme heterogeneity precluded the use of meta-analytic techniques to estimate effect sizes.

Overall, the majority of included studies comprised United States based samples of urban populations of easily identifiable HIV positive persons; and focused upon access and utilization of care or HIV treatment adherence. This undoubtedly points to institutional vs. community driven research in this area; and the ability of researchers to ethically identify and access research populations of people living with HIV. The small number of studies that assess housing and health status outcomes is a concern, though we suspect this is likely due to the high-cost associated with conducting utilization and adherence studies, particularly using research designs that include longitudinal clinical indicators (viral load, CD4) and measures of quality of life as health status outcomes. Although the study from Cote d'Ivoire is interesting, caution must be used with this particular study when considering the potential effect of housing status on access to treatment, given the various other issues related to access to HIV treatments in Cote d'Ivoire and this specific United Nations program.

Implications for Researchers

For many of the included studies the relationship between housing status and health outcomes as measured by clinical indicators and other health-related outcomes for people living with HIV was not the main focus of the research. Strong studies tended to focus on well-defined empirical characteristics of housing status and stability, and included appropriate correlation and analysis procedures to examine the potential relationship. The dearth of longitudinal

studies in this area of inquiry is important to note. The relationship between housing status and indicators of health status warrants further investigation and the need for prospective studies of well-designed housing interventions for people living with HIV at risk of housing instability and homelessness in various global regions. In particular, future adherence studies should include longitudinal clinical outcome measures with community and/or non-cohort samples of people living with HIV.

Most studies included samples of both men and women living with HIV (data not shown), unless the study specifically focused on gay, bisexual or other men who have sex with men. However, no studies included in this review reported whether any participants identified as a Trans person (transsexual or transgender) or inter-sexed. In addition, various ethnocultural populations were included in studies relevant to the respective geographic region where the study was conducted. In most instances studies included in this review focused on urban-poor and/or marginalized populations, (i.e.: African Americans in New York City), however, no studies focused on specifically on housing and Indigenous peoples in North America, Australia, New Zealand, Latin America or other global contexts. Future research is encouraged to focus specific studies on Trans people, migrant and Indigenous peoples populations relative to local contexts.

One study (Stewart et al., 2005) focused on housing status/stability and the potential relationship to psychological outcomes for people living with HIV, noting no significant relationship. Future research is encouraged to include psychological health-related outcomes such as access to, or utilization of community-based social support programs, general mental health outcomes, psychiatric or substance use counselling or treatment programs.

Regarding the measurement of health outcomes, this review did not assess the strength or validity of health-related outcomes in the rating of articles included in this review. Future research is encouraged to expand inquiry to mental health outcomes and the potential relationship with housing status and stability. We also encourage future research to consider the strength and validity of selected health outcomes, whereby the most robust measurements of adherence, access and utilization of health care, social services and behavioural science methodology will improve the development of the field and overall understanding of the relationship between housing and health in the context of HIV.

The notable relationship between stable housing and the utilization of complementary and alternative therapies is important and requires future inquiry. HIV treatments cannot be solely reduced to HAART regimens, as this does not reflect the reality of holistic and integrated care in the treatment models currently in practice by HIV care teams in the health, social service and naturopathic professions.

Implications for Clinicians, Social Service Providers and Policy Makers

The complexity of competing subsistence, health service and support needs have a substantial impact on health-related quality of life, indicators of health, mental health and mortality of people living with HIV. This is accentuated for urban-poor and marginalized populations, the majority of whom comprise the study samples included in this review. Indeed, a burgeoning literature indicates that the need for stable housing circumstances is highly prevalent among people living with HIV, particularly among homeless and injection drug using populations (Andia et al., 2001; Bonuck, 2001; Crane, Quirk, & van der Straten, 2002; Goiceochea-Balbona, Barnaby, Ellis, & Foxworth, 2000; Hendriks & Leckie, 1993; Piette, Fleishman, Stein, Mor, & Mayer, 1993; Reilly & Woo, 2003a; Reilly et al., 2003b; Schrooten et al.,2002). In addition to issues of AIDS human rights abuses (Leech 2003), AIDS stigma and discrimination have also been notable barriers to the maintenance and access to stable housing circumstances for people living with HIV, particularly for women (Gielen et al., 2000) and Native American populations in the United States (Duran et al., 2000). Policy that integrates affordable and stable housing as integral to the holistic model of care and treatment, across federal, state and local service delivery systems may best address the complete care of the individual living with HIV and overall community health.

The substantive evidence that housing status is related to treatment adherence and HIV drug use and sexual risk taking behaviour is important for a variety of reasons relating to individual access to care and treatment; but also to interventions and programming to support and sustain adherence across time, with the aim to ensure health, quality of life and physical functioning of people living with HIV. Sustained adherence is also a paramount public health concern because intermittent adherence can result in far more devastating outcomes for the AIDS pandemic beyond the emergence of treatment failure for individual patients. Non-adherence has the known potential to result in drug-resistant strains of the virus, which may manifest as either cross-resistance between seroconcordant sexual partners; or multi-drug resistant HIV to newly infected individuals (Blower, Aschenbach, Gershengorn, & Kahn, 2001; Morris et al., 2006).

Conclusion

Review findings suggest that housing stability for people living with HIV/AIDS is vital. It behooves researchers, healthcare providers and public health planners alike to acknowledge the impact of sustained housing stability

upon access to health and social services, adherence to HIV treatment regimens and other health promoting behaviours of persons living with HIV.

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Appendix 1

Quality rating criteria for grading the internal validity of individual studies (28).

Rating "Good" if Meets all Criteria

Clear definition* of housing status classification;
Clear definition and adequate measurement of outcome;
Adequate adjustment for confounders.

* A clear definition of housing stability includes reference to at least one or more of the following components of housing status classification: (i) aspects of dwelling context, (ii) personal asset; and/or (iii) housing quality. For instance, a clear definition of stable housing would specify respondents housing circumstance as: living in a house or apartment—rented or owned by the participant (asset); and unstable housing would specify the participant as living in a short-term occupancy hotel, residence, or motel, or having moved more than once in the last year (context). A clear definition of unstable housing or homelessness may also be defined in studies as living in a hospice, shelter, on the street, or a car (context). Further, classification may also include actual quality of housing or structural dimensions of the dwelling relevant to the care and mobility of people living with HIV/AIDS, such as living in a walk-up apartment building (excessive stairs) or adequate amenities of the dwelling for privacy, rest or medication storage (crowding, ventilation or refrigeration).

Rating "Fair" if any or all of the Following Problems Occur, Without the Fatal Flaws Noted in the "Poor" Category

Clear* definition of housing status classification, but not ideal (undefined parameters of stable versus unstable housing);
Clear definition and measurement of outcome considered;
Partial adjustment for confounders.

Rating "Poor" if any of the Following Fatal Flaws Exist

Vague or unclear criteria for classification of housing status;
Vague or unclear definition of outcome considered;
Inadequate measurement of outcome considered;
Lack of adjustment for confounders.

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