Examining Multilevel Factors Associated with the Process of Resilience among Women Living with HIV in a Large Canadian Cohort Study: A Structural Equation Modeling Approach

Roula Kteily-Hawa, BSc, BEd, MPH, MSc, PhD[1,2] $\textcolor{green}{\textbf{ID}}$,
Laura Warren, BSc, MSc, MA[1,3], Mina Kazemi, MSc[1],
Carmen H. Logie, BA, MSW, PhD[1,4], Shazia Islam, BA[1,5],
Angela Kaida, BSc, MSc, PhD[6], Tracey Conway[1], Yasmeen Persad[1],
Alexandra de Pokomandy, MD, MSc[7,8]
Mona Loutfy, MD, MPH[1,3,9] & on behalf of the CHIWOS research team

Abstract

Objectives: We examined how multiple, nested, and interacting systems impact the protective process of resilience for women living with HIV (WLWH). **Methods:** Using data from a Cohort Study, we conducted univariate analyses, multivariable logistic regression, and a 2-step structural equation modeling for the outcome, high resilience (N = 1422). **Results:** Participants reported high overall resilience scores with a mean of 62.2 (standard deviation = 8.1) and median of 64 (interquartile range = 59-69). The odds of having high resilience were greater for those residing in Quebec compared to Ontario (adjusted odds ratio [aOR] = 2.1 [1.6, 2.9]) and British Columbia (aOR = 1.8 [1.3, 2.5]). Transgender women had increased odds of high resilience than cisgender women (aOR = 1.9 [1.0, 3.6]). There were higher odds of resilience for those without mental health diagnoses (aOR = 2.4 [1.9, 3.0]), non-binge drinkers (aOR=1.5 [1.1, 2.1]), and not currently versus previously injecting drugs (aOR = 3.6 [2.1, 5.9]). Structural equation modeling confirmed that factors influencing resilience lie at multiple levels: micro, meso, exo, and macro systems of influence. **Conclusion:** There is a need to consider resilience as the interaction between the person and their environments, informing the development of multilevel interventions to support resilience among WLWH.

Introduction

Resilience is a protective factor that helps people withstand, recover, or grow from difficult, stressful, and adverse situations.[1,2] In the general population, people with high resilience present fewer symptoms of depression, anxiety, and perceived stress[3] and are hardier and better able to accept their life circumstances.[1,4] Resilience has been conceptualized as a *trait* reflective of individual character and personal strength.[5-7] Focusing solely on resilience at the individual level, however, negates the impact of the antecedents of resilience, which are a function of the micro, meso, exo, and macro systems of influence (eg, people, family, community, society, culture, institutions, and human-built and natural environments).[8,9] Ungar[9] referred to these as multiple, nested ecological levels.

[1] Women's College Research Institute, Women's College Hospital, Toronto, Ontario, Canada
[2] Faculty of Education, Queen's University, Kingston, Ontario, Canada
[3] Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada
[4] Factor-Inwentash Faculty of Social Work, University of Toronto, Toronto, Ontario, Canada
[5] Alliance for South Asian AIDS Prevention, Toronto, Ontario, Canada
[6] Faculty of Health Sciences, Simon Fraser University, Vancouver, British Columbia, Canada
[7] Department of Family Medicine, McGill University, Montreal, Quebec, Canada
[8] Chronic Viral Illness Service, McGill University Health Centre, Montreal, Quebec, Canada
[9] Department of Medicine, University of Toronto, Toronto, Ontario, Canada

Corresponding Author:
Roula Kteily-Hawa, Women's College Research Institute, Women's College Hospital, 76 Grenville Street, Toronto, Ontario, Canada M5S1B1.
Emails: roula.hawa@queensu.ca; hawaroula@gmail.com

What Do We Already Know about This Topic?

For women living with HIV, resilience has been linked to better quality of life; as such, there is a need to understand the processes contributing to resilience using a social ecological approach.

How Does Your Research Contribute to the Field?

This study fills a gap in the literature by applying a social ecological perspective to understand pathways to resilience among Canadian women living with HIV.

What Are Your Research's Implications toward Theory, Practice, or Policy?

Informed by our results, policy makers and care providers can assertively address enabling multiple level factors that lead to high resilience in this population, which include promoting good mental health, assisting with substance use with supportive harm-reduction strategies, and addressing food insecurity.

More recent work conceptualizes resilience as an interactive *process* between the individual and their environment, encompassing individual assets and contextual resources.[9-14] This insight opens the door to a social ecological approach that allows for the exploration of associations between resilience and multilevel factors. The social–ecological approach accommodates the complex, often reciprocal, interplay among individuals, relationships, community, and societal factors, which occurs across multiple levels at the same time.[15]

Within the HIV literature, resilience is discussed as a protective factor among people living with HIV (PLWH) that buffers the relationship between stress and mental health.[16-18] Resilience has also been associated with positive health benefits, including viral suppression,[19] treatment adherence,[16] and quality of life (QoL), both physical and mental.[2,20-23] For women living with HIV (WLWH) in particular, resilience has been linked to better QoL.[24] Women living with HIV experience significant stress and adversities due to gendered vulnerabilities of HIV, resulting in part from the social–environmental contexts of stigma, discrimination, economic insecurity, and inability to safely disclose (factors that have been linked to poor health outcomes).[25-28] In addition, WLWH experience daily systemic forms of oppression that contribute to lower resilience, self-worth, and self-esteem.[29]

With resilience being a key factor impacting the QoL of WLWH, there is a need to understand the processes contributing to resilience using a social–ecological approach, which includes individual assets *and* contextual resources. Not only are people affected on many levels, but they are often hindered by multiple sources of disadvantages, discrimination, and oppression, often explained by intersectional theory.[30] Of relevance is the reality that identity markers (eg, gender, HIV status, class, or ethnicity) interact with each other and can create a convergence of disadvantages and opportunities[30] for WLWH.

Social–ecological factors that may influence pathways to resilience among WLWH include sociodemographic factors such as socioeconomic status (SES), ethnicity, gender identity, age, and province of residence and psychosocial factors such as substance or drug use. In the general population, economic resources, employment opportunities, and related economic capacity have been identified as important resources in supporting resilience processes.[31-33] For WLWH, economic factors, food, and housing insecurity present significant stress and adversity that may challenge their resilience processes.[25,27] Moreover, environmental and psychosocial resources (eg, higher education, higher income, stable housing, employment, and better psychosocial status) are associated with higher resilience among WLWH.[34-36] There is a relationship between societal stigma and racial/ethnic HIV disparities, including risk, incidence and screening, treatment, and survival. Research has shown that resilience acts as a moderator of the association between societal stigma and racial/ethnic HIV disparities.[37] Societal stigma related to race and ethnicity is associated with racial/ethnic HIV disparities through its indicators at the structural and individual levels.[37] Because racial/ethnic minorities at risk of and living with HIV often possess multiple stigmas (eg, HIV-positive, substance use), an intersectionality lens accounting for the interdependence among co-occurring stigmas is plausible.

When examining health of transgender (trans) women with and without HIV infection, the literature supports the fact that gender affirmation (perceiving validation of one's gender identity and expression) has been associated with increased protection against stigma (internalized and experienced), discrimination, transphobia,[38] and a host of positive mental health outcomes, including increased resilience, improved coping with stress, and positive emotional affect.[39] When considering social–ecological factors that may influence pathways to resilience among WLWH, there is a need to examine age. Using survey data from the Canadian HIV Women's Sexual & Reproductive Health Cohort Study (CHIWOS) with a sample frame comprising 1422 women, Kteily-Hawa et al[40] found that the more resilient WLWH are, the higher their physical health-related quality of life (HR-QoL). Compared to younger WLWH, older WLWH may be more resilient because they can draw from and make sense of life experiences. The physical health of older women with HIV was impacted by resilience, mental health, food security, and depressive symptoms stressing the link between psychosocial and structural factors and physical health (ie, the social–ecological connections).[40]

For WLWH, context-specific variables such as modes of transmission, experiences of HIV-related stigma, and use of health-care services vary by region across Canada.[41-43] The literature suggests that there are often regional differences associated with experiences of discrimination, social support,

HIV stigma, gender discrimination, and resilience which can help inform interventions for WLWH in Canada. Given Canada's vast size, regional differences, and the differing demographic characteristics of WLWH in each of these areas, understanding variation in resilience by province of residence becomes important to examine in order to facilitate appropriate care.[41-43]

Research suggests that resilience may be an important buffer against the negative effects of substance use, violence, and other stressors on adherence.[19] Similarly, using latent class analysis to identify substance use patterns for 1363 WLWH in Canada who took part in CHIWOS, Carter et al[44] found that factors that significantly associated with "Illicit Poly-substance Users of All Types" were sexual minority status, lower income, and lower resiliency, indicating a need for increasing social and structural supports for WLWH who use substances. More recently, a study involving 55 mothers living with HIV in the US Midsouth tested the relationship between substance abuse and violence and depressive symptoms, as moderated by resilience, reported that co-occurring adversities exacerbated depressive symptoms and that resilience played a key protective factor.[36]

To summarize, the results from the abovementioned studies support using the social–ecological approach to understand factors related to resilience processes in WLWH. This study fills a gap in the literature by applying a social–ecological perspective to understand pathways to resilience among Canadian WLWH.

In particular, in order to understand resilience in WLWH as a complex, multidimensional process, Ungar's[9] approach to social ecology was used. Ungar[9(p15)] posited that a social ecological perspective on resilience supports a focus on the person's social and physical environment, viewed as being able to "potentiate positive development under stress." This contrasts with a focus on "the capacity of individuals to exercise personal agency during their recovery from risk exposure."[9(p15)] Ungar[9] proposed that individuals engaged in resilience processes have more success when they take advantage of, and exercise influence over, the opportunities they have in culturally meaningful ways. In other words, the *opportunity* structures (available and accessible) that surround an individual will shape his or her capacity to experience resilience when facing adversity. Moreover, *meaning*, a culturally constructed multidimensional concept, "determines the decisions people make with regard to which resources (opportunities) they value and access and which resources their family, community and nation provides."[9(p22)]

Using the social–ecological approach, we sought to both (1) characterize resilience scores in a cohort of Canadian WLWH and (2) understand the association between sociodemographic factors (gender identity, age, ethnicity, and province of residence), SES (marital status, education, income, housing stability, and food security), drug use (history of or current injection drug use, hazardous alcohol use, cigarette use, cannabis use, and history of and current recreational drug use), clinical status (mental health, HIV risk factors such as having consensual or non-consensual sex, sharing needles, blood transfusion/other medical procedure, and perinatal exposure), duration of living with HIV, hepatitis C, hepatitis B, and resilience among Canadian WLWH.

Method

Study Population and Design

This cross-sectional study used the baseline data collected as part of the CHIWOS. CHIWOS was a multisite, prospective, community-based study involving self-identified women ≥ 16 years of age living with HIV in 3 Canadian provinces (Ontario, British Columbia [BC], and Quebec). A complete description of CHIWOS can be found elsewhere (www.chiwos.ca).[45,46] Participants (N = 1422) completed an interview-administered baseline questionnaire between August 2013 and March 2015. For inclusion in this study, participants must have responded to $\geq 50\%$ of the 10 questions included in the Resilience Scale (RS-10; N = 1415).

Data Collection

CHIWOS was founded on the principles of both community-based research and the meaningful involvement and engagement of WLWH.[45,47] Accordingly, WLWH were involved in all research stages and were trained and supported to work as peer research associates (PRAs).[45] Utilizing purposive, nonrandom sampling methods, the PRAs assisted in the recruitment of potential participants.[46,48] Explained in detail elsewhere,[49] a CHIWOS questionnaire was designed by a national team of experts in HIV and women's health, including individuals with lived experience with HIV. By compiling established validated scales and unique questions crafted by the CHIWOS research team, an original survey tool was developed, pilot tested, and subsequently revised. The final questionnaire comprised 9 sections related to demographics and SES, medical, and HIV disease information, health-care utilization, sexual and reproductive health, stigma and discrimination, substance use, and HR-QoL.[46] The PRAs administered the baseline questionnaire, in English or French, in person, by phone, or Skype. In-person questionnaire administration occurred at collaborating HIV clinics, community-based organizations, or in women's homes.

Instrument Used for the Outcome of Interest

Resilience was the outcome of interest, measured using the RS-10 (range of scale: 10-70; Cronbach $\alpha = 0.88$), with higher scores indicating increased resilience.[4] The RS-10 is an abbreviated version of the RS-25, including items such as "When I'm in a difficult situation, I can usually find my way out of it." The RS-10 includes 10 measures, while the original scale has 25 measures. The scale is scored using a 7-point Likert-type scale from 1 (strongly disagree) to 7 (strongly agree). The RS-10 has been validated[50] but not for this population. As such, we used a median split to divide the RS-10 into high- (≥ 64) and

low-resilience (<64) categories for the univariate and multivariate analyses.[51,52] Resilience was left as a continuous variable for the structural equation model.

Correlates of Interest

Following Ungar's[9] social–ecological framework, sociodemographic and psychosocial (ie, drug use) as well as clinical factors were examined as covariates. Respectively, sociodemographic factors included province of residence (Ontario, BC, and Quebec), age (16-29, 30-39, 40-49, and ≥50), racial/ethnic background (Caucasian/white, Indigenous, African/Caribbean/black, and other), gender identity (cis women, trans women, and other gender), level of education (lower than high school, high school, or higher), personal gross yearly income (<\$20 000 CAD, \$20 000-\$40 000 CAD, and ≥\$40 000 CAD), marital status (married/common law/in a relationship but not living together, single, separated/divorced/widowed, other), housing status (stable and unstable), and food security (food secure and food insecure). Stable housing was coded as participants who lived in an apartment (own/rent) or a house (own/rent). Housing instability included living in a self-contained room, transition house, halfway house, safe house, couch surfing, outdoors on street, parks, or in a car. Food insecurity was derived from 3 statements focused on experiences in the last 12 months: fear of running out of food, experience with running out of food, and inability to eat balanced meals (score range: 0-6; scores of 0-1 were coded as secure and 2-6 were coded as insecure).

Drug use variables included hazardous alcohol use (non-binge drinkers [never had a drink containing alcohol in the last year or did not have ≥4 drinks on one occasion in the last year], binge drinking [≥4 drinks on one occasion], and heavy drinkers [>8 binge drinking episodes per month]), cigarette use (yes, former, and never), cannabis use (yes, former, and never), history of recreational drug use (RDU; yes, no), current RDU (current RDU, previous RDU, and never), history of injection drug use (IDU; yes, no), and current IDU (current IDU, previous IDU, and never).

Clinical status factors included HIV risk factors (consensual sex, nonconsensual sex, sharing needles, blood transfusion/other medical procedure, perinatal exposure, contaminated needles, and other); duration of HIV diagnosis (<6 years, 6-14 years, and >14 years); hepatitis B status (yes, no); hepatitis C status (yes, no); and prevalence of mental health condition (yes, no).

Statistical Analysis

Data were analyzed using SAS software version 9.4.[53] We started by determining the median and interquartile range (IQR) and mean and standard deviation (SD) of resilience for the overall CHIWOS. The cohort was described overall and by high and low resilience (RS-10-score ≥ and < 64) using medians and IQRs for continuous variables and frequencies and proportions for categorical variables.

Univariate analyses, multivariable logistic regression, and structural equation modeling (SEM)[54] were conducted to determine the associations between sociodemographic, drug use, and clinical variables and the outcome variable, resilience (high resilience defined as a RS-10 score ≥64 for univariate and multivariate analyses). Univariate associations for categorical variables were assessed using chi-square tests and *t* tests for continuous variables. The final variables for the multivariable logistic regression model were selected by first including any variable with a univariate association with $P \leq .20$, and then the backward, manual stepwise elimination procedure was used until all remaining variables had a P value ≤.05.

The SEM was done using a 2-step approach. The first step was conducted to identify the measurement model via confirmatory factor analysis.[54,55] The second step identified the structural part of the model using maximum likelihood estimation methods, specifying direct and indirect relationships among latent variables tested in this study: (1) drug use (ie, cannabis use, history of recreational drug use, current recreational drug use, current injection drug use, cigarette use, hazardous alcohol consumption, and history of injection drug use), (2) SES (marital status, level of education, income, housing stability, and food security), and (3) clinical status (ie, diagnosed mental health condition, HIV risk factors, duration of HIV, hepatitis C status, and hepatitis B status). Gender identity (cisgender and transgender), age (continuous), ethnicity (Caucasian/white and other ethnicities), and province (Quebec, BC, and Ontario) were hypothesized to have both direct and indirect effects on resilience, mediated by drug use, SES, and clinical status. Scree plots of eigenvalues and factor loadings on latent variables were used to determine the appropriate number of factors. Latent variables with fewer than three indicator variables loading independently on them were removed. Indicator variables with factor loadings <0.30 were removed.

Modifications to the proposed model were made based on goodness-of-fit indices including the chi-square test, the comparative fit index (CFI), normed fit index (NFI), root mean square error of approximation (RMSEA), standard root mean square residual (SRMSR), and the non-normed fit index (NNFI). After each modification, model estimation and assessment of fit were conducted. Modifications to the model continued until either all reasonable modifications were made or a model with a good fit (fit indices ≥0.90; RMSEA and SRMSR ≤0.06) was identified.[55-56]

Ethics Approval and Informed Consent

All clinical investigations were conducted according to the principles expressed in the Declaration of Helsinki. All participants provided written, voluntary, informed consent (or oral consent with a study team member present as a witness for surveys conducted by phone or Skype) and received a \$50 CAD participation honorarium. Research ethics board approval was obtained from: Women's College Hospital in Ontario (REB #

2011-0024-E), Simon Fraser University in British Columbia, University of British Columbia/Providence Health, and McGill University Health Centre in Quebec. Study sites that had independent Research Ethics Boards received their own approval prior to commencing enrolment.

Results

Overall (N = 1415), high-resilience scores were reported with an overall mean score of 62.2 ± 8.1 and a median score of 64 (IQR = 59-69). Univariate associations between resilience and sociodemographic, drug use, and clinical status variables are reported in Table 1. All reported variables had a statistically significant association ($P < .05$) with resilience except for hepatitis B status, duration of HIV, marital status, and age.

Univariate and Multivariable Logistic Regression Model

The univariate and multivariable logistic regression analyses are presented in Table 2. Province of residence, gender identity, food security, prevalence of diagnosed mental health condition, hazardous alcohol consumption, and current IDU were included in the final multivariable logistic regression model (Table 2). After adjusting for confounding variables, the odds of a participant having high resilience was over 2 times higher for participants residing in Quebec compared to Ontario (adjusted odds ratio [aOR] = 2.1 [1.6, 2.9]) and BC (aOR = 1.8 [1.3, 2.5]; $P < .0001$). Transgender women had higher odds of high resilience than cisgender women (aOR = 1.9 [1.0, 3.6]; $P = .02$). Higher odds of resilience were also found for participants who had no mental health diagnosis compared to those with a mental health diagnosis (aOR = 2.4 [1.9, 3.0]; $P < .0001$), were non-binge drinkers compared to binge drinkers (aOR = 1.5 [1.1, 2.1]; $P = .02$), and who were not currently injecting drugs compared to previously injecting drugs (aOR = 3.6 [2.1, 5.9]; $P < .0001$).

Structural Equation Modeling

The final structural equation model was based on 1407 observations due to missing values for included indicator variables (see Figure 1). Clinical status was not included in the final model, as it had fewer than 3 indicator variables loading independently on it. Several indicator variables for drug use and SES were also removed due to their poor factor loading values (<.30). Goodness-of-fit and parsimony indices were all indicative of a good fit, $\chi^2(31) = 124$ for the final model, NFI = 0.92, NNFI = 0.89, CFI = 0.94, RMSEA = 0.049 [0.040, 0.058], SRMSR = 0.03. The final model had improved goodness-of-fit and parsimony indices over the initial model where $\chi^2(39) = 307$, NFI = 0.81, NNFI = 0.71, CFI = 0.83, RMSEA = 0.074, and SRMSR = 0.07.

Drug use (indicator variables: cigarette use, cannabis use, and hazardous alcohol consumption) and SES (indicator variables: education, income, food security, and housing stability) were the only statistically significant latent variables associated with resilience. Standardized factor loadings for the final model are displayed in Table 3.

All indicator variables had statistically significant factor loadings on their respective latent variables. Gender identity, ethnicity, and province of residence all had direct and indirect effects on resilience. Ethnicity had an indirect effect through SES and drug use ($P \leq .0001$; Table 3). Non-Caucasian/white participants with a higher SES had lower resilience in comparison to Caucasian/white participants with a higher SES. Non-Caucasian/white participants with lower drug use (eg, more likely to use cigarettes, cannabis, and drink alcohol) had higher resilience in comparison to Caucasian/white participants with a lower drug use. The effect of gender identity on resilience was mediated by SES (indirect path estimate = −0.018; $P \leq .01$). Transgender women with higher SES had significantly lower resilience in comparison to cisgender women with higher SES. The direct effect of gender identity was positive (ie, transgender women had higher resilience in comparison to cisgender women), but it was not statistically significant ($P > .05$). Province of residence had a statistically significant direct, indirect (via drug use), and total effect on resilience, showing the same trend as the logistic regression model where participants from Ontario and BC had lower resilience than participants from Quebec (see Table 4).

Discussion

We found that the overall resilience scores were high for Canadian WLWH, with a median resilience score of 64 (IQR = 59-69) of a maximum of 70. Results affirmed the need to consider resilience as a set of processes occurring within multiple, nested ecological levels.[9,57-58] Through exploratory analyses, gender identity, ethnicity, and province of residence along with 3 drug use variables (cigarette use, cannabis use, and hazardous alcohol consumption) and 4 SES variables (education, income, food security, and housing stability) were found to be associated with resilience among Canadian WLWH. The SEM confirmed that these factors lie at multiple ecological levels. All indicator variables had statistically significant loadings on the final latent variables (SES and drug use). Gender identity and ethnicity were indirectly associated with resilience mediated through SES and drug use. Province of residence had both direct and indirect effects on resilience, with Quebec having higher resilience rates than Ontario and BC.

The association between gender identity on resilience merits further discussion. The logistic regression analyses revealed that trans women had higher resilience than cisgender women. Dale et al[19] found that silencing the self (such as gender) predicts higher resilience, as these groups have had to fight for their right to be (eg, to freely express their identity). Also, trans women are inclined to be connected as a community that provides social support, an important factor in predicting resilience.[59] Ungar's[9] social–ecological approach accommodates this assertion. He holds that resilience processes partly depend upon people partaking in social discourse to influence how resilience is defined and what it looks like. Through

Table 1. Sociodemographic, Drug Use, and Clinical Characteristics of CHIWOS Study Population by Resilience Status (Resilience Score ≥ or < 64).[a]

Variable	Total (n = 1415), n (%)	High Resiliency (10-point Resiliency Score ≥64), n = 746	Low Resiliency (10-point Resiliency Score <64), n = 669	P Value
Sociodemographic characteristics				
Province				
British Columbia	355 (20.78)	155 (43.66)	200 (56.34)	**<.0001**
Ontario	707 (47.45)	354 (50.07)	353 (49.93)	
Quebec	353 (31.77)	237 (67.14)	116 (32.86)	
Age, years				
16-29	136 (9.61)	74 (54.51)	62 (45.59)	.88
30-39	427 (30.18)	227 (53.16)	200 (46.84)	
40-49	455 (32.16)	233 (51.21)	222 (48.79)	
≥50	397 (28.06)	212 (53.40)	185 (46.60)	
Racial/ethnic background				
Indigenous	317 (22.40)	156 (49.21)	161 (50.79)	**.02**
African/Caribbean/black	414 (29.26)	244 (58.94)	170 (41.06)	
Caucasian/white	582 (41.13)	299 (51.37)	283 (48.63)	
Other	102 (7.21)	47 (46.08)	55 (53.92)	
Gender identity				
Cis women	1352 (95.55)	711 (52.59)	641 (47.41)	.01
Trans women	54 (3.82)	34 (62.96)	20 (37.04)	
Other	9 (0.64)	1 (11.11)	8 (88.89)	
Education				
Lower than high school	225 (15.90)	92 (40.89)	133 (59.11)	**<.001**
High school or higher	1183 (83.60)	650 (54.95)	533 (45.05)	
Don't know/prefer not to answer	7 (0.49)	4 (57.14)	3 (42.86)	
Personal gross yearly income				
<$20 000 CAD	995 (70.32)	501 (50.35)	494 (49.65)	**<.01**
$20 000-$40 000 CAD	241 (17.03)	132 (54.77)	109 (45.23)	
≥$40 000 CAD	144 (10.18)	97 (67.36)	47 (32.64)	
Don't know/prefer not to answer	35 (2.47)	16 (45.71)	19 (54.29)	
Housing status				
Stable	1264 (89.33)	680 (53.80)	584 (46.20)	.02
Unstable	151 (10.67)	66 (43.71)	85 (56.29)	
Food security	n=1408			
Food insecure	506 (35.94)	316 (62.45)	190 (37.55)	**<.0001**
Food secure	902 (64.06)	428 (47.45)	474 (52.55)	
Marital status				
Married/common-law/in a relationship, not living together	455 (32.16)	260 (57.14)	195 (42.86)	.06
Single	683 (48.27)	337 (49.34)	346 (50.66)	
Separated/divorced/widowed	270 (19.08)	146 (54.07)	124 (45.93)	
Other	5 (0.35)	3 (60.00)	2 (40.00)	
Prefer not to answer	2 (0.14)	0 (0.00)	2 (100.00)	
Drug use				
Hazardous alcohol use				
Non-binge drinkers	1104 (78.02)	608 (55.07)	496 (44.93)	<.001
Binge drinkers	212 (14.98)	91 (42.92)	121 (57.08)	
Heavy drinkers	30 (2.12)	8 (26.67)	22 (73.33)	
Don't know/prefer not to answer	69 (4.88)	39 (56.52)	30 (43.48)	
Cigarette use				
Yes	616 (43.53)	271 (43.99)	345 (56.01)	<.0001
Former	169 (11.94)	102 (60.36)	67 (39.64)	
Never	623 (44.03)	370 (59.39)	253 (40.61)	
Don't know/prefer not to answer	7 (0.49)	3 (42.86)	4 (57.14)	
Cannabis use				
Yes	362 (25.58)	156 (43.09)	206 (56.91)	<.0001
Former	271 (19.15)	129 (47.60)	142 (52.40)	

(continued)

Table 1. (continued)

Variable	Total (n = 1415), n (%)	High Resiliency (10-point Resiliency Score ≥64), n = 746	Low Resiliency (10-point Resiliency Score <64), n = 669	P Value
Never	762 (53.85)	452 (59.32)	310 (40.68)	
Don't know/prefer not to answer	20 (1.41)	9 (45.0)	11 (55.0)	
Current recreational drug use (RDU)				
Previous RDU	385 (27.21)	197 (51.17)	188 (48.83)	<.0001
Currently RDU	257 (18.16)	86 (33.46)	171 (66.54)	
Never RDU	749 (52.93)	449 (59.95)	300 (40.05)	
Don't know/prefer not to answer	24 (1.70)	14 (58.33)	10 (41.67)	
Current injection drug use (IDU)				
Previous IDU	316 (22.33)	154 (48.73)	162 (51.27)	<.0001
Currently IDU	123 (8.69)	25 (20.33)	98 (79.67)	
Never IDU	953 (67.35)	555 (58.24)	398 (41.76)	
Don't know/prefer not to answer	23 (1.63)	12 (52.17)	11 (47.83)	
Clinical characteristics				
HIV Risk Factors				
Consensual sex	680 (48.06)	383 (56.32)	297 (43.68)	<.001
Non-consensual sex	216 (15.27)	109 (50.46)	107 (49.54)	
Sharing needles	262 (18.52)	105 (40.08)	157 (59.92)	
Blood transfusion/other medical procedure	70 (4.95)	41 (58.57)	29 (41.43)	
Perinatal exposure	50 (3.53)	32 (64.00)	18 (46.00)	
Other	5 (0.35)	1 (20.00)	4 (80.00)	
Contaminated needles	17 (1.20)	8 (47.06)	9 (52.94)	
Don't know/prefer not to answer	115 (8.13)	67 (58.26)	48 (41.74)	
Hepatitis C				
Yes	451 (31.87)	204 (45.23)	247 (54.77)	<.001
No	958 (67.70)	540 (56.37)	418 (43.63)	
Don't know/prefer not to answer	6 (0.42)	2 (33.33)	4 (66.67)	
Hepatitis B				
Yes	119 (8.41)	57 (47.90)	62 (52.10)	.18
No	1279 (90.39)	683 (53.40)	596 (46.60)	
Don't know/prefer not to answer	17 (1.20)	6 (35.29)	11 (64.71)	
Prevalence of mental health conditions				
Yes	573 (40.52)	225 (39.27)	348 (60.73)	<.0001
No	833 (58.91)	517 (62.06)	316 (37.94)	
Don't know/prefer not to answer	8 (0.57)	3 (37.50)	5 (62.50)	
Duration of HIV diagnosis				
<6 years	342 (24.17)	176 (51.46)	166 (48.54)	.23
6-14 years	549 (38.80)	308 (56.10)	241 (43.90)	
>14 years	476 (33.64)	238 (50.00)	238 (50.00)	
Don't know/prefer not to answer	48 (3.39)	24 (50.00)	24 (50.00)	

[a]N = 1415.

community-connected gender identity, WLWH have the power to bring *meaning* to the process. However, our SEM analyses also found that the effect of gender identity on resilience was mediated by SES reflecting the need for an intersectional approach to examine the ways in which gender and economic security interact to shape experiences that foster or inhibit resilience processes.[35]

In our study, racialized (ethnically diverse) participants with a higher SES had lower resilience in comparison to Caucasian/white participants with a higher SES. This result compels further exploration of the role racism has in shaping resilience. Macrosystemic contextual factors (including race and ethnicity) may be more important than individual personalities in resilience processes.[9] And, although they reported more substance abuse, ethnically diverse Canadian WLWH had higher resilience than Caucasian/white participants. Ethnically diverse participants with drug use challenges (eg, higher use of cigarettes, cannabis, and alcohol) also had higher resilience in comparison to Caucasian/white participants with a lower drug use. This result could reflect their long-standing oppression in society in general, making them more resilient by necessity. It could also reflect the recent focus on programming for this community, whereby engagement and connections are increased. This result implies the

Table 2. Univariate and Multivariable Logistic Regression Analyses for High versus Low Resiliency (≥ versus < 64).[a]

Variables	Odds Ratio (OR)	P Value	Adjusted OR	P Value
Sociodemographic characteristics				
Province				
Quebec	Reference	<.0001	Reference	<.0001
British Columbia	0.38 (0.28, 0.52)		0.57 (0.41, 0.80)	
Ontario	0.49 (0.38, 0.64)		0.47 (0.35, 0.62)	
Age, years				
16-29	Reference	.88		
30-39	0.95 (0.65, 1.40)			
40-49	0.88 (0.60, 1.29)			
≥50	0.96 (0.65, 1.42)			
Racial/ethnic background				
Indigenous	Reference	.02		
African/Caribbean/Black	1.48 (1.1, 1.99)			
Caucasian/white	1.09 (0.83, 1.43)			
Other	0.88 (0.56, 1.38)			
Gender identity				
Cis women	Reference	.04	Reference	.02
Trans women	1.53 (0.87, 2.69)		1.94 (1.04, 3.64)	
Other	0.11 (0.01, 0.91)		0.15 (0.02, 1.21)	
Education				
Lower than high school	Reference	<.001		
High school or higher	1.76 (1.32, 2.36)			
Don't know/prefer not to answer	1.93 (0.42, 8.83)			
Personal gross yearly income				
<$20 000 CAD	Reference	<.01		
$20 000-$40 000 CAD	1.19 (0.90, 1.58)			
≥$40 000 CAD	2.04 (1.41, 2.95)			
Don't know/prefer not to answer	0.83 (0.42, 1.63)			
Housing status				
Stable	Reference	.02		
Unstable	0.67 (0.47, 0.94)			
Marital status				
Married/common-law/in a relationship, not living together	Reference	.14		
Single	0.73 (0.58, 0.93)			
Separated/divorced/widowed	0.88 (0.65, 1.20)			
Other	1.13 (0.19, 6.81)			
Prefer not to answer	<0.001 (<0.001, .)			
Food security				
Food insecure	Reference	<.0001	Reference	<.0001
Food secure	0.54 (0.44, 0.68)		0.59 (0.46, 0.74)	
Drug use				
Hazardous alcohol use				
Non-binge drinkers	Reference	<.001	Reference	.02
Binge drinkers	0.61 (0.46, 0.83)		0.65 (0.47, 0.90)	
Heavy drinkers	0.30 (0.13, 0.67)		0.47 (0.19, 1.15)	
Don't know/prefer not to answer	1.06 (0.65, 1.73)		1.19 (0.69, 2.02)	
Cigarette use				
Yes	Reference	<.0001		
Former	1.94 (1.37, 2.74)			
Never	1.86 (1.49, 2.33)			
Don't know/prefer not to answer	0.96 (0.21, 4.31)			
Cannabis use				
Yes	Reference	<.0001		
Former	1.20 (0.87, 1.65)			
Never	1.93 (1.49, 2.48)			
Don't know/prefer not to answer	1.08 (0.44, 2.67)			
Current RDU				
Previous RDU	Reference	<.0001		

Table 2. (continued)

Variables	Odds Ratio (OR)	P Value	Adjusted OR	P Value
Currently RDU	0.48 (0.35, 0.67)			
Never RDU	1.43 (1.12, 1.83)			
Don't know/prefer not to answer	1.34 (0.58, 3.08)			
Current IDU				
Previous IDU	Reference	<.0001	Reference	<.0001
Currently IDU	0.27 (0.16, 0.44)		0.28 (0.17, 0.47)	
Never IDU	1.47 (1.14, 1.89)		1.15 (0.86, 1.54)	
Don't know/prefer not to answer	1.15 (0.49, 2.68)		0.82 (0.32, 2.06)	
Clinical characteristics				
HIV risk factors				
Consensual sex	Reference	<.001		
Non-consensual sex	0.79 (0.58, 1.07)			
Sharing needles	0.52 (0.39, 0.69)			
Blood transfusion/other medical procedure	1.10 (0.67, 1.81)			
Perinatal exposure	1.38 (0.76, 2.51)			
Other	0.19 (0.02, 1.75)			
Contaminated needles	0.69 (0.26, 1.81)			
Don't know/prefer not to answer	1.08 (0.73, 1.62)			
Duration of HIV diagnosis				
<6 years	Reference	.23		
6-14 years	1.21 (0.92, 1.58)			
>14 years	0.94 (0.71, 1.25)			
Don't know/prefer not to answer	0.94 (0.52, 1.73)			
Hepatitis C				
Yes	Reference	<.001		
No	1.56 (1.25, 2.0)			
Don't know/prefer not to answer	0.61 (0.11, 3.34)			
Hepatitis B				
Yes	Reference	.19		
No	1.25 (0.86, 1.82)			
Don't know/prefer not to answer	0.59 (0.21, 1.71)			
Prevalence of mental health conditions				
Yes	Reference	<.0001	Reference	<.0001
No	2.53 (2.03, 3.15)		2.38 (1.88, 3.02)	
Don't know/prefer not to answer	0.93 (0.22, 3.93)		0.80 (0.18, 3.57)	

Abbreviations: RDU, recreational drug use; IDU, injection drug use.
[a]n = 1407 for multivariable analysis.

need to explore intersectional identities and how they are associated with resilience.[60] The WLWH actively engage in identity management, and their success in this enterprise is likely reflected in their resilience. Ungar concurred asserting that resilience processes are influenced by the meanings people bring to their situation.

Province of residence was the only observed variable that had a statistically significant direct and indirect effect through drug use as well as a total effect on resilience. In the regression analysis, the association between the province of BC and resilience flipped from the univariate (highest resilience) to multivariable (lowest resilience). This result can be interpreted by drawing on the confounding role of other variables and Ungar's[9] social–ecological approach. Regarding the former, BC, especially the city of Vancouver, may be attractive because of the weather, scenery, and other factors. But expensive housing, cost of living, and higher reported prevalence of

"ever RDU" among WLWH in BC may have confounded the issue, leading to lower resilience.[38]

Women living with HIV in the province of Quebec had the highest levels of resilience. A social–ecological approach suggests that future research should examine the impact of multiple sociocultural and contextual factors, including provincial and territorial laws and policies. This contextual variance may influence the resilience of Quebec WLWH, where most women in the study were enrolled from clinics. Perhaps the higher income (more were employed and fewer received social assistance) and education among women from Quebec,[46] and the differing ethnic distribution in the province, could explain this result. Also, the role played by the Quebec's HIV stigma programming and policy could explain the difference, something worthy of exploration since it may be useful for other jurisdictions. Ungar's[9] social–ecological concepts of opportunities and meaning may shed light on this result. Meaning determines the decisions
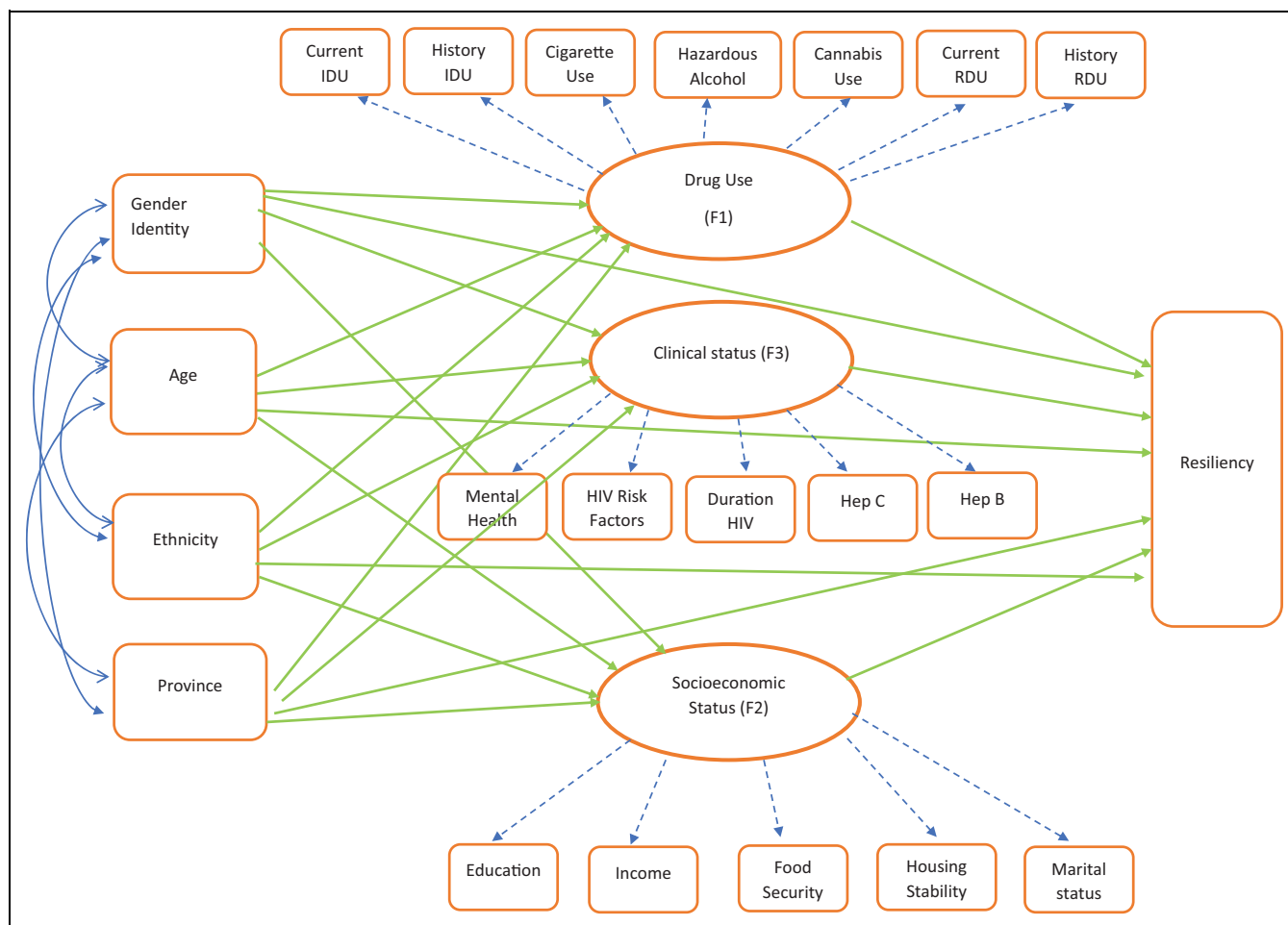
Figure 1. Hypothesized relationships between gender identity, age, ethnicity, and province and resilience mediated by drug use, socioeconomic status, and clinical status.

people make with regard to which opportunities they value and access and which resources are put at their disposal, including policy-informed programming. Access to and valuing stigma programming may increase resilience processes for WLWH living in Quebec. As noted, most Quebec WLWH were enrolled from a clinic, meaning they already had more opportunities available and accessible before entering the study.

We found food insecurity to be an indicator for SES similar to Weiser et al.[61] They reported a bidirectional link between food insecurity and HIV in that worsened HIV health outcomes were triggered by an inability to procure food in socially and acceptable ways. Logie et al[62] underscored the urgent need for health professionals to assess for food insecurity when working with Canadian WLWH. In our study, we also found that SES (education, income, food security, housing stability) and drug use (cigarette use, cannabis use, hazardous alcohol consumption) were statistically significant *latent* variables associated with resilience (ie, inferred from observed variables). The SES mediated the impact of gender identity and ethnicity on resilience, confirming previous findings.[19,34] Regarding gender identity, Dale et al[19] found that silencing the self and one's needs (a prescribed gender role) tended to predict resilience

in WLWH more so than SES factors. To illustrate SES' latent impact when assessing any links between HIV disease progression and people's social situation, Delpierre et al[34] found that disease progression was higher for unemployed PLWH. Our results reinforce the need to consider the process of resilience as the interaction between people and their environments, shifting the focus from individual traits to multilevel, nested, and interconnected ecological factors.[9]

We further found that SES and psychosocial resources were associated with higher resilience among Canadian WLWH.[34,35] Ungar's[9] social–ecological approach let us frame factors such as higher education, higher income, stable housing, employment (SES), and better psychosocial status as opportunities that can be valued differently and accessed in varying degrees. As such, "processes associated with resilience ... are always dependent upon the factors that trigger and sustain them."[9(p21)] Ungar[9] cautioned that the capacity of a person's ecological environment to impact resilience is constrained by the available opportunities, which dramatically influence a person's life trajectory.

In summary, we found that multilevel, nested social–ecological factors influenced resilience directly or through mediating factors (see other studies).[9,57,58] Previous studies have also
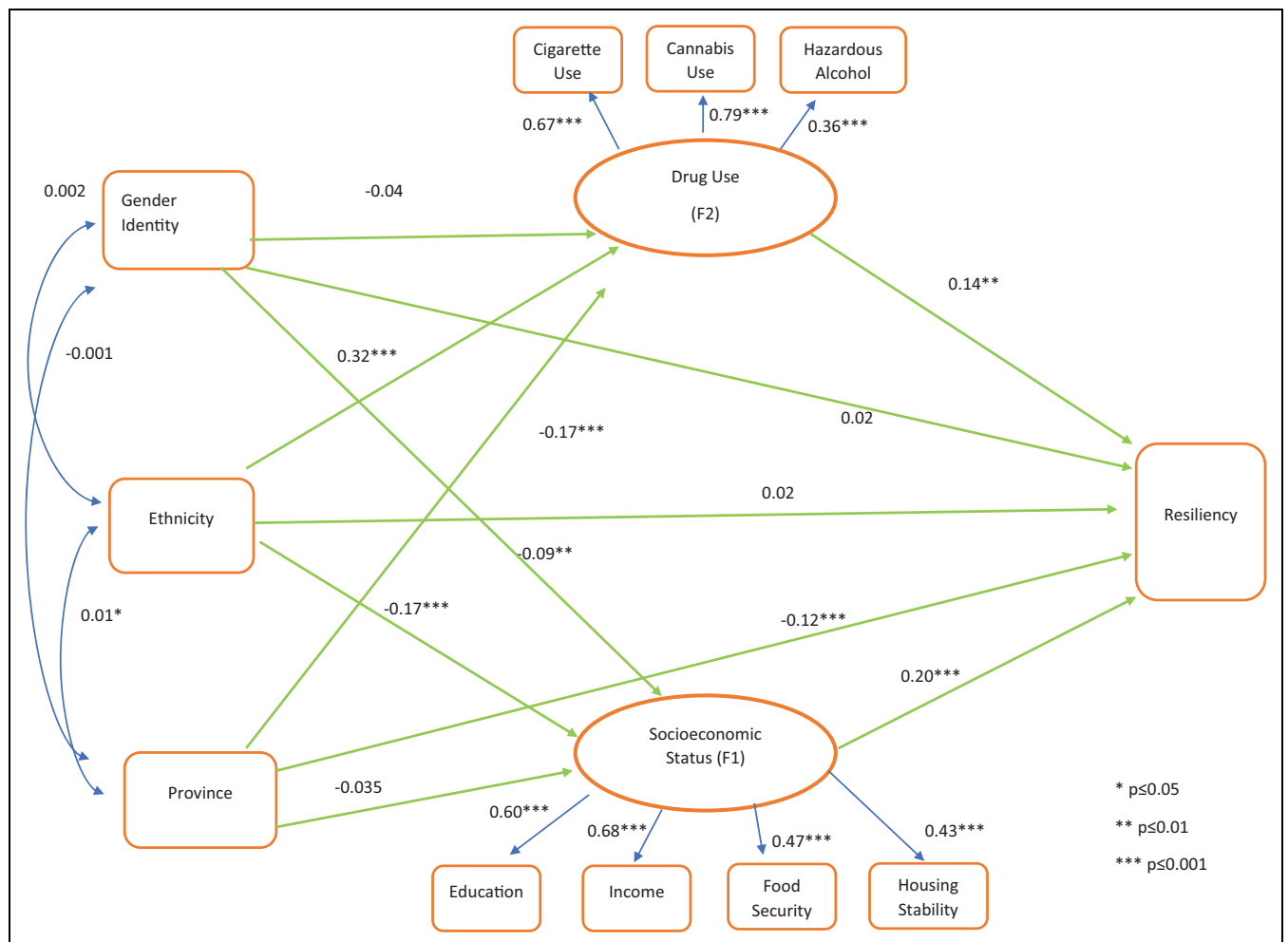
Figure 2. Final structural equation model depicting the relationships between gender identity, ethnicity, and province and resilience mediated by drug use and socioeconomic factors.

Table 3. Final Structural Equation Model for Resilience as Mediated by Latent Constructs Drug Use and Socioeconomic Status.[a]

Variable	Predictor	Standardized Estimate (SE)	P Value
Education	Socioeconomic status (F1)	0.60 (0.03)	**<.0001**
Income	Socioeconomic status (F1)	0.68 (0.03)	**<.0001**
Food security	Socioeconomic status (F1)	0.47 (0.03)	**<.0001**
Housing stability	Socioeconomic status (F1)	0.43 (0.03)	**<0.0001**
Cigarette use	Drug Use (F2)	0.67 (0.03)	**<.0001**
Cannabis use	Drug Use (F2)	0.79 (0.03)	**<.0001**
Hazardous alcohol consumption	Drug Use (F2)	0.36 (0.03)	**<.0001**
Gender identity	Socioeconomic status (F1)	−0.10 (0.03)	**<.01**
Ethnicity	Socioeconomic status (F1)	−0.17 (0.03)	**<.001**
Province of residence	Socioeconomic status (F1)	−0.03 (0.03)	.30
Gender identity	Drug use (F2)	−0.04 (0.03)	.20
Ethnicity	Drug use (F2)	0.32 (0.03)	**<.0001**
Province of residence	Drug use (F2)	−0.17 (0.03)	**<.0001**
Gender identity	Resilience	0.02 (0.03)	.38
Ethnicity	Resilience	0.017 (0.03)	.58
Province	Resilience	−0.12 (0.03)	**<.0001**
Socioeconomic status (F1)	Resilience	0.20 (0.04)	**<.01**
Drug use (F2)	Resilience	0.13 (0.04)	**<.001**

[a]n = 1255.

Table 4. Standardized Direct, Total Indirect, Indirect, and Total Effect Path Estimates for the Final Structural Equation Model on Resilience.[a]

	Direct Path Estimate (SE)	Total Indirect Path Estimate (SE)	Indirect Path (via Drug Use) Estimate (SE)	Indirect Path (via Socioeconomic Status) Estimate (SE)	Total Effect Path Estimate (SE)
Ethnicity -> Resilience	0.0174 (0.0315)	0.0090 (0.0180)	0.0444 (0.0125)[b]	−0.0343 (0.0093)[b]	0.0265 (0.0279)
Gender identity -> Resilience	0.0245 (0.0276)	−0.0250 (0.0097)[c]	−0.0056 (0.00484)	−0.018 (0.0076)[c]	−0.0005 (0.0279)
Province -> Resilience	−0.1176 (0.0279)[b]	−0.0301 (0.0109)[d]	−0.0238 (0.00764)[b]	−0.007 (0.00694)	−0.1477 (0.0276)[a]

[a]n = 1255.
[b]*P* ≤ .0001.
[c]*P* ≤ .01.
[d]*P* ≤ .001.

reported that factors influencing resilience among WLWH are intersectional and interactive.[25,27,35] For example, lower educational levels, lower income, unstable housing, unemployment, stigma impacting racialized people, and stigma attached to substance abuse and mental illness have been found to, alone and in combination, present serious challenges to resilience among WLWH.[25,27,35] This intersection reinforces the premise that researchers should consider resilience as a set of processes occurring at nested ecological levels.[9]

Inspired by the social–ecological perspective, our results support an analysis of the factors that are likely to influence the effectiveness of interventions designed to curtail challenges to resilience and improve WLWH's QoL. Informed by our results, policy makers and care providers can assertively address enabling factors that lead to high resilience in this population. This includes promoting good mental health, assisting with substance use with supportive harm-reduction strategies and addressing food insecurity. Identifying multiple levels (and variables) that impact resilience strengthens the provision of health care and related services for WLWH. On a related front, it paves the way for the development of WLWH health-care programs grounded in a women-centered HIV care approach that promotes positive resilience in WLWH.[24,46]

This study has some limitations. The cross-sectional design does not allow examining causation, an issue that could be addressed with a longitudinal study. The self-reported measures may have been influenced by social desirability biases. The purposive, nonrandom sample may have been biased to include women already accessing HIV care, therefore experiencing higher levels of resilience and physical functioning, for example. Conversely, women experiencing multiple forms of marginalization, including younger women, were over-sampled—a research design decision that may have led to the inclusion of WLWH with low access to resources to bolster resilience. In addition to measurement tool content, several concerns and cautions have been raised regarding the use of instruments in the assessment and research of resilience. Recognizing this, Windle et al[50] urged researchers to report as much information as possible so as to inform others' assessment of the usefulness of their chosen instrument. In this study, we dichotomized resilience scores by the median; however,

other cutoff points maybe more clinically relevant. For instance, others have suggested categorizing data ranges into low, medium, and high.[50] Various researchers emphasize that, as a process, resilience is not a stable or static construct.[63,64] Future studies should look into a measure for resilience that works with the social–ecological approach, which would include community and contextual aspects of resilience as well as meaning and opportunities. Longitudinal studies could address this concern and help further explore correlates and causations of resilience.

Conclusions

This study tapped into an emerging consensus that nuanced analyses of multiple factors that predict resilience are needed in order to address the existing inequities faced by WLWH. Our results demonstrate that using the social–ecological framework allows for assessment of these complexities. The study examined multilevel factors associated with the resilience processes among Canadian WLWH and found that a full range of social–ecological factors is important to consider when examining how the process of resilience can be understood and fostered. Factors included gender identity, ethnicity, and province of residence as well as drug use and SES variables.

We conclude that drug use and SES factors need to be targeted through programming to foster Canadian WLWH's resilience. Quebec's programming needs to be further explored to explain the high resilience self-reported in this province. Our results also reinforce the need to consider resilience as the interaction between people and their environments. Shifting the focus from individual traits to processes can inform the development of multilevel interventions to support resilience among Canadian WLWH.

The complexity of intersectional identities and resilience processes for WLWH also needs to be further unpacked and explored. To better understand the causal, and perhaps reciprocal, nature of these relationships, future studies should examine the longitudinal associations between changes in resilience as they pertain both to micro-psychosocial (eg, drug use) and macro social–ecological factors. Additionally, studies can focus on the impact of resilience on HIV and overall health

outcomes and concentrate on the development of upstream multilevel interventions to foster resilience processes among Canadian WLWH.

Authors' Note

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ORCID iD

Roula Kteily-Hawa ⓘ https://orcid.org/0000-0001-5581-0017

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