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Reliability, Validity, and Exploratory Factor Analyses of Gentrification Health Research Measures

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Reliability, Validity, and Exploratory Factor Analyses of Gentrification Health Research Measures

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Abstract

Background

Gentrification is a type of neighborhood change (NC) that causes demographic shifts and improvement in the built environment. Adverse health outcomes associated with NC have not been consistently established in the literature. Yet, major methodological barriers define this field of study including lack of tailored and culturally relevant measures. This aim of this study was to assess the psychometric properties of novel and adapted NC measures that sought to improve appropriateness for all literacy levels, to enhance survey efficiency, and to assess features of the built environment.

Methods

We conducted a cross-sectional study in a highly gentrifying neighborhood in Washington, DC using 17 scales and indexes on neighborhood attachment, effects on family/friends, perceived impact on certain population, and assessment of intensity of NC. We assessed reliability and validity to include tests of internal consistency, split-half reliability testing, and correlation analyses. We sought dimension reduction through factor analysis to understand areas of NC.

Results

The analytic sample included 146 respondents. The multiitem scales – Neighborhood Attachment (NA), Ability to Influence Neighborhood Change (AINC), and Heightened Perceptions of Neighborhood Change (HPNC) – performed well based on reliability and validity analyses. The factors analysis resulted in three components on NC: positive perceptions of NC, social dimension of NC, and NC change intensity and decline.

Discussion

Given the promising psychometric quality of measures, this study opens new pathways for conducting gentrification health research by providing new tools and methods for tailoring.

Keywords

Gentrification, neighborhood change, community health, mental health, public health liberation

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The authors do not have any conflict of interest

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ARTICLE

Reliability, Validity, and Exploratory Factor Analyses of Gentrification Health Research Measures

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Background: Gentrification is a type of neighborhood change (NC) that causes demographic shifts and improvement in the built environment. Adverse health outcomes associated with NC have not been consistently established in the literature. Yet, major methodological barriers define this field of study including lack of tailored and culturally relevant measures. This aim of this study was to assess the psychometric properties of novel and adapted NC measures that sought to improve appropriateness for all literacy levels, to enhance survey efficiency, and to assess features of the built environment.

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Discussion: Given the promising psychometric quality of measures, this study opens new pathways for conducting gentrification health research by providing new tools and methods for tailoring.

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Gentrification health research (GHR) is characterized as a relatively new field of study. Gentrification is defined as a form of change in the built environment of a neighborhood that causes shifts in the demographic makeup of the neighborhood toward a more affluent and educated population.^{1–3} Of the 177 studies appearing in PubMed based on a keyword search of “gentrification,” 71% have been published since 2017. Eighty-eight studies on gentrification and health appear within the last five years. As an evolving science, several key features have been noted in the GHR literature. Systematic reviews have found no consensus on the health implications of gentrification and identified

major methodological barriers that include the lack of definitional clarity, differing assessed outcomes and exposures of interest, not accounting for contextual factors, and differences in analytical techniques to assess the true effect.⁴

Further, gentrification is often treated as a singular phenomenon that does not fully account for the mediational factors such as intensity of neighborhood change (NC), basal social cohesion, support, and place attachment.^{5,6} It is not just context-dependent, which may help to explain the lack of clear impact on the health of communities. Gentrification may be best understood as a class of NC variants that vary in temporality, health and

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psychosocial impact, and severity. The basis for this argument is informed by seven cities that accounted for half of the gentrification in the United States from 2000-2013.⁷ Even then, gentrification is typically confined to a handful of neighborhoods within those cities.^{1,3}

A causal model on the health impact of gentrification posits that changes in the physical and social environments mediate healthcare utilization, health behaviors, and biological responses.⁴ Yet, little is known about GHR and citizen research approaches that communities can pursue to determine the association between health threats and neighborhood change based on principles of self-determination and empowerment.^{8,9} Public Health Liberation is a new public health Transdiscipline that seeks to develop scientific methods within real-world budget and resource constraints.¹⁰ The purpose of this research is to provide a framework for evaluating the quality of GHR measures to fill this need.

1. Methods

This study seeks to advance GHR through reliability and validity testing of adapted and novel measures of neighborhood change. Since US-based gentrification is associated with certain neighborhoods within a limited number of cities, we situated our research within a highly gentrifying neighborhood in Washington, DC — the top US city for intense gentrification, described as a ratio of gentrified over eligible or gentrifiable neighborhoods.^{11,12} We sought to better understand the dimensions of neighborhood change by applying liberation principles that require working within real-world constraints — no funding, student-led, and community-based.¹³ The principal investigator's (CW) residence in the targeted neighborhood supported tailored research and NC insight, along with a community advisory board drawn from the study population.

We conducted an unfunded GHR population-based study from September 2019–February 2020 in the Southwest neighborhood of Washington, DC. Two sampling methods were deployed — Phase I using clustered random address sampling and Phase II using convenience sampling.¹⁴ Due to the Covid-19 pandemic, all recruitment took place via mail or electronic solicitation, with several solicitation flyers posted in public areas. G*Power was used to compute a required sample size ($n = 140$) based on self-reported health as previously published in the GHR literature.¹⁵ The University of Maryland Institutional Review Board (IRB) approved this study in August 2020 (#1559568-1).

We used twelve measures to assess perceptions of neighborhood change using a variety of conceptualizations, scales, and indexes (Table 1). We sought to understand the perceived impact of neighborhood change on respondents personally and their family and friends in Southwest. Two novel Likert scales on the extent of neighborhood change (NC) and whether NC is negative or positive (NCOI). We sought to understand the factors associated with NC whether in the demographics (FANC-1), built environment (FANC-2), and services (FANC-3). Since gentrification is associated with exacerbation of the social and health conditions of vulnerable populations, we asked respondents to select the groups that are negatively impacted by NC based on seven categories: education, income, gender, race/ethnicity, disability, property type, and family type. Each category contained an inclusive list. For example, “education” provided options for all groups: “People who have a high school diploma or less,” “People who have some college education or less,” “People who have a bachelor's degree or more.” We dichotomized groups for vulnerable populations (GNI-1, public housing, people with a high school diploma or less, some college, low income, Black/African American, large families) and all others (GNI-2). We adapted a neighborhood attachment (NA) or connectedness from the Healthy Neighborhoods Study (HNS), a longitudinal study on the effects of neighborhoods on health for nine communities in the metropolitan Boston area.¹⁶ We modified the HNS Ownership of Change scale, which we renamed Ability to Influence Neighborhood Change (AINC), to improve readability, reduce question complexity by using an agreement scale rather than a matrix, and included additional structural barriers.¹⁵ We assessed how often respondents thought about neighborhood change (TNC).

1.1. Reliability and validity analyses

We employed four single- or multi-item scales in our study. We assessed the internal consistency of multi-item scales — Neighborhood Attachment (NA), Ability to Influence Neighborhood Change (AINC), Better/Worse Neighborhood Change (NCII), and Heightened Perceptions of Neighborhood Change (HPNC) using the Cronbach's alpha metric. A Cronbach's alpha of 0.7 was considered adequate for the scale overall and each item if deleted.¹⁷ Split-half reliability testing using Spearman-Brown coefficient was also conducted.¹⁸ Splitting alternated between even and odd questions. We employed criterion validity to assess each

Table 1. Measures of neighborhood change (NC) and NC perceptions and reliability and validity analysis.

Scale 1: Personal Impact (single-item)	Description:	“How do you think neighborhood change will impact you personally?” (Mostly negative, somewhat negative, neutral, somewhat positive, mostly positive)	
	Validity*:	Family/Friends Impact	FANC-2
		NC	TNC
		NCOI	NCII
		GNI-1	HPNC
Scale 2: Family/Friends Impact (single-item)	Description:	“How do you think neighborhood change will impact family and/or friends who live in Southwest?” (Mostly negative, somewhat negative, neutral, somewhat positive, mostly positive)	
	Validity*:	Personal Impact	NE-1
		NC	TNC
		NCOI	NCII
		GNI-1	HPNC
Scale 3: Neighborhood Change (NC) (single-item)	Description:	“Do you feel that Southwest is experiencing neighborhood change?” (No change, some change, much change, a lot of change)	
	Validity*:	Personal impact Family/Friends impact	TNC
		NC	NCII
		GNI-2	HPNC
		GNI-2	
Scale 4: Neighborhood Change Overall Impact (NCOI) (single-item)	Description:	“What is your perception of neighborhood change?” (Mostly negative, somewhat negative, neutral, somewhat positive, mostly positive)	
	Validity*:	Personal impact	FANC-2
		Family/friends impact	TNC
		NC	NCII
		GNI-1	HPNC
Index 1: Factors Associated with Neighborhood Change (FANC)	Description:	Factors associated with neighborhood change (e.g. new buildings, more minority residents, change in neighborhood culture, etc.) (19 items, checkbox) FANC 1 (Demographics); FANC 2 (Built Environment); FANC 3 (Services)	
	Validity*: (FANC 1)	NA	HPNC
		FANC-2	
	Validity*: (FANC 2)	Personal impact	NE-1
		NCOI	NE-2
		GNI-2	FANC-1
		NA	HPNC
	Validity*: (FANC 3)	NE-2	

Index 2: Groups Negatively Impacted by Neighborhood Change (GNI)	Description:	<p>“I feel that neighborhood change is currently negatively affect the following groups (check all that apply).”</p> <p>Vulnerable Groups (GNI-1) - public housing, people with a high school diploma or less, some college, low income, Black/African American, large families; All Others (GNI-2)</p>	
	Validity*: (GNI-1)	Personal impact	GNI-2
		Family/friends impact	TNC
		NCOI	HPNC
Scale 5: Neighborhood Attachment (NA (Multi-item)	Validity*: (GNI-2)	Personal impact	FANC-2
		Family/friends impact	TNC
		NC	NCII
		NCOI	HPNC
Index 3: Neighborhood Enjoyment (NE)	Description:	<p>Adapted scale includes, “I really enjoy living in my neighborhood,” “My neighborhood is a nice place to raise kids,” “My neighborhood allows me to get easily to places by car, metro, or bus,” etc. (Strongly disagree, disagree, neutral, agree, strongly agree)</p>	
	Reliability:	.810	
	Split-half Reliability:	.713	
	Validity*:	NE-1	FANC-1
Scale 6: Thinking about Neighborhood Change (TNC) (single-item)		NE-2	FANC-2
			AINC
	Description:	<p>A list of 27 places that respondents had “enjoyed” prior to the COVID-19 pandemic (e.g., farmer's market, specific parks, etc.)</p> <p>NE-1 – Social spaces (private), NE-2 – Public spaces</p>	
	Validity*: NE-1	Family/Friends Impact	NE-2
Scale 7: Ability to Influence Neighborhood Change (AINC) (multi-item)		NA	FANC-1
	Validity*: NE-2	NA	FANC-2
		NE-11	FANC-3
		FANC-1	AINC
Index 4: Neighborhood Change (NC)	Description:	<p>“How often do you think about neighborhood change?” (Almost never, rarely, sometimes, often, and always)</p>	
	Validity*:	Personal impact	GNI-1
		Family/friends impact	GNI-2
		NC	NCII
Scale 8: Neighborhood Change (NC)		NCOI	HPNC
	Description:	<p>“I feel that residents can influence any neighborhood change,” “I feel that I can personally influence neighborhood change,” “I feel that residents can influence the level of construction and renovation activity in the neighborhood,” etc. (Strongly disagree, disagree, neutral, agree, strongly agree)</p>	
	Reliability:	.728	
	Split-half Reliability:	.771	
Index 5: Neighborhood Change (NC)	Validity*:	NA	NCII
		NE-2	HPNC

Index 3: Better or Worse (NCII)	Description:	“Please indicate what effect neighborhood change is currently having in the following areas.” (e.g., community feel, housing costs, crime, noise level, etc.) (is better, no change, is worse)	
	Reliability:	.608	
	Split-half Reliability:	.446	
	Validity*:	Personal impact	GNI-2
Scale 8: Heightened Perceptions of Neighborhood Change (HPNC) (multi-item)	Description:	Family/friends impact	FANC-1
		NC	TNC
		NCOI	HPNC
		16-item scale. Example questions include: “I think neighborhood change is very positive for everyone in Southwest,” “Neighborhood change has led to minorities being displaced,” “I am excited that my property value is increasing,” etc. (Strongly disagree, disagree, neutral, agree, strongly agree)	
	Reliability:	.868	
	Split-half Reliability:	.862	
	Validity*:	Personal impact	GNI-2
		Family/friends impact	FANC-1
		NC	FANC-2
		NCOI	TNC
		GNI-1	NCII

Note: Due to space limitations, significant pairwise comparisons are displayed rather than the results from all 120 analyses.

* $p < 0.05$.

measure and used Spearman's rho correlation. A p -value lower than 0.05 was regarded as statistically significant.

1.2. Factor analysis

We conducted exploratory factor analyses (EFAs) using principal component analysis with promax rotation ($Kappa = 4$). We hypothesized that the measures on neighborhood change are correlated. Eigenvalues >1 and factor loadings of $> .6$ were used. Since the matrix containing all variables was not positive definite and justifying the rotation, we entered each set of variables sequentially starting with the highest loadings for factor. A non-positive definite matrix indicates that at least one variable is a linear combination of other variables.¹⁹ We compared communalities, total variance explained, and correlations between factor analyses to determine the final principal components. The final model retained factors that explained an adequate total variance, contained distinct factors based on low or moderate factor and item correlations, an acceptable Kaiser-Meyer-Olkin Measure (KMO) of Sampling Adequacy ($>.4$), and Bartlett's Test of Sphericity ($p < 0.05$). Factor loadings of $> .6$ were used. SPSS software version 28.0 was used for all statistical analyses.

2. Results

The total sample size was 146 respondents from Phase I and II after data cleaning. No imputation was conducted since missingness was low ($<3\%$). The overall impact of NC was "somewhat positive" for personal (mean = 3.7) and neutral for impact on family/friends in Southwest (mean = 3.3). The mean overall enjoyment was 9.5 public and private spaces. The mean for overall positive/negative impact of neighborhood was neutral (3.3). The average respondent thought about NC was "sometimes". Based on a range of 16 (positive)-80 (negative), Heightened Perceptions of Neighborhood Change (HPNC) was biased toward positive change (mean = 35.8).

2.1. Reliability and validity analyses

The Cronbach's alpha was acceptable for Neighborhood Attachment (NA) ($\alpha = 0.81$) (Table 1). The Cronbach's alphas if item deleted ranged from 0.78 to 0.82. Cronbach's for each part was .661 and .768. The Spearman-Brown coefficient was .713 for split-half reliability analysis.

The Ability to Influence NC (AINC) had an acceptable Cronbach's alpha ($\alpha = 0.728$) (Table 1). If

removed, four variables' Cronbach's alpha were below the overall internal consistency, while one (item 5 - "Community leaders ... representing my interests related to neighborhood change") was slightly above the overall ($\alpha = 0.739$). For split-half reliability analysis, we ran an analysis with and without this variable. Retaining the original scale, the Spearman-Brown coefficient (unequal length) was .542. The Spearman-Brown coefficient was .771 for the second analysis. Item 5 was dropped from all subsequent analyses.

NCII had less than adequate reliability ($\alpha = 0.608$). The alphas for each item if removed were similar, except cost of groceries ($\alpha = 0.631$) and crime ($\alpha = 0.624$), which would improve the reliability. The split-half analysis was conducted with and without these variables. The Spearman-Brown coefficient (unequal length) was somewhat adequate (.446) with these variables and highly adequate ($\alpha = 0.740$) without these variables. HPNC had high reliability .868 for its 12 items. Based on Cronbach's alpha if item deleted, the range hardly varied (.842 - .878). The Spearman-Brown coefficient (equal length) was .862.

Of the 120 pairwise comparisons conducted for validity analysis, 53 or 44% were significant (not shown). The following scales were correlated to each other: personal impact, impact on friends and family, NC, NCOI, GNI-1, TNC, and HPNC. Due to space limitations, we provide the p -value range: 0.046 - <0.001 . Forty-one comparisons had a significance less than 0.01. NA is not associated with the impact scales, NC, NCOI, TNC, NCII, or HPNC, but is associated with all enjoyment indexes ($p < 0.001$). Enjoyment indexes are highly correlated ($p < 0.001$). HPNC is associated with all measures ($p < 0.05$) except for NA, enjoyment indexes, and AINC. Indexes associated with demographic changes and public services are not correlated with other measures except for enjoyment of public spaces ($p = 0.01$). The built environment and demographic factors associated with NC are highly correlated ($p < 0.001$), but not correlated with services. AINC is only correlated with NA ($p = 0.007$) and enjoyment of public spaces ($p = 0.046$).

2.2. Factor analysis

We conducted a factor analysis with all measures. Five factors resulted, which explained 82% of total variance (not shown). The item correlation matrix was not positive definite so we proceeded in a stepwise fashion by first entering the following variables which had the highest factor loadings for each factor: NCOI (-.972), NE-2 (.928), NCII (.819),

FANC-1 (.819), and NC (.831). Two principal components resulted. The KMO was highly acceptable (.608). Bartlett's Test of Sphericity was significant ($p < 0.001$). The communalities were $\geq .498$. The cumulative percentage of total variance was 57% – PCA 1 (34%) and PCA 2 (24%). NCOI (-.702), NCII (.774), and NC (.710) loaded on PCA 1. PCA 2 included NE-2 (.817) and FANC-1 (.768). The component correlation was 0.135.

We added the variables with the second highest factor loadings to determine whether additional variables would improve the model: Personal Impact (-.948), GNI-1 (-.89), NA (.793), AINC (-.81), and TNC (-.73). Three factors resulted (Table 2). The KMO increased slightly (.683) and the test of sphericity remained significant ($p < 0.001$). All communalities were $> .4$, except AINC (.213). The cumulative percent of total variance explained was 57%: PCA 1 (28%), PCA 2 (17%), PCA 3 (12%). NC (.875), NCII (.666), and TNC (.69) loaded on PCA 1. GNI-1 (-.888), NCOI (.78), and Personal Impact (.712) loaded on PCA 2 (Table 2). The variables associated with PCA included NE-2 (.614), FANC-1 (.714), and NA (.755). AINC did not load on any factor. The correlations of the components were low to moderate: PCA 1 vs. PCA 2 (-.402), PCA 1 vs. PCA 3 (-0.12), and PCA 2 vs. PCA 3 (0.032).

3. Discussion

This is the first GHR study to be situated within a Public Health Liberation framework by relying on self-funding and innovative methods, consistent with the development of a field of research that works within limited resources.¹⁰ The sample size was adequate and missingness was low, suggesting that GHR within real-world constraints is a feasible study design. A major strength of this study was the use of novel NC measures that included wide-ranging aspects concerning the social and built

environment while varying the techniques to collect responses for a general population.

All scales performed well based on reliability analysis, except that NCII was less adequate. Removal of crime and housing from this scale improved its reliability and likely indicated that they are not associated with NC. Given that these scales are novel and achieved high reliability, this is a significant contribution to GHR. Basal neighborhood attachment (NA), ability to influence change (AINC), and perceptions about NC (HPNC) can support future research on the mediational influences between NC and health. Since the measures all concerned aspects of neighborhood change, the 44% of significant pairwise comparisons provided support for convergent validity, particularly for Personal and Family/Friends Impact, HPNC, GNI-2, NCII, NCOI, and TNC, which appeared most frequently. On the other hand, improved serviced associated with neighborhood change (FANC-3), enjoyment of public and social spaces (NE-1, NE-2), and neighborhood attachment (NA) appeared least frequently, a possible indication of divergent validity. Our novel neighborhood attachment scale captured established correlates such as perceived safety, emotional connectedness, amenities, and neighborliness.²⁰ The enjoyment index is unique to the Southwest neighborhood but may be modified as needed to further advance GHR in other communities.

Results from our EFAs reduced the complexity of identifying dimensions of neighborhood change (Table 2). Both factor analytic models were similar in KMO, total variance explained with retained factors, communalities, and test of sphericity results. There is no clear advantage to either model. Since our exploratory factor analysis is novel in the literature, we opted for the second model since it increased the number of PCA from two to three to open discussion and further research in the mediational analysis between NC and health.

Table 2. Findings from factor analysis.

	Total Explained Variance (%)	Factor loadings
PCA 1 - Neighborhood Change Intensity and Decline	28%	
Neighborhood Change (NC)		.875
Better or Worse (NCII)		.666
Thinking about Neighborhood Change (TNC)		.69
PCA 2 - Positive Perceptions of Neighborhood Change	17%	
Groups Negatively Impacted by NC - Vulnerable (GIN-1)		-.888
Neighborhood Change Overall Impact (NCOI)		.78
Personal Impact		.712
PCA 3 - Social Dimension of Neighborhood Change	12%	
Social spaces- public (NE-2)		.614
Demographic Factors Associated with Neighborhood Change (FANC-1)		.714
Neighborhood Attachment (NA)		.755

The final factor analytic model approached 60% in explaining total variance and met other standards for a satisfactory model fit. PCA 1 captures measures on the extent of NC and whether these changes further betterment or decline. It also included a single item measure on how often respondents thought about NC. Together, PCA 1 can be described as “Neighborhood Change Intensity and Decline.” The intensity is not only related to NC, but also the rumination or cognitive attention given to NC.

PCA 2 captured NC measures on overall impact (NCOI), personal impact on respondents, and negative impact on vulnerable groups, which was inversely correlated to the other two measures. As the scales for NCOI and Personal Impact increase, positive perceptions also increase. On the other hand, GNI-1 is a negatively framed variable. PCA-2 can be characterized as “Positive Perceptions of Neighborhood Change”. PCA 3 contained an index of enjoyment of public spaces, demographic changes associated with NC, and neighborhood attachment. This factor is capturing a “Social Dimension of Neighborhood Change” that includes both an interaction with the built environment, but also residents’ interaction with each other. This factors with associated with community engagement within social spaces, high neighborhood attachment, and perceptions of increasing subpopulations.

These findings supported the proposed conceptual model by Bhavsar and colleagues on the gentrification-related influences on health, although it does not seek to test the causal or mediational relationship.⁴ Future research should build upon our novel measures for types of citizen research in GHR.

3.1. Limitations

There are several limitations to this study. The study occurred at the height of response to the COVID-19 pandemic in the U.S. This likely affected the sample recruited for the study, and responses provided by those recruited. For instance, one item inquired about local places the respondent “had enjoyed prior to the COVID-19 pandemic,” which introduces a recall bias as compared to asked about the places a respondent might enjoy now. We did not evaluate where the respondents were representative of the study population, so these results may not be generalizable. Further, we used novel scales and indexes. Although we conducted reliability analyses, further study is needed. Discriminant validity analysis would be beneficial in

confirmatory factor analysis. Additional testing for reliability for indexes and other validity tests are needed before these tools should be widely adopted. Although a study strength for working within real-world constraints, the convenience sampling may have biased results in favor of those with strong negative or positive opinions about neighborhood change.

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Conflict of interest

The authors do not have any conflict of interest.

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