The association between social cohesion and community resilience in two urban slums of Port au Prince, Haiti

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ABSTRACT

Multiple recent global agendas have advanced the case for resilience to underpin humanitarian action and disaster risk reduction. These agendas have been incorporated into multiple efforts but evidence to guide action has lagged behind. This study examines a specific link, often cited through qualitative research, between social cohesion and community resilience in two urban slums of Port au Prince, Haiti. Scales to measure social cohesion and resilience are applied to these communities to develop a quantitative measure of these two characteristics. These two characteristics are then analyzed with various other demographic variables of community members to quantitatively explore associations among them. The results show that a higher social cohesion score is statistically associated with a higher resilience score and among the variables tested, social cohesion had the greatest impact on the community resilience as measured by these scales. and shows a statistical association between the two. The findings add to the growing but nascent literature on empirical evidence for resilience characteristics. Further examinations are drawn out of the findings and future investigations should tackle the inductively derived characteristics of resilience to further guide programs and policy.

1. Introduction and background

The recent World Humanitarian Summit emphasized the need to place humanitarian action within a broader development and resilience framework [1]. The recent Sendai Framework for Disaster Risk Reduction also renewed the focus on resilience mentioned in the previous Hyogo Framework [2,3].

Yet the thrust of most disaster risk reduction efforts are often limited to reducing exposure to natural hazards or minimizing their impact [4]. Resilience allows a broader means of addressing disaster risk by encompassing the wide variety of protective factors that allow individuals, communities and systems to mitigate the impacts of a shock and enable recovery [5]. Disaster risk reduction has been more narrowly defined and has had greater focus on developing measurement tools and research to study the effectiveness of measures to reduce risk. Far fewer measures of, and research on, resilience exists. Multiple definitions and concepts of resilience have been put forward as part of operational activities by humanitarian aid agencies [6]. The resilience of communities in particular has been a growing area of discussion [3]; yet as community resilience takes a more prominent role in aid activities, evidence to guide how resilience can be built is somewhat thin.

Promising efforts by the International Federation of Red Cross and Red Crescent Societies have begun to build evidence for six characteristics of resilience, highlighting that resilient communities: are knowledgeable and healthy; organized; connected; have infrastructure and services; have economic opportunities; and can manage their natural assets [7]. Recent work on building urban resilience by the Rockefeller Foundation through its 100 resilient cities program driven by the resilience framework from ARUP along with UN Habitat's Resilience Profiling Tool among others have pushed forward action on urban resilience [8,9]. These resilience frameworks rest on some empirical qualitative research among marginalized communities and advocate an inclusive approach [10,11]. Yet advancing resilience practice requires further research. These frameworks operate, as designed, at the level of local governments even though they apply to the whole city including the urban poor. The urban poor, though, can be excluded from top-down resilience building efforts or remain difficult to impact given their marginalization [12].

A significant factor in the vulnerability of residents in urban slums is

their inability to respond to disasters as a community. In the case of urban slums such as Solino and Tesso in Haiti, the government has largely ceded management of these areas, ultimately limiting its ability to engage in efficient and effective urban planning and disaster preparedness. Although improvements have been made in capacity and coordination for emergencies at the national and departmental levels, these efforts have not necessarily reached the poor and disadvantaged communities. This state retreat places even greater value on community driven processes and social cohesion may be important to building resilience to disasters. At the same time, when disconnected from government resources, these communities may find and develop their own modes of resilience. These urban slum communities often face a brunt of the disaster risks due to a complex combination of factors such as their location in hazardous geography, isolation from public services, the nature of the built environment and baseline disparities in health and wellbeing making resilience all the more critical for them [13]. Studying communities that may be marginalized by their own governments, such as Solino and Tesso, are necessary to advance our understanding of resilience to effectively impact the lives of the urban poor. Resilience studies note the importance of social capital as critical assets for communities [14,15]. Social cohesion has been highlighted as a positive factor that can play an important compensatory role in such communities but studies are limited, often to outcomes on crime or specific behavior change [16,17]. Despite marginalization, deficiencies in public services and even higher disaster risk, social cohesion may enable a wider array of resources that are drawn for greater cooperation, sharing and helping one another in times of stress for the urban poor. Social cohesion has been often cited as a protective factor that confers some resilience upon communities [18–20]. There are qualitative studies showing the value of social cohesion for urban resilience in violent settings [21,22], with one quantitative study showing the association of social cohesion with neighborhood resilience [23]. Specific to Haiti, after the 2010 Earthquake, social cohesion was cited as a strength in some displaced communities [24]. Rigorous examinations of the association between a social cohesion measure and resilience measure within urban slum communities are necessary.

The objective of this research is to determine the association between social cohesion and resilience in the two urban informal settlements of Solino and Tesso of Port au Prince, Haiti. The neighborhoods of Solino and Tesso are marginalized urban slum communities with almost no urban planning, marked by poor to absent conscious development and prone to natural hazards. On an annual basis, these communities face a variety of shocks from heavy rains and flooding (of both water and waste), to landslides, mudslides, and seismic activity. Further compounding these hazards, both communities are at an increased risk of disaster due to the high population density of the area, the sloping topography that creates flood plains, and the prevalence of dwellings classified as having high seismic risk.

To date, little has been done to interrogate the association between social cohesion and resilience to disasters in urban slum communities. The objective of the overall project is to identify ways in which social cohesion and resilience may be improved both independently and simultaneously to allow for more effective and targeted interventions to improve disaster risk reduction in urban communities worldwide. In doing so, this research tests the association between community resilience and social cohesion.

2. Methodology

2.1. Study population

Solino and Tesso are home to nearly 13,000 and 15,000 residents, respectively. As there was no previously established list of households, the sampling frame for this study utilized population estimates. This research employed a conservative approach, assuming that no homogeneity existed between individual blocks (or sections) within the

Table 1
Adapted social cohesion scale.

Item	Statement
	How much do you agree with the following statements about your neighborhood…
1	Overall, I am attracted to living in this neighborhood.
2	I feel like I belong to this neighborhood.
3	I visit my neighbors in their homes.
4	The friendships and associations I have with other people in my neighborhood mean a lot to me.
5	If I had the opportunity I would move out of this neighborhood.
6	If the people in my neighborhood were planning something, I'd think of it as something "we" were doing, rather than "they" were doing
7	If I need advice about something I could go to someone in my neighborhood
8	I think I agree with most people in my neighborhood about what is important in life
9	I believe my neighbors would help in an emergency
10	I feel loyal to the people in my neighborhood
11	I borrow things and exchange favors with my neighbors
12	I would be willing to work together with others on something to improve my neighborhood
13	I plan to remain a resident of this neighborhood for a number of years
14	I like to think of myself as similar to the people who live in this neighborhood
15	I rarely have a neighbor over to my house to visit
16	I regularly stop and talk with people in my neighborhood
17	Living in this neighborhood gives me a sense of community

The Likert response scale comprised the following five options: Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree; Ranked 1–5 respectively.

communities of Tesso or Solino. A systematic random sample was obtained using a two-stage sampling strategy whereby each block was sampled proportionate to its population size and a random sample of households within each block was selected. As such, using a 95% confidence level and a 2.5% margin of error, a total of 1895 participants were recruited into the study: 730 from Tesso, and 1165 from Solino.

2.2. Population survey

Local enumerators administered a systematic, randomized cross-sectional quantitative questionnaire survey in the communities of Solino and Tesso from September-October 2014. This survey instrument was developed from qualitative research through 6 focus group discussions with community members in July 2014. The final questionnaire comprised of 67 questions and was designed to gather information in four main areas of interest: basic demographics (Table 3), social cohesion indicators (Table 1), resilience indicators (Table 2), and community insecurity (results not shown). Oral consent was obtained from all participants prior to administration of questionnaire. This research was overseen by the Partners Healthcare Institutional Review Board Protocol #2014P001788.

2.3. Definitions

For the purposes of this research, we employed the following working definitions of social cohesion and resilience:

2.3.1. Social cohesion
The presence of features such as social organization, such as trust, norms, and networks that can improve the efficiency of society by facilitating coordinated actions [25].

2.3.2. Resilience
The ability to activate protective qualities and processes at the individual, community, institutional and systems level to engage with hazards or stressors and cooperate with other in order to maintain or

Table 2
The communities advancing resilience toolkit (CART) survey.

How much do you agree with the following statements about your neighborhood…

Item	Statement
1	People in my community are committed to the well-being of the community
2	People in my community have hope about the future
3	People in my community help each other
4	My community has the resources it needs to take care of community problems (resources include: money, information, technology, tools, raw materials, and services)
5	My community has effective leaders
6	People in my community are able to get the services they need
7	People in my community know where to go to get things done
8	People in my community communicate with leaders who can help improve the community
9	People in my community are aware of community issues that they might want to address together
10	People in my community discuss issues so they can improve the community
11	People in my community work together to improve the community
12	My community looks at its successes and failures so it can learn from the past.
13	My community develops skills and finds resources to solve its problems and reach its goals
14	My community has priorities and sets goals for the future
15	My community tries to prevent disasters
16	My community actively prepares for future disasters
17	My community can provide emergency services during a disaster
18	My community has services and programs to help people after a disaster

The Likert response scale comprised the following five options: Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree; Ranked 1–5 respectively.

recover functionality and prosper while adapting to a new equilibrium and minimizing the accumulation of pre-existing or additional risks and vulnerabilities [26].

2.4. Social cohesion scale

To accurately measure social cohesion, this study adapted the Neighborhood Cohesion Index (NCI) [27]. This selection is justified by the fact that this scale was developed to capture the collective-level attribute of sense of community as it exists specifically in a neighborhood context making it an ideal parameter for this research as it focuses specifically on neighborhood social cohesion. This index has also been used and well-validated in various communities [28–31]. Finally, while the NCI is grounded in the theory of sense of community as a uni-dimensional as opposed to multidimensional construct the NCI remains appropriate for this study on individual perceptions. One item ("A feeling of fellowship runs deep between me and other people in this neighborhood") was excluded because the meaning was not deemed transferable in this Haitian culture by local staff. This adaptation of the NCI does not substantially alter the index or exclude any of the theoretical domains that underlie the scale and remaining questions can ascertain similar information. The single item omission is also a minor adaptation in comparison with other applied uses of the NCI [32]. This social cohesion scale comprised of 17 five-point Likert-type scale items (1 = *strongly disagree*, 2 = *disagree,* 3 = *neither agree nor disagree*, 4 = *agree*, 5 = *strongly agree)* (Table 1). Each participant's sense of community is reported as the mean score for the 17 items, with a higher score representing a greater level of community cohesion.

2.5. Community resilience scale

Community resilience was measured using the Communities Advancing Resilience Toolkit (CART) Survey [33]. CART is a field-tested instrument, which assesses a community's resilience and disaster management. This community resilience scale comprised of 18 five-

Table 3
Demographic variables: summary statistics.

	n (%)			
	n (%)	Solino	Tesso	p
Sex				0.060
Male	671 (35.5)	431 (37.2)	240 (32.8)	
Female	1219 (64.5)	728 (62.8)	491 (67.2)	
Religion				0.017*
Catholic	812 (42.7)	487 (41.8)	325 (44.2)	
Protestant	821 (43.2)	523 (44.9)	298 (40.5)	
Adventist	45 (2.4)	17 (1.5)	28 (3.8)	
Jahovas Witness	11 (0.6)	7 (0.6)	4 (0.5)	
Vaudou	43 (2.3)	29 (2.5)	14 (1.9)	
Other	168 (8.8)	102 (8.8)	66 (9.0)	
Marital Status				0.105
Married	492 (26.0)	292 (25.2)	200 (27.2)	
Single	514 (27.1)	337 (29.1)	117 (24.1)	
Divorced	13 (0.7)	9 (0.8)	4 (0.5)	
Domestic Partnership	876 (46.2)	552 (45.0)	354 (48.2)	
Average Monthly Income				≪ 0.001***
0–5k Gourdes	959 (50.8)	567 (49.0)	392 (53.7)	
5–10k Gourdes	557 (29.5)	349 (30.2)	208 (28.5)	
10–15k Gourdes	204 (10.8)	109 (9.4)	95 (13.0)	
15k − 20k Gourdes	100 (5.3)	83 (7.2)	17 (2.3)	
20k + Gourdes	66 (3.5)	48 (4.2)	18 (2.5)	
Level of Education				0.002**
Primary	763 (403)	449 (38.8)	314 (42.7)	
Secondary	732 (38.7)	440 (38.1)	292 (39.7)	
University	131 (6.9)	77 (6.7)	54 (7.3)	
None	265 (14.0)	190 (16.4)	75 (10.2)	
Type of Residence				≪ 0.001***
Own	849 (44.7)	500 (42.9)	349 (47.4)	
Rent	827 (43.5)	618 (53.0)	209 (28.4)	
Squat	194 (10.2)	29 (2.5)	165 (22.4)	
Other	31 (1.6)	18 (1.5)	13 (1.8)	
Primary Source of Income				0.004**
Small Business	912 (48.3)	570 (49.3)	342 (46.8)	
Permanent Employment	340 (18.0)	222 (19.2)	118 (16.1)	
Short-Term Employment	380 (20.1)	203 (17.5)	177 (24.2)	
Other	256 (13.6)	162 (14.0)	94 (12.9)	

	Mean (sd)			
	Mean (sd)	Solino	Tesso	p
Age	38.17 (13.41)	39.16 (13.9)	36.62 (12.3)	< 0.001***
Income Earners in Household	0.73 (0.88)	0.77 (0.87)	0.67 (0.91)	< 0.001***
Number of Children	3.54 (1.60)	3.6 (1.7)	3.4 (1.4)	0.052
Years in Community	15.15 (12.17)	17.8 (12.3)	10.8 (10.3)	≪ 0.001***
Years in Current Residence	9.37 (10.28)	10.8 (11.2)	6.7 (7.63)	≪ 0.001***
Household Size	5.14 (2.27)	5.2 (2.3)	5.1 (2.2)	0.391

Note: *N* = 1627. Significance codes: *0.05, **0.01, ***0.001. Statistical tests: Wilcoxon Rank-Sum test was used for continuous outcomes; Chi-Square test was used for dichotomous outcomes.

point Likert-type scale items (1 = *strongly disagree*, 2 = *disagree,* 3 = *neither agree nor disagree*, 4 = *agree*, 5 = *strongly agree)* (Table 2). Each participant's sense of resilience was reported as the mean score for the 18 items. This specific scale was chosen because it applies specifically to the community level and not a larger urban or smaller household unit while drawing on the responses from individuals. Several recent systematic reviews have highlighted the commonalities and specific deficiencies of various resilience scales and there is no established standard of practice to measure community resilience or preferred scale.[34–36] The CART instrument has applies very well to this study population and design.

Table 4
Years in community and years in current residence.

	< 3	3–5	6–10	11–20	21 +
Years in community					
Number of Respondents *(%)*					
Solino	125 *(10.7)*	89 *(7.7)*	140 *(12.0)*	278 *(23.9)*	531 *(45.7)*
Tesso	120 *(16.3)*	156 *(21.3)*	165 *(22.5)*	147 *(20.0)*	146 *(19.9)*
Years in Current Residence					
Number of Respondents *(%)*					
Solino	320 *(27.5)*	210 *(18.1)*	175 *(15.0)*	190 *(16.3)*	268 *(23.0)*
Tesso	202 *(27.5)*	267 *(36.3)*	111 *(15.1)*	94 *(12.8)*	61 *(8.3)*

Note: Cut points were chosen such that grouping reflects arrival into the community pre and post 12 January 2010 earthquake.

2.6. Data analysis

Data were analyzed using RStudio statistical software (Version 0.98.1087). Associations between individual demographics and community were examined at the $p < 0.05$ level of significance. Following a Principle Components Analysis, Factor Analysis was used to determine the presence of separate constructs within the NCI Social Cohesion Scale. Social cohesion and resilience scores were analyzed as the mean values for the items in each category of the separate scales.

2.7. Covariates

Covariates included in the model represent known predictors of resilience and potential confounders.

Years in Community and Years in Current Residence were modeled as categorical variables. Cutpoints were chosen to reflect the arrival of participants into the community pre and post 12 January 2010 earthquake (Table 4). This categorization resulted in the following groupings: ' < 3 years', '3–5 years', '6–10 years', '11–20 years', and '21 + years'. Therefore, those participants who are in the ' < 3 years' group represent those respondents who arrived in the community/their current residence *after* the 12 January 2010 earthquake; those in the '3–5 year' category were living in their community *at the time* of the earthquake; and those living in the communities in the remaining categories were established residence before the earthquake event for varying amounts of time.

Because baseline demographic (exposure) characteristics varied widely between the two communities, all analyses were run stratified by study site, resulting in the development of two linear regression models. Both models incorporated important predictors of both social cohesion and resilience. The same demographic covariates (questions 2–17 on the household questionnaire) were included in both models for comparability. Final model selection included the following covariates: sex, monthly income, educational attainment, residential status, primary employment, years lived in current community, years lived in current household or dwelling, household size, number of children, number of income earners per household, and age.

3. Results

3.1. Community characteristics

A descriptive summary of demographic variable distributions stratified by community is presented in Table 3. As per the sampling methodology, 61.3% of respondents were from the community of Solino, while 38.7% of respondents were from the community of Tesso. Females, given their availability for answering the survey were over-represented, comprising 64.5% of the sample. Of those sampled, the average age was 38.

Important differences across the two communities were observed. At the $\alpha = 0.05$ level of significance, only four of the demographic variables were found to be similar between the two communities: sex (p = 0.06), marital status (p = 0.11), number of children (p = 0.05), and household size (p = 0.39). However, the majority (9 of 13) of demographic variables were found to be significantly different between the two communities.

Specifically, religion (p = 0.02), income level (p ≪ 0.01), education status (p = < 0.01), type of residence (p ≪ 0.01), and primary source of income (p = < 0.01) significantly differed between the two communities. Additionally, it was found that residents of Solino are, on average, older than residents of Tesso (39.16 and 36.62, respectively; $p < 0.01$), have more income earners per household ($p < 0.01$), and have lived in their communities and current residences longer ($p \ll 0.01$). This result is not unexpected due to the high statistical power that this study had by design, whereby we were able to detect even small differences between these two communities and such differences should be interpreted with caution.

3.2. Community social cohesion and resilience

Mean social cohesion among all participants was 3.47. The difference in social cohesion score was found to be statistically insignificant between Solino and Tesso [mean (sd), 3.45 (0.6) vs. 3.50 (0.7), respectively] (p = 0.12). Further, mean resilience among participants was 2.94, with a statistically significant difference between Solino and Tesso [mean (sd), 2.93 (0.6) vs. 2.86 (0.6), respectively] (p < 0.006).

Mean social cohesion and resilience scores are summarized for the two communities in Table 5. Following the Likert Scale reporting where 1 = *strongly disagree* and 5 = *strongly agree*, a score of '5′ represents the highest degree of both social cohesion and resilience.

3.3. Multivariable linear regression: community resilience

Results of the Multivariable Linear Regression analyses representing the associations between demographic variables and mean resilience scores are represented in Table 6.

In Tesso, results of the multivariable regression analysis indicate that of the various covariates included in the model, males and a higher monthly income were found to be significantly associated with increased resilience, after controlling for social cohesion. Further, and perhaps of note, responders with no stable household (squatters) and those with varying employment were found to have greater resilience. Results from Solino show, however, that those participants with greater educational achievement and who have more income earners living in their household have higher resilience. Interestingly, these results further indicate that participants in Solino who have a greater monthly income, more stable employment, are older, and have lived in their current community for 10–20 years and their current house for more than 20 years have *decreased* resilience.

3.4. Multivariable linear regression: community social cohesion

Results of the multivariable linear regression analyses representing the associations between demographic variables and mean social cohesion scores are presented in Table 7. Results of this analysis show improved social cohesion in both communities when residents reported living in their communities for 5 or more years. Males in both

Table 5
Mean social cohesion and resilience scores.

	Mean (sd)		
	Total Population	Tesso	Solino
Social Cohesion	3.47 (0.63)	3.50 (0.66)	3.45 (0.60)
Resilience	2.9 (0.58)	2.86 (0.57)	2.93 (0.58)

Table 6
Multivariable associations between demographic variables and resilience scores.

	TESSO			SOLINO		
	β	p		β	p	
Males	0.171	< 0.001	***	0.051	0.128	
Monthly Income	0.083	< 0.001	***	− 0.044	0.005	**
Education	− 0.007	0.753		0.061	≪ 0.001	***
Residence Status						
Own	*Reference*	–		–	–	
Rent	0.02	0.705		− 0.061	0.144	
Squat	0.196	0.001	**	− 0.117	0.262	
Other	0.074	0.63		− 0.164	0.19	
Employment						
Small Business	*Reference*	–		–	–	
Permanent	0.089	0.149		− 0.057	0.205	
Short Term Contract	0.083	0.105		− 0.103	0.02	*
Other	0.156	0.015	*	− 0.12	0.015	**
Yrs in Community						
0–3	*Reference*	–		–	–	
5-Mar	− 0.051	0.553		0.021	0.789	
10-May	− 0.137	0.114		− 0.126	0.084	
20-Oct	− 0.045	0.635		− 0.15	0.029	*
20–100	− 0.099	0.308		− 0.021	0.764	
Yrs in Current House						
0–3	*Reference*	–		–	–	
5-Mar	− 0.064	0.37		− 0.059	0.284	
10-May	0.084	0.322		0.069	0.231	
20-Oct	0.008	0.932		0.041	0.505	
20–100	− 0.01	0.927		− 0.13	0.054	*
Household Size	0.004	0.688		− 0.007	0.339	
Num. Children	0.002	0.919		− 0.014	0.16	
Age	0.002	0.315		− 0.003	0.005	**
Num. Income Earners	− 0.35	0.142		0.116	≪ 0.001	***

Note: Linear regression model. N = 1627.
Outcome: Resilience, whereby 1 = strongly disagree through 5 = strongly agree.
Significance codes: *0.05, **0.01, ***0.001.

Table 7
Multivariable associations between demographic variables and social cohesion scores.

	TESSO			SOLINO		
	β	p		β	p	
Males	− 0.22	≪ 0.001	***	− 0.18	≪ 0.001	***
Monthly Income	− 0.02	0.5		− 0.05	< 0.001	***
Education	− 0.0004	0.98		0.04	0.005	**
Residence Status						
Own	*Reference*					
Rent	− 0.07	0.22		− 0.06	0.15	
Squat	0.12	0.07		0.03	0.79	
Other	− 0.27	0.13		− 0.22	0.36	
Employment						
Small Business	*Reference*					
Permanent	− 0.15	0.04	*	− 0.04	0.43	
Short Term Contract	− 0.02	0.8		0.03	0.54	
Other	− 0.13	0.09		− 0.22	≪ 0.001	***
Yrs in Community						
0–3	*Reference*					
5-Mar	0.16	0.11		0.17	0.05	*
10-May	0.28	0.001	**	0.22	0.005	**
20-Oct	0.41	≪ 0.001	***	0.33	≪ 0.001	***
20–100	0.64	≪ 0.001	***	0.39	≪ 0.001	***
Yrs in Current House						
0–3	*Reference*					
5-Mar	0.008	0.92		0.07	0.22	
10-May	0.03	0.8		0.06	0.35	
20-Oct	− 0.2	0.86		0.12	0.08	
20–100	− 0.2	0.13		0.14	0.06	
Household Size	0.007	0.56		0.01	0.2	
Num. Children	− 0.02	0.38		− 0.001	0.92	
Age	0.0007	0.73		0.002	0.11	
Num. Income Earners	0.09	0.001	**	− 0.07	0.002	**

Note: Linear regression model. N = 1627.
Outcome: Resilience, whereby 1 = strongly disagree through 5 = strongly agree.
Significance codes: *0.05, **0.01, ***0.001.

communities are shown to have decreased social cohesion as compared to females. Among Tesso residents, a higher monthly income, varying types of employment, and an increase in number of income earners per household was associated with *decreased* social cohesion, while greater education attainment was shown to increase social cohesion in this community. Among residents of Solino, residents with permanent employment had decreased social cohesion, while residents with a greater number of income earners within the household had increased social cohesion.

In addition to the multivariable linear regression models examining the associations between multiple covariates and social cohesion and resilience scores, a separate linear regression was run to determine the presence and magnitude of the effect of social cohesion on resilience disaggregated by community. The results of this analysis are presented in Table 8.

3.5. Social cohesion and resilience scores

A test of significance comparing social cohesion scores between the two communities demonstrates an insignificant difference, yet a test of significance comparing resilience scores between the two communities demonstrates a highly significant difference ($p \ll 0.001$) between the communities. These results imply that there are some differences in social cohesion scores and significant differences in resilience scores between the communities of Solino and Tesso. The direction and magnitude of these associations are discussed further below.

4. Discussion

The main outcome of interest in this study, community resilience, was found to be associated with several distinct and different factors

Table 8
Linear regression analysis of social cohesion and resilience, disaggregated by community.

	β	p
Social Cohesion: Solino	0.348	≪ 0.001
Social Cohesion: Tesso	0.261	≪ 0.001

between study sites. The variability in associations between these community characteristics and community resilience across study sites highlights the large influence of context and community composition on overall resilience. Despite this variability in factors associated with community resilience between these two communities, social cohesion was found to be most significantly associated with community resilience in both communities in both strength and magnitude. Of the 11 covariates considered, we found only one common predictors of resilience between the two communities: social cohesion (Table 6). This finding demonstrates that social cohesion is likely a critical predictor of community resilience, regardless of differences in demographic makeup of these two communities.

This result allows for the conclusion that among the studied features that could be associated with community resilience, social cohesion is likely to have the greatest and most substantial impact in improving resilience at the community level in these two urban slums. As such, this study highlights the potential for improving community resilience through improved community social cohesion in both Solino and Tesso.

This findings also demonstrates a non-linear relationship between social cohesion and resilience whereby both scores increase together yet the degree of increase in social cohesion is greater than the corresponding degree of increase in resilience, demonstrating the potential limitations in building resilience through investment in social cohesion after a certain amount of resilience is achieved through social cohesion.

The value of multiple other elements that contribute to community disaster resilience is reinforced.

Importantly, this research also demonstrated variability in the magnitude and direction of the association between various demographic covariates and resilience or social cohesion between the two communities emphasizing the importance of context.

Additionally, various factors such as income, time in community, education level and others were included in the study because of underlying assumptions that they have a positive relationship to resilience. The research revealed some surprising results that run counter to these assumptions. These have both implications for practice and research that are discussed in the conclusion.

Certain demographic variables were more strongly associated with social cohesion in these communities. Lower education status, greater time in the community and females were found to be most strongly associated with greater social cohesion. It's difficult to interpret these findings without further qualitative research. It is possible that women engage more with their community or spend more time in it, perhaps building cohesion out of daily necessity. Also, a longer length of stay in a community may naturally allow more time for individuals to build cohesion with their neighbors. But those with lower education reporting greater cohesion becomes harder to easily understand and a deeper investigation into community dynamics may help explain this. This association may also be less generalizable.

Targeting marginalized groups seems important. Those demographics that associate less with social cohesion and resilience may be an issue of perspective but they are likely the same groups that are not as well integrated into the community or feel served by it. Special attention should be given to groups whose responses are *not* significantly associated with social cohesion. Engaging these groups is critical to ensure that programs are inclusive and build overall community resilience rather than leaving them at increased risk during disasters. Future programs must ensure that these groups are not excluded either by design or by accident.

Given the solely quantitative nature of the study, several limitations remain. While providing valuable quantitative insight into these two communities, this study could not account for their different histories or their relationship with government. These are very different communities in these two regards and it was impossible to measure these differences or incorporate them into such a quantitative analysis. Nonetheless, these factors play a very important role in both social cohesion and resilience.

The over-representation of women may have introduced bias. While the methodology sought the available head of household, women were generally more available and thus, they comprised 61% of respondents. Potentially different gender roles with women engaged in domestic activities that may reinforce time within their own communities and relationships with others and possible lack thereof by male breadwinners could have influenced the overall strength of the findings. But no assumption was made about these roles or their impact and the analysis did not use gender as the unit of analysis except for the one analysis by that demographic variable. There also is no clear difference in the experience of social cohesion or resilience as measured that could have reasonably biased the results. Thus, the findings likely remain valid despite the overrepresentation by women.

This study also did not include several specific topics that may play a role in affecting the resilience of these communities. Government has an important role to play in helping communities achieve resilience. Policies that enable communities and empower them to achieve resilience make them a positive force in the equation. Conversely, a poorly functioning government and over-reliance on it for otherwise community level activities can hinder the development of community resilience. Aside from the demographic make-up of these two communities, we suspect that the role of government is an important influence on their resilience.

Community narratives and histories also play a role in developing or hindering social cohesion and, as this study proves, this cohesion impacts resilience. Again, a non-quantifiable factor in this study, community histories could explain some of the variance between the communities that these data show. Although the initial focus groups were of limited value, future focus groups may help elucidate how histories and narratives impact these two communities and their cohesion and resilience.

Finally, the intrinsic quality of community leaders and community-based organizations (CBO's) can have either a positive or adverse impact on community social cohesion and resilience. Additionally, community leaders and CBOs interact with government and other outside agencies such as aid organizations. Such interactions may in some cases override the intrinsic social cohesion and resilience measured in these communities and mitigate or amplify the impact that the government, identified above, can have on them. Unfortunately, we could not use this quantitative study to evaluate these interactions among community leaders and CBOs with outside entities and their own communities.

Drawing from the limitation of the study, a few avenues of research emerge. Further qualitative study through case studies or outcome mapping exercises that explore the relationship with government and allow this to be factored into an analysis is important. Recent work on resilience highlights the government community cooperation as a protective factor and learning the various beneficial and counter-productive parameters of this relationship as it relates to resilience would refine this prior work and add new insights for proper governance [37].

As suggested earlier, the quality of community leaders and CBOs identified above should be explored as well. Follow-up qualitative and/or anthropologic studies could add significant value.

There is a general inclination to assume that these individuals and organizations are effective and representative but there is wide variation. Learning how they may be more systematically assessed and accounted for in programs aimed at improving community based resilience would be important for such program success.

The primary finding of this research demonstrates that among the variables investigated, social cohesion was the most strongly associated with a higher community resilience score as measured in these two urban informal settlements of Solino and Tesso in Port au Prince, Haiti. While this relationship has previously been studied qualitatively, this study provides a quantitative empirical association between measures of these two concepts with implications for policy and programming. Without the ability to conduct an experimental trial, this finding adds support to the idea that increasing social cohesion can increase community resilience in urban Haitian communities. Investing in social cohesion is likely to strengthen community resilience. With all the current attention on resilience in global policy discussions and stated goals of humanitarian and development efforts, this study adds strong impetus to focusing on social cohesion as a pathway towards resilience.

5. Conclusions

While this study focuses on two urban communities within Haiti, the results of this study have far reaching implications for policy, programs and research in other settings. Although the findings need to be contextualized for different communities, the methodology and findings of this study can be utilized widely. Our key finding, that social cohesion helps drive resilience, highlights the importance of considering social cohesion in all programs and policies aimed at improving resilience and disaster risk reduction.

The research also revealed that specific individual factors such as income or length of residence that may be assumed to enhance resilience were not associated with increased resilience on their own and in fact seemed to correlate with decreased resilience scores and vice versa as it relates to stable employment or housing status. Decision makers should not make assumptions about individual demographic or other factors that may be assumed to enhance resilience, focusing resources solely those, including social cohesion. The effects could be

counterproductive and taking a more multidimensional understanding of resilience is critical to planning programs and writing policy. There is also substantial research that shows the important impact that various other macro level and community level factors such as critical infrastructure, risk and hazard management, response capacity, among many others impact urban resilience [26,38]. Social cohesion may, however, compensate for weaknesses in a wide variety of factors that lead to reduced resilience and increased risk. This could explain the findings from this research, highlighting the importance of social cohesion as a valuable area of focus for decision makers where risk is high and resources are limited.

Important research endeavors emerge from the secondary findings about the impact of individual factors on resilience. The key implication is that factors that reduce resilience or enhance resilience interact with one another to exert the overall impact on resilience. Studying how various factors interact to make a person, household, community or city more resilient would be very fruitful. Finally, resilience, as has been said, must be to something - a specific hazard, threat or risk. In addition to studying how factors such as social cohesion interact with other factors to enhance resilience, further research should explore how specific factors, individually and collectively, work against specific risks or collections of risks. Studying resilience is incredibly complex and this study shows that social cohesion is key but much more remains to be explored.

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