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Measures of Personal Social Capital Over Time:

A path analysis assessing longitudinal associations among cognitive, structural, and network elements of social capital in women and men separately

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Keywords: social capital, trust, structural equation models, hypertension, Canada

Abstract

Studies on personal social capital and health have relied on several key measures of social capital – trust, participation, network capital – all with the aim of capturing the resources to which individuals or groups might have access through their social networks. As this work has evolved, researchers have sought to differentiate among key measures, often arguing that each represents a different type of social capital. Despite the importance of this work, few studies have examined (a) whether these measures are in fact distinct constructs, particularly over time, (b) if these relationships are causal, and (c) whether gender patterns the ways these measures are related. Using a probability-based sample of adults with 1-3 observations per respondent, we apply generalized structural equation modeling to assess in women and men separately whether generalized trust, trust in neighbors, network diversity, social isolation, and social participation are associated with each other, hypertension, and self-reported health over a five-year period. The initial response rate was 38.7%, with cooperation rates of 60.4% and 56.3% at waves two and three. Findings highlight stability in the longitudinal relationship of the same measure across waves. They also suggest that social capital measures operate differently for men and women, with key measures of one type of social capital more often associated with another type in women than men. Nevertheless, the strengths of the associations remain weak in women and men, particularly over time, suggesting that these measures (especially generalized trust) may be inadequate proxies for each other. Lastly, social capital seemed more salient for women's than men's health. Future research on social capital might consider more deeply the role and meaning of gender in interpreting the results of studies linking social capital to health. Further consideration of trust, participation, and network capital as distinct constructs is also warranted.

Keywords: Canada, social capital, gender, social networks

Introduction

Since social capital emerged as a prominent social science concept in health research over two decades ago, researchers have relied on a wide range of measures to assess it at different levels of conceptualization. This eclecticism has especially been the case in studying personal social capital—that is, an individual's access to resources through their respective social networks, which is studied as the extent of social capital available to a person as opposed to the resources of a community, though social capital can be a product of individuals and collectives.

Personal social capital has been conceptualized in ways centered on either cohesion or network traditions from different social capital theorists (Kawachi 2006). *Cohesion perspectives*, informed by Coleman (1988) and Putnam (2000), tend to emphasize personal trust (in general and in particular others) and formal participation in civic associations, whereas *network perspectives*, based on scholarship by Bourdieu (1986) and Lin (2001), emphasize one's informal social ties and the diversity of resources accessible through those ties (Kawachi 2006; Moore et al. 2005; Carpiano and Fitterer 2014a). As such, measures of personal social capital have differed depending on the conceptual perspective adopted. Nevertheless, trust, participation, and diverse network ties are the most common measures.

Studies have examined the extent to which these different measures may correlate—and thus represent—multiple indicators of the same underlying theoretical construct. Though this research has found inconsistent associations between trust, participation, and network ties (e.g., Uslaner 2002, Moore et al. 2011), the question is whether these alternative measures represent different dimensions of social capital (i.e., cognitive, structural, or network) or important precursors to each other, linking, for example, generalized trust in others to the formation of actual network ties. However, with some important exceptions (e.g., Claibourne and Martin

2000; Glanville, Andersson, and Paxton 2013; van Ingen and Bekkers 2015), existing studies have relied primarily on cross-sectional data, limiting the types of conclusions that might be drawn about the relationships among the social capital measures.

The present study contributes to our understanding of social capital and its measurement by investigating how different social capital measures correlate across time with each other and health. To accomplish this, we analyze three waves of data from a probability-based panel study of adults in Montreal, Quebec Canada. Our findings inform existing health research on individual social capital by providing evidence regarding the convergence, divergence, and ultimately, the construct validity, of different, commonly used social capital measures.

Three Types of Personal Social Capital and their Measures

Health research has tended to categorize personal social capital into three types: cognitive, structural, and network social capital. We review these perspectives and how they are commonly measured in health research.

Cognitive Social Capital

Cognitive social capital refers generally to individuals' perceptions, beliefs, and attitudes toward their social surroundings, with corresponding measures focused mainly on the concepts of generalized and particularized trust. Generalized trust focuses on one's perceptions of the trustworthiness of the social environment, and is often operationalized using the question "Generally speaking, would you say that most people can be trusted or you can't be too careful in dealing with people?" As such, generalized trust presumably extends to individuals or groups outside one's immediate social circle (Glanville and Story 2018), who have the potential to serve as "bridging ties" (e.g., Putnam, 2000) for facilitating access to health-promoting resources.

Particularized trust, by contrast, captures one's trust of specific others (e.g., neighbors) and is thus rooted in one's knowledge and familiarity with specific persons or groups (Glanville and Story 2018).

Studies of cognitive social capital and health have shown both general and particular trust associated with a range of health behaviors and conditions, even net of other types of personal social capital (Carpiano and Fitterer 2014). Studies have identified changes in a person's generalized trust were associated with health changes, as well as temporal ordering such that prior generalized trust is associated with later health—both findings net of other social capital variables (Giordano & Lindstrom 2010; Giordano, Bjork, and Lindstrom 2012). While generalized and particularized trust are often considered cognitive measures of social capital, the mechanisms by which they affect health may in fact differ, leading to variations in how each may be associated with health.

Structural Social Capital

The concept of structural social capital has been frequently examined alongside cognitive social capital. Structural social capital refers generally to the presence of formal opportunity structures or activities in which individuals build or strengthen their social connections (Moore and Kawachi 2017). These structures and activities are often operationalized through measures of an individual's civic or social participation (e.g., membership in professional and cultural organizations) or engagement in public affairs (e.g., voting) (Ehsan and De Silva 2015). Studies report that those with higher participation tend to report better health status and behaviors (Poortinga 2006b; 2006a; Giordano & Lindstrom 2010). However, a review of 39 studies on personal social capital and common mental disorders found no effects of structural social capital on mental disorders (Ehsan and De Silva 2015). Yet, given the dissonance between findings on

trust and participation as they relate to health, it is surprising that few studies have sought to assess whether structural social capital measures correlate with cognitive or network social capital measures.

Network Social Capital

Network social capital (sometimes termed "network capital") refers to the resources to which individuals or groups have access through their social ties. Health studies of network capital have often drawn on measures of network diversity (i.e. range of network ties) to capture the heterogeneity of potential resources accessible within networks. Greater network diversity has been shown associated with more beneficial health behaviors (e.g., smoking cessation) (Moore, Teixeira, and Stewart 2014a), self-rated health (Carpiano and Hystad 2011), and conditions (e.g., obesity) (Wu, Moore, and Dubé 2018), although studies have also highlighted the possible negative consequences of network capital on health (Carpiano and Kimbro 2012; Moore et al. 2009).

Social isolation pertains primarily to structural features of personal networks (i.e., the objective absence of social ties) and, to a lesser degree, compositional characteristics (e.g., primarily relatives instead of friends) (Cudjoe et al. 2018). Though not often considered a measure of social capital, social isolation may be seen under Bourdieu's (1986) conceptualization of social capital as a critical element in accessing network resources—specifically whether someone has a network tie through which they might access resources. Social isolation is associated with numerous poor health behaviors and mental and physical health conditions and higher mortality (Pantell et al. 2013; Holt-Lunstad, Smith, and Brayton 2010) and an important contributor to social capital inequalities in health (Moore, Stewart, and Teixeira 2013).

The Need to Evaluate Potential Overlap of Different Social Capital Perspectives

Despite the fact that cognitive, structural, and network capital have been shown associated with health, the degree to which these possible types of capital correlate with one another and actually reflect "network-accessed resources" is debatable. For example, Carpiano and Fitterer (2014) suggest that general and particular (i.e. neighbor) trust are conceptually distinct from and an inadequate proxy for social capital (see also Carpiano 2014). Their argument is consistent with prior non-health scholarship finding inconsistent contemporaneous and longitudinal associations among these three social capital types (e.g., see Glanville et al. 2013; van Ingen and Bekkers 2015). Notably, Putnam's (2000) social capital conceptualization is quite popular in health research —arguing that social capital consists of reciprocal relationships between multiple factors such as trust, networks, and social participation/civic engagement. Hence, such conceptualizations may provide some researchers with a rationale to either combine available measures of any of these components into one "social capital" scale (van Ingen and Bekkers 2015) or treat one measure as a proxy for another.

The construct validity of social capital remains of central concern for two main reasons. First, theoretically, the advancement of research in this field requires an understanding of the extent that these different social capital measures are related to one another (if at all). Second, practically, without an understanding of how cognitive, structural, and network social capital interrelate, interventions aiming to leverage social capital towards improving public health may misidentify or misestimate actual effects of social capital on intervention outcomes.

To help advance knowledge of this field, we examine longitudinally whether cognitive, network, and structural capital represent similar or distinct constructs. While other studies have aimed to identify the relationship between different measures of social capital (Carpiano and

Fitterer 2014a; Glanville and Story 2018; Glanville et al. 2013, Claibourne and Martin 2000), few have used longitudinal data with more than two time points (e.g., van Ingen and Bekkers 2015). Furthermore, we consider whether such inter-relationships vary by gender, an important factor in understanding network ties and their potential inherent resources.

Gendered Social Capital

Gendered social roles and norms may act at multiple levels to shape the structure and composition of men's and women's social networks and, by extension, the types of resources that they have access to in their networks. For example, McPherson and Lovin (1982) showed that men in the United States were more likely to belong to economic- and business-related organizations, whereas women in the US were more likely to be involved in community-focused organizations. Compared to men's networks, which are often more heavily composed of coworkers and friends, women's networks have been shown to include a higher percentage of relatives (Moore 1990). Life events, such as childrearing and marriage, can also impact men's and women's social networks differently (Munch, McPherson, and Smith-Lovin 1997). Finally, social networks and relationships can differentially affect men's and women's health (Eriksson and Emmelin 2013; Shye et al. 1995). Research that has focused more specifically on whether social capital may be more important for men's or women's health have shown mixed results. In terms of cognitive social capital, trust – general and particular – has been shown to be more strongly associated with women's health (Bassett and Moore 2013; Karhina et al. 2016). However, for structural and network types of social capital, studies have shown greater health benefits for men. For example, civic engagement was shown associated with fewer depressive symptoms in men, but not women (Landstedt et al. 2016); while social participation and non-

161 familial social ties were associated with men's (but not women's) self-reported health (Ferlander
162 and Mäkinen 2009).

163 Researchers have relied on a number of theoretical approaches (e.g., socialization,
164 structural, bio-behavioral) to explain gendered differences in the relationship between social
165 networks and health. Socialization theories argue that boys and girls are socialized differently,
166 with boys encouraged to display behaviors often antithetical to intimacy (e.g., aggressiveness)
167 and girls encouraged to display emotions and nurturing behavior. Social institutions, media, and
168 peers reinforce these gendered patterns of socialization as children age (Umberson et al. 1996).
169 Structural approaches, on the other hand, highlight the macro-level social forces that
170 differentially shape the opportunities, resources, and constraints that men and women face in
171 building social networks. Although our study is not designed to test any particular theory for
172 understanding social capital and health, the empirical and theoretical research on gender and
173 social capital raise the likelihood that the pathways by which social capital affects health may
174 differ for men and women. To address this issue, our analyses will examine these pathways
175 separately in men and women.

176 **Study Objectives**

177 Analyzing longitudinal data on personal social capital and health, we evaluate the
178 associations among (1) measures of different types of social capital, (2) their respective
179 relationships to health outcomes, and (3) how the patterns of associations between these social
180 capital and health measures potentially differ between men and women.

181 *Objective 1: Evaluating Relationships among Social Capital Measures*

In evaluating the relationships among different concepts and measures of social capital\, we test two opposing hypotheses.

The first hypothesis, which we term "the distinct construct hypothesis," posits that cognitive, structural, and network social capital represent three distinct constructs and thus do not all fall under the umbrella term "social capital." If these constructs are distinct, then empirically, we would expect to observe little substantive correlation among their respective measures of trust (general and particular), social participation, and network capital (network diversity and network isolation) at wave one or across subsequent waves.

The second hypothesis, which we term the "causal pathway hypothesis," posits that trust, social participation, and network capital represent different types of social capital that may either act as proxies for each other or possibly lie at different points along the social capital-to-health pathway. If this is the case, then we would anticipate trust, social participation, and network diversity and isolation to be substantially correlated with each other at wave one, with each measure predicting the other types of social capital at later time periods.

Prior longitudinal analyses find differing results consistent with both hypotheses, depending on the social capital types examined (e.g., trust, informal ties, formal ties via social participation) (Li, Pickles, and Savage 2005; Glanville, Andersson, and Paxson 2013; Claibourne and Martin 2000; Van Engen and Bekkers 2015).

Objective 2: Testing the Relationships to Health Measures

Our second objective aims to test the relationship between different social capital measures and health. Here, we focus on self-rated health (SRH) and diagnosed hypertension as two health variables. SRH and hypertension have been examined cross-sectionally in relation to

social capital, but few studies have evaluated their relationship to social capital longitudinally (e.g., Giordano & Lindstrom 2010). Even less research has sought to disentangle the different measures of social capital and assess whether each has a different relationship with SRH or hypertension. Hence, this study aim does not have specific, directional hypotheses to test with respect to potential associations between these social capital and health measures, although we would anticipate that social capital, if significantly associated, would be beneficial for a person's health (as shown in abovementioned cited studies).

Objective 3: Gendered Patterns of Social Capital and Health

Finally, our third aim focuses on potential differences in observed patterns for men and women. As noted above, there have been no studies comparing the validity of social capital measures in men and women separately, while mixed findings show the relative importance of trust, participation, and network capital for men's and women's health. Hence, we do not have any specific hypotheses regarding the relationship among trust, participation, network capital, and health differ for men and women. Rather, we simply aim to test the general hypothesis that observed patterns of associations will differ between men and women. Empirically, this entails stratifying all of our analyses for objectives 1 and 2 by men and women. Overall, testing this general hypothesis is valuable in contributing to a broader understanding of whether social capital is gendered and, if so, which measures of social capital are more or less salient for men and women. Figure 1 illustrates the conceptual model for our analyses..

Methods

Sample

Our data came from the Montreal Neighbourhood Networks and Healthy Aging (MoNNET) Panel. The MoNNET Panel consists of three waves (2008, 2010, 2012/2013) of

survey data collected from a probability-based sample of 2707 Montreal adults aged 25 years and older. The study's initial response rate was 38.7%. Details about the MoNNET sampling design and study eligibility may be found elsewhere (Moore, Buckeridge and Dubé, 2014b).

Initial participants were recontacted in 2010 (Wave 2) and 2012/2013 (Wave 3). The cooperation rates were 60.4% and 56.3% for waves The sample size decreased, such that waves two and three had a sample size of 1400 and 972 participants respectively. Compared to 2006 Montreal Census data, wave-one participants over-represented older adults (by design), females, persons residing in their current place for more than five years, and adults with more than a high school degree (Moore et al. 2014b). Analyses of attrition found recurrent participants tending to reside in French-speaking households, being higher educated, and between 35 and 74 years old in 2008 (Moore et al. 2014b).

Measures

Social Capital Variables

Social capital was examined using five variables measured at all three time points: generalized trust and neighbor trust (both representing cognitive social capital); social participation (representing structural social capital); and network diversity and social isolation (both representing network social capital).

Generalized trust was assessed using an ordinal variable based on the question "Generally speaking, would you that most people can be trusted or that you can't be too careful in dealing with people?" with the response scale of (1) most people can be trusted, (2) can't be too careful, (3) depends, (4) most people cannot be trusted, and (5) don't know. Responses were reverse-coded so that higher numbers indicated greater trust, with 'don't know' treated as missing.

Neighbor trust was based on responses to a single item, "People in your neighborhood can be trusted" and treated as an ordinal variable using a five-point Likert scale from strongly agree to strongly disagree. Responses were reverse coded so that higher numbers indicated greater neighbor trust, with "don't know" treated as the neutral category.

Social participation was assessed by asking participants whether they had been active in the last five years as a volunteer or officer in a group or association outside or inside their neighborhood. Social participation was defined dichotomously as those who participated in some form or location compared to those who did not participate at all.

Network diversity was a count of the number of occupations (0-10) that a person reported being able to access on the MoNNET position generator instrument, and therefore coded as a continuous variable. The occupations with the highest and lowest prestige value were physician and janitor respectively. More details on the study's position generator can be found elsewhere (Moore et al. 2011).

Social isolation was based on whether a participant reported in the name generator having had at least one person with whom they could discuss important matters in the last six months. This single item was coded as zero for non-isolated adults and one for isolated adults.

Health Variables

Our two health variables were also measured at all three time points. *Self-reported health* (SRH) was operationalized using the question "In general, would you say your health is (i) excellent, (ii) very good, (iii) good, (iv) fair or (v) poor." Responses were dichotomized into high and low SRH, with excellent and very good considered high SRH.

Hypertension was based on participants' reports of whether a doctor or other health professional had previously diagnosed them with hypertension, and coded as a dichotomous variable (yes=1, no=0).

Control Variables

We included age and socioeconomic status (SES) as control variables. Age was a six category variable based on the participant's age at wave one (ranging from 25-34 years old to 75 years or older). Using principal components analysis, SES was estimated from participants' wave-one data on educational attainment, income category, and employment status. The scoring coefficients were 0.32, 0.49, and 0.24 respectively. The specific coding for these variables is detailed in Table 1.

Analyses

To examine the relationships among social capital measures and their relationships with the health variables, we undertook three sets of statistical analyses for each gender. First, we calculated descriptive statistics for each of the social capital and health variables from the panel in waves one through three, and, using analysis of variance (ANOVA), Mann-Whitney U, or chi-square tests, assessed whether there were significant differences between men and women at each wave. Second, we estimated Spearman's rank correlations among the wave one (W1) social capital and health measures for men and women separately. Third, we undertook separate generalized structural equation modeling (GSEM) to analyze the paths among measured social capital, health, and control variables at the three waves of the MoNNET study. GSEMs allow fitting binary and ordered logistic, and linear estimations or paths simultaneously (Stata, 2015). To maximize the data available, we allowed the sample size to vary for each path and between

each wave. We examined and compared a simple to a full path model. The simple path model had the following characteristics:

1. Age and SES at wave 1 (W1) were treated as exogenous variables influencing the endogenous set of four social capital measures and hypertension or SRH at W1.
2. The endogenous W1 variables—i.e. all five social capital and health variables—were used to assess their longitudinal relationship across the next two waves, with the W1 variables used to predict W2 variables and W2 used to predict W3 (e.g., W1 general trust→W2 general trust→W3 general trust).

Also, as shown in Figure 1, the full model added the following cross-lagged effects:

3. Each W1 social capital variable was considered to influence each of the other W2 social capital and health variables, with W2 variables considered to influence the W3 variables (e.g., W1 general trust → W2 neighbor trust → W3 network diversity).

Because our focus was on the interrelationship among social capital variables and their direct effects on specific health outcomes, we ran models examining the direct effects of social capital on hypertension and SRH separately. In addition, we examined in separate models the structural paths linking W1 variables directly to W3 variables.

The path coefficients of the relationship between W1→W2→W3 or W1→W3 variables were estimated separately for men and women, with standard errors adjusted for clustering of observations within individuals. GSEM is more limited than SEM in terms of diagnostic tests for evaluating model fit. For space considerations, we provide the statistically significant variables and path coefficients ($p<0.05$) in Table 3 and all path coefficients and standard errors in the supplementary Tables 2S-3S. To discuss substantive significance in the text, we convert, where

appropriate, coefficients to odds ratios to ease interpretation. To help assess model fit, we also estimated an optimized path model for women and men separately that consisted in only those paths that were shown significant in the full path models. Likelihood ratio tests (LRTs) were used to compare the simple path models to the full path models and the optimized models to the full models. We also examined the Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) for each model. The AIC and BIC both estimate the relative quality of a model by balancing either higher goodness-of-fit (AIC) or likelihood (BIC) values against model parsimony. The BIC rewards model parsimony more than the AIC. In general, lower AIC and BIC values indicate better-fitting models (Burnham and Anderson, 2004). Analyses were conducted using the GSEM feature in Stata, version 14.

Results

Descriptive Statistics.

Table 1 provides descriptive information on the exogenous socio-economic and -demographic variables by gender. Women were more likely to respond to the initial wave-one interviews than men, with sample sizes reflecting this differential response pattern. At wave one, 1751 women and 956 men completed the household questionnaire. Depending on the wave, sample sizes varied for women and men from these initial counts. Socioeconomic factors were to the advantage of men, who, compared to women, were more likely to be employed, have a university degree or more, and be in the highest income category.

Table 2 presents descriptive information on the endogenous variables by gender at each wave. Women tended to have lower levels of generalized trust at all three waves and lower levels of network diversity at W1 than men. No significant differences existed between men and women for the other social capital measures or health variables.

W1 Correlations.

The Wave 1 subheading of Table 3 provides the significant non-parametric partial correlation coefficients among social capital and health variables by gender. Among women (estimates listed below the diagonal), the cognitive social capital measures of generalized trust and neighbor trust were more strongly correlated with each other (0.25) than with social participation and both network capital measures (each trust item's correlation with these variables ≤0.10). Conversely, social participation and both network capital measures showed stronger correlations with each other than with the cognitive social capital measures. Specifically, generalized trust was significantly correlated in expected directions with neighbor trust, social participation, and network diversity, but not with social isolation. Neighbor trust was also correlated with network diversity and social participation. Furthermore, social participation was correlated with network diversity (0.26) but not isolation—with both network capital measures correlating modestly in the expected negative direction (-0.22). Women's hypertension was negatively correlated with generalized trust (-0.12) and network diversity (-0.06), but positively correlated with social isolation (0.11). Higher SRH in women was correlated with all social capital measures in expected directions.

Among men, the pattern of correlations was similar in direction and magnitude to that observed for women (e.g., cognitive social capital measures correlating more strongly with each other than with the social participation and network capital variables), but some differences existed. Generalized trust was positively correlated with neighbor trust (0.31) and negatively with social isolation (-0.08), but not with social participation as in women. Neighbor trust also correlated with social participation (0.07), while social participation correlated positively with network diversity (0.26) but not social isolation. Network diversity and social isolation were

negatively correlated. Additionally, men's hypertension was only correlated with social isolation (0.11), while men's higher SRH was correlated positively with all the social capital measures except social participation. High SRH and hypertension were negatively correlated in men (-0.18) and women (-0.23).

The GSEM Path Model for Women

W1 Exogenous Paths. Table 3 also lists the statistically significant path coefficients (p<0.05) for the relationships among the exogenous and endogenous variables in women, with Supplementary Table 2S providing full information. Figure 1S illustrates the significant paths among the exogenous variables (SES and age), five social capital measures, and both health outcomes in women. Table 3 provides a summative account of the statistically significant (p<0.05) paths among study variables. At W1, women's age was positively associated with their risk of social isolation and hypertension; women's SES was associated with all five social capital variables, hypertension, and SRH. Generalized trust was negatively associated with having hypertension in women; generalized and neighbor trust were both associated with women's SRH.

W1 →W2. The model showed stability for each of the W1 social capital measures in their relationship to the equivalent social capital measure at W2. With respect to predicting other social capital variables, each W1 social capital measure except social participation predicted women's W2 generalized trust. Furthermore, for the trust variables, women's W1 generalized trust also predicted women's W2 neighborhood trust; while W1 neighborhood trust predicted W2 network diversity. W1 social participation also predicted W2 network diversity. Among the network capital variables, W1 network diversity predicted women's W2 neighbor trust and social

isolation. For example, for each occupation named in the position generator at W1 (i.e. one unit higher network diversity), women had 14% lower odds of being isolated at W2.

For the W2 health variables, women's W1 generalized trust was related to better W2 SRH while W1 network diversity was related to W2 hypertension and SRH.

W2→W3. To estimate the W2 to W3 relationships, we had, depending on the specific variable, a sample size of 888 women. With the exception of W2 social isolation, the remaining four W2 social capital measures predicted their equivalent W3 social capital measure. However, with regard to the W2 variables' respective associations with other W3 social capital variables, the extent and pattern of associations are more circumscribed compared to what was observed for W1→W2 variables.

Among the W2 trust variables, women's generalized trust also predicted W3 social participation while W2 neighbor trust predicted both W3 generalized trust and W3 network diversity. W2 network diversity predicted W3 generalized trust. Lastly, neither W2 health variable was associated with either of the W3 health variables.

W1→W3. With the exception of social isolation, the four W1 social capital measures predicted their equivalent W3 social capital measure.

With respect to W1 variables predicting other W3 variables, among the trust variables, women's W1 generalized trust predicted W3 neighbor trust; while W1 neighbor trust predicted W3 generalized trust and social participation. For social participation, women's W1 participation only predicted W3 network diversity. Among the network capital variables, W1 network diversity predicted W3 generalized and neighbor trust as well as social participation; but W1 social isolation was negatively related to W3 generalized trust.

The GSEM Path Model for Men

406 *W1 Exogenous Paths.* Table 3 reports the significant path coefficients for the same
407 GSEM in men, with Supplementary Table 3S providing full information. Figure 2S illustrates the
408 significant paths among the study variables.

409 Among men, age was significantly associated with W1 hypertension and each W1 social
410 capital variable except generalized trust. Men's SES was associated with all W1 social capital
411 variables and W1 SRH. W1 neighbor trust and social isolation were respectively positively and
412 negatively associated with SRH, but no W1 social capital variables were associated with W1
413 hypertension.

414 *W1→W2.* Each of the W1 social capital measures predicted their equivalent W2 social
415 capital measure, but results were generally limited for W1 social capital variables predicting
416 *other* W2 social capital variables: W1 neighbor trust predicted W2 generalized trust, while W1
417 network diversity positively predicted W2 generalized trust and social participation, but
418 negatively predicted W2 social isolation. Similar to women, for each additional unit of network
419 diversity listed at W1, men had 20% lower odds of being isolated at W2. For W2 health
420 variables, only W1 social isolation predicted men's W2 SRH, but no W1 measures were
421 associated with W2 hypertension.

422 *W2→W3.* Similar to the W2→W3 findings for women, with the exception of men's W2
423 social isolation, the other four W2 social capital measures predicted their equivalent measure at
424 W3. Furthermore, men's W2 generalized trust predicted W3 social isolation; while W2 social
425 participation predicted W3 generalized trust and network diversity. No W2 social capital
426 measures predicted W3 hypertension or SRH.

427 *W1→W3.* In testing the W1→W3 associations for men, again, with the exception of
428 social isolation, the four W1 social capital measures predicted the equivalent W3 social capital

measure. As for predicting other social capital variables, results were limited to men's W1 neighbor trust predicting W3 generalized trust; W1 social participation predicting W3 generalized trust and network diversity, and W1 network diversity predicting W3 social participation and social isolation. No W1 social capital measures predicted W3 hypertension or SRH.

Model diagnostics. The model diagnostics can be found in Supplementary Table 4S. The Likelihood Ratio Tests (LRTs) showed that the full models provided a better goodness-of-fit than the simple path models for women and men; the LRTs also showed the full model to provide a better fit than the optimized model. The lowest AIC and BIC values were in the models estimating the paths directly linking the waves one and three variables, since the W1→W3 model specified the same set of relationships as the W1→W2→W3 model but without the additional six W2 variables.

Discussion

Research on social capital and health has tended to measure three types of social capital – cognitive, structural, and network – with few studies examining the degree to which these measures correlate with each other over time. Using longitudinal data from a Canadian adult sample, this study aimed to evaluate the associations among (1) measures of different types of social capital and (2) their relationships to health outcomes, specifically SRH and hypertension; and, examine (3) how the patterns of associations between these social capital and health measures differed between men and women. For objective one, we tested two hypotheses – the distinct construct and causal pathways hypotheses. The findings suggested that the relationships among social capital measures differed for women and men, with specific social capital variables generally predicting their analog at a later time period, but also with the different social capital

452 measures more strongly correlated in women than men. We therefore discuss our hypothesis tests
453 separately for women and men, and then consider the implications of our findings for advancing
454 research on social capital and health.

455 *The Distinct Constructs Hypothesis*

456 The distinct constructs hypothesis suggests that cognitive (generalized trust,
457 neighborhood trust), structural (social participation), and network (network diversity, social
458 isolation) measures capture unique and distinct dimensions of social and psychosocial influences
459 on health. If this were the case, we would expect few or weak correlations among the social
460 capital variables at W1 or over time. Our findings revealed similar patterns of social capital
461 measures predicting their analogous subsequent wave measures (with the exception of social
462 isolation), consistent with prior longitudinal research (Claibourne and Martin 2000). However,
463 other gender-specific patterns existed.

464 Among women, the analyses showed that generalized and neighbor trust, social
465 participation, and network diversity all significantly correlated with each other at W1. Yet, the
466 strength of these correlations was relatively low (<0.32), suggesting that the different variables
467 only weakly reflected the same construct. At W2 and W3, however, the number of significant
468 W1 correlations declined, although the cognitive and network social capital measures tended to
469 remain more closely—albeit weakly—associated. W1 generalized and neighbor trust each
470 predicted the other at the later waves. Structural social capital (i.e., social participation)
471 gravitated toward network diversity, with W1 social participation predicting network diversity at
472 W2 and W3. While W1 network diversity predicted W3 social participation, network diversity
473 also tended to be the more consistent predictor of social isolation at later waves.

For men, the path analyses showed more consistent support for the distinct construct hypothesis. First, there were a fewer number of correlations among the social capital measures for men compared to women—at W1 or later waves with the strength of those correlations low. Second, compared to women, the cognitive social capital measures for men appeared to be more distinct. For example, W1 neighbor trust predicted only generalized trust at later waves, and was not correlated with other social capital measures. Third, when significantly correlated, social participation, network diversity, and social isolation tended to coalesce more closely in men than women. With this in mind, we would suggest that, for men, cognitive social capital seems distinct from the network and structural measures of social capital, as argued in prior cross-sectional analyses (Carpiano and Fitterer 2014a).

The Causal Pathways Hypothesis

The causal pathways hypothesis suggested that the different measures of social capital predicted the other types of social capital at later waves. While testing this hypothesis led us to examine the same relationships that we discussed in the previous subsection, our focus here is on whether social capital variables preceded other variables in time, and not whether social capital measures were correlated over time.

In women, the various measures of social capital tended to be intertwined across the three waves with no clear measure appearing to be an upstream causal driver of other social capital measures. In men, there was also little evidence supporting this hypothesis. Generalized trust tended to be more sensitive to earlier measures of neighbor trust, social participation, and network diversity, which is consistent with prior US and British longitudinal studies identifying that close or domain-specific interactions can increase generalized trust (Glanville et al. 2013; Li

et al. 2005). However, there was no social capital measure that stood out as a consistent predictor of generalized trust or any other social capital measure.

Social Capital and Health

Similar to the interrelationships among the social capital variables, social capital seemed to be more salient for women's health than men's. At W1, generalized trust, network diversity, and social isolation significantly correlated with women's SRH and hypertension risk. Neighbor trust and participation were correlated with SRH. Over time, the strength of the relationship between the social capital measures and health weakened in women. Nevertheless, W1 generalized trust and network diversity were associated with W2 SRH, and W1 network diversity was also associated with W2 hypertension.

The social capital-health relationship was weaker in men. Hypertension was not related to any measures of social capital at any wave. At W1, men's SRH was correlated with the cognitive and network measures of social capital; only W1 social isolation predicted SRH at wave two. Collectively, these findings are consistent with prior work finding cognitive social capital to be more strongly associated with women's health (Bassett and Moore 2013; Karhina et al. 2016). However, for structural and network types of social capital, unlike prior work (Ferlander and Mäkinen 2009; Landstedt et al. 2016), our findings do not indicate any substantial health benefit for men.

Despite differences in the study sample size between men and women and across waves, our study shows the stability of social capital related variables over time, with cross-lagged effects between certain variables. For example, for every unit increase in W1 network diversity (i.e., knowing one additional occupation on the position generator), our adjusted findings suggest between a 18%-36% decrease in the odds of men being socially isolated and a 14% - 30%

519 decrease in the odds of women being socially isolated at W3 (These values were calculated by
520 exponentiating the coefficients and standard errors for the relationships shown in Table 3). The
521 practical significance of such findings is worth highlighting since they show the importance of
522 fostering generalized social connectivity as a means of addressing individual social isolation.
523 Other findings, such as the role that neighborhood trust may play in generating greater
524 generalized trust, might also be leveraged for population health goals.

525 *Strengths and Limitations*

526 Though our study analyzed three waves of data containing information on multiple
527 domains of personal social capital and health, our findings must be considered with respect to
528 several limitations. First, regarding our data, we chose to maximize our sample size and therefore
529 used all available observations at each wave versus restricting the analysis to only those
530 participants with three waves of data. Panel attrition meant that we had smaller numbers to
531 estimate the later waves compared to the W1 cross-sectional correlations in particular. To assess
532 the possible impact of attrition on our findings, we conducted sensitivity analyses in which we
533 reran the models with only those female (n=444) and male (n=262) participants who participated
534 in all three waves. These analyses provided similar results as those reported in this study with the
535 exception that social isolation was weakly correlated with the other social capital variables and
536 health outcomes. This may have been due to the fact that W1 social isolates tended to drop out
537 of MoNNET at later waves (as noted in other studies) (Watanabe et al., 2017).

538 Second, though the original sample was probability based, panel attrition resulted in a
539 sample more representative of French-speaking households, higher educated, and middle aged
540 adults (Moore et al. 2014b). The generalizability of the findings may thus be more limited than in
541 cross-sectional studies where attrition is not an issue. However, the richness of the multiple

542 measures and the longitudinal design enables us to better disentangle temporal ordering of the
543 different measures than cross-sectional studies on this topic. Nevertheless, future research might
544 examine the patterns of these measures and their health implications over longer time periods
545 than were available in this longitudinal data set of three time points within five years..

546 Third, regarding study measures, we would draw readers' attention to two limitations.
547 First, in terms of our social capital measures, our study did not exhaust all social capital items
548 used in health research. For example, we did not assess cognitive measures related to norms of
549 reciprocity (e.g., one common item asking respondents the degree they believe "People would
550 take advantage of you if they had the chance"), structural social capital variables related to
551 specific social or civic club and organization membership, and network social capital measures
552 derived from using a resource generator instrument (Van Der Gaag and Snijders 2005).
553 Nevertheless, our study did include frequently used social capital measures. Second, in terms of
554 our health outcomes, we relied on self-reported measures of doctor-diagnosed hypertension and
555 health status. In population-based studies, self-reported hypertension often underestimates
556 measured hypertension rates, especially in men. This is due to low levels of awareness or access
557 to diagnostic services (Wilkins et al., 2010). However, more than four-fifths (83%) of Canadians
558 with hypertension have been shown aware of their condition (Wilkins et al., 2010). While the
559 prevalence of hypertension was greater in our sample than its prevalence in the Canadian
560 Community Health Survey (25.1% vs. 18.4% in 2008), (Blais et al., 2013) this is likely due to
561 MoNNET's oversampling of older adults.

562 *Implications for Future Research*

563 We conclude by discussing how our findings might advance research on personal social
564 capital and health. First, in support of previous cross-sectional research, our longitudinal analysis

suggests that gendered social experiences modify the relationship among different measures of social capital and between social capital and health. For men, trust measures appear to be inadequate proxies for other social capital domains (namely structural and network social capital), with particularized trust (i.e., trust in neighbors) appearing as a precursor to general trust, but little else. For women, generalized trust is also an inadequate proxy for network social capital, although particularized trust and network diversity are correlated with each other across waves. Recognizing these gendered differences may help elucidate the specific mechanisms by which social capital influences health for men and women.

Second, our longitudinal analyses show that, regardless of gender, specific social capital measures are predictive of the same measure/domain over time, thereby suggesting the stability of a person's social capital over this circumscribed time period. Our study did not assess whether these measures remained stable over time for older versus younger adults or low versus high SES groups. Nevertheless, studies that use a cross-sectional measure of a particular aspect of social capital may be indirectly capturing the effect of that aspect over at least a short-term (i.e. at least several year) period.

Third, with respect to social capital measures being predictive of other types/domains of measures at later time periods, this is not necessarily an argument that specific items are measuring the same domain. Rather, it is more indicative of how elements like neighbor trust may be key in forming and/or a product of possessing specific network ties (e.g., having greater social participation or network diversity).

Finally, health studies of personal social capital need to consider the existence of differences between men and women in access to and utility of social capital for health. Such considerations require careful a priori theoretical specification regarding why such differences

588 might exist with respect to specific social capital domains and health outcomes—and not simply
589 rely on post-hoc tests of statistical difference.

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Appendix

Table 1: Descriptive Statistics, Montreal Neighborhood Network and Healthy Aging Panel (MoNNET), Men and Women, 2008-2013, n=2707.

Table 2: Descriptive Statistics for Endogenous Social Capital and Hypertension Variables, MoNNET Panel, Men and Women, 2008-2013, n=2707.

Table 3: Summative results categorizing path coefficients among women and men with *p-value* <0.05, MoNNET, 2008-2013, n=2707.

Figure 1: Conceptual model illustrating the paths estimated across three waves of data in women and men, MoNNET, 2008-2013, n=2707.

Table 1: Descriptive Statistics for Socioeconomic Status and Age Exogenous Variables, Montreal Neighborhood Network and Healthy Aging (MoNNET) Baseline Panel.

	Female (n=1751)	**Male (n=956)**
Socioeconomic status		
Educational attainment		
Less than High School	13.5%	9.1%
	(0.01)	(0.01)
High School	30.1%	27.5%
	(0.01)	(0.03)
College	21.4%	19.5%
	(0.01)	(0.03)
University degree plus	35.1%	44.0%
	(0.01)	(0.02)
Income group		
Lowest income group	25.1%	17.9%
	(0.01)	(0.01)
Low income group	27.0%	28.7%
	(0.01)	(0.02)
Middle income group	22.9%	24.5%
	(0.01)	(0.02)
High income group	12.5%	12.6%
	(0.01)	(0.01)
Highest income group	12.5%	16.3%
	(0.01)	(0.01)
Employed	51.4%	59.8%
	(0.01)	(0.02)
Age Category		
25-34 years	15.4%	13.3%
	(0.01)	(0.01)
35-44 years	16.7%	19.2%
	(0.01)	(0.01)
45-54 years	19.8%	20.8%
	(0.01)	(0.01)
55-64 years	16.2%	16.4%
	(0.01)	(0.01)
65-74 years	21.0%	20.7%
	(0.01)	(0.01)
75 years or older	11.0%	9.5%
	(0.01)	(0.01)

NOTE: Values in parentheses are standard errors.

Table 2: Descriptive Statistics for Endogenous Social Capital and Hypertension Variables, MoNNET Panel.

	Female			**Male**		
	Wave 1 (n=1751)	**Wave 2 (n=890)**	**Wave 3 (n=621)**	**Wave 1 (n=956)**	**Wave 2 (n=510)**	**Wave 3 (n=351)**
Generalized Trust	3.24*	3.35*	3.35*	3.33*	3.46*	3.45*
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.04)
Neighbor Trust	0.81*	0.85	0.88	0.74*	0.83	0.90
	(0.03)	(0.04)	(0.04)	(0.03)	(0.05)	(0.05)
Network Diversity	4.21*	4.46	4.62	4.42*	4.62	4.74
	(0.06)	(0.08)	(0.09)	(0.08)	(0.10)	(0.12)
Social Isolation	13.2%	8.8%	4.5%	15.1%	11.0%	6.3%
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
No Social Participation	54.7%	59.9%	56.7%	58.7%	63.3%	60.2%
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Hypertension (diagnosed)	25.1%	24.6%	28.7%	22.8%	27.5%	31.0%
	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)
Self-reported Health (High)	60.2%	60.0%	56.2%	58.0%	52.7%	56.2%
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)

Note: Values in parentheses are standard errors

Table 3: Summative results of significant (*p<0.05)* path coefficients among women and men, MoNNET Panel, n=2707.

Wave 1 Social capital Correlates (Spearman's rank correlation coefficients)

Wave 1	**Wave 1 Female**	**Wave 1 Male**
General Trust	Neighbor Trust: 0.31*** Social Participation: 0.17*** Network Diversity: 0.20*** Social Isolation: -0.12 Hypertension: -0.12*** Self-reported Health: 0.17***	Neighbor Trust: 0.34*** Social Participation 0.11* Social Isolation: -0.13* Self-reported Health: 0.17**
Neighbor Trust	General Trust: 0.25*** Social Participation: 0.12* Network Diversity: 0.14** Social Isolation: -0.08* Self-reported Health: 0.21***	General Trust: 0.31*** Social Participation: 0.10* Self-reported Health: 0.17***
Social Participation	General Trust: 0.17*** Neighbor Trust: 0.12* Network Diversity: 0.30*** Self-reported Health: 0.08*	Neighbor Trust: 0.10* Network Diversity: 0.29***
Network Diversity	General Trust: 0.20*** Neighbor Trust: 0.14** Social Participation: 0.30*** Social Isolation: -0.26*** Hypertension: -0.12** Self-reported Health: 0.15***	Social Isolation: -0.25*** Social Participation: 0.29*** Self-reported Health: 0.12**
Social Isolation	Network Diversity: -0.26*** Social Participation: -0.12*** Hypertension: 0.12*** Self-reported Health: -0.15***	General Trust: -0.13* Network Diversity: -0.25*** Hypertension: 0.12*** Self-reported Health: -0.16***

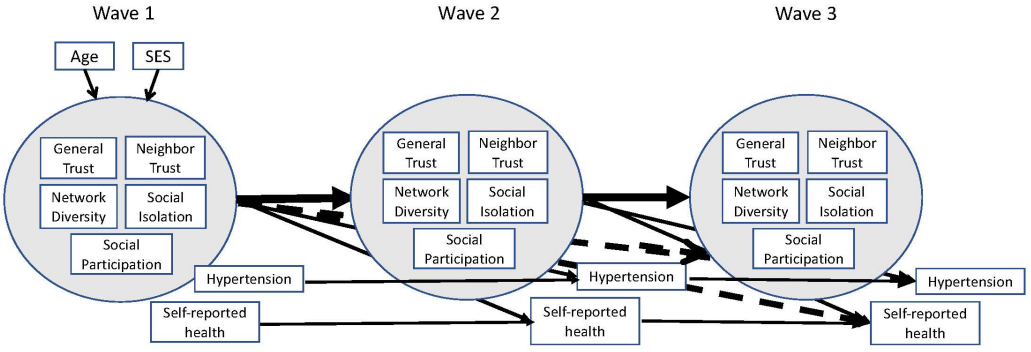
Wave 1 Exogenous Variables→Wave 2 [Path Coefficients (Standard Errors)]

Wave 1	**Wave 2 Female**	**Wave 2 Male**
Age→	Social Isolation: 0.32*** (0.06) Hypertension: 0.51*** (0.05)	Neighbor Trust: 0.18*** (0.04) Social Participation: 0.17** (0.05) Network Diversity: 0.12 (0.05) Social Isolation: 0.29*** (0.07) Hypertension: 0.42*** (0.06)
SES→	General Trust: 0.73*** (0.07) Neighbor Trust: 0.67*** (0.07) Social Participation: 0.54***	General Trust: 0.61*** (0.09) Neighbor Trust: 0.50*** (0.09) Social Participation: 0.44*** (0.09)

	(0.07) Network Diversity: 1.11*** (0.07) Social Isolation: -0.77*** (0.12) Hypertension: -0.28** (0.10) Self-reported Health: 0.64** (0.08)	Network Diversity: 1.06*** (0.10) Social Isolation: 0.88*** (0.14) Self-reported Health: 0.45*** (0.10)

Table 3 (continued): Summative results of significant (*p<0.05)* path coefficients among women and men.		
Wave 1 → Wave 2 [Path Coefficients (Standard Errors)] (n_f=883; n_m=504)		
Wave 1	**Wave 2 Female**	**Wave 2 Male**
General Trust→	Neighbor Trust: 0.32*** (0.10) Self-reported Health: 0.27* (0.11)	…
Neighbor Trust→	General Trust: 0.29*** (0.06) Network Diversity: 0.78*** (0.08)	General Trust: 0.19* (0.09)
Social Participation→	Network Diversity: 0.22 (0.09)	…
Network Diversity→	General Trust: 0.08* (0.04) Neighborhood Trust: 0.12** (0.03) Social Isolation: -0.15* (0.06) Hypertension: -0.16** (0.06) Self-reported Health: 0.08* (0.04)	General Trust: 0.08* (0.04) Social Participation: 0.13** (0.05) Social Isolation: -0.22** (0.07)
Social Isolation→	General Trust: -0.68*** (0.25)	Self-reported Health: -0.66* (0.32)
Wave 2 → Wave 3 [Path Coefficients (Standard Errors)] (n_f=444; n_m=261)		
Wave 2	**Wave 3 Female**	**Wave 3 Male**
General Trust→	Social Participation: 0.48* (0.19)	Social Isolation: -1.13* (0.55)
Neighbor Trust→	General Trust: 0.20* (0.09) Network Diversity: 0.18* (0.08)	…
Social Participation→	…	General Trust: 0.44* (0.20) Network Diversity: 0.37* (0.16)
Network Diversity→	General Trust: 0.12** (0.04)	…
Social Isolation→	…	…
Wave 1 → Wave 3 [Path Coefficients (Standard Errors)] (n_f=617; n_m=349)		
Wave 1	**Wave 3 Female**	**Wave 3 Male**
General Trust→	Neighbor Trust: 0.34* (0.14)	…
Neighbor Trust→	General Trust: 0.26** (0.08) Social Participation: 0.22* (0.10) Hypertension: -0.22* (0.11)	General Trust: 0.40*** (0.10)

Social Participation→	Network Diversity: 0.36*** (0.10)	General Trust: 0.48** (0.16)
Network Diversity→	General Trust: 0.14*** (0.04) Neighbor Trust: 0.10** (0.04) Social Participation: 0.09* (0.04) Social Isolation: -0.25* (0.10)	Social Participation: 0.10* (0.05) Social Isolation: -0.32 (0.12)
Social Isolation→	General Trust: -0.67* (0.33) Hypertension: 0.99** (0.37)	…
*p<0.05; **p<0.01; ***p<0.001		



Note: Figure 1 shows age and SES as exogenous variables related to the set of five wave-one social capital variables and two health variables. Solid arrow lines show wave-one social capital variables related to wave-two social capital variables and health variables and wave-two social capital variables related to wave-three social capital variables and health variables. Dashed lines show wave-one social capital variables related to wave-three social capital and health variables. Hypertension and SRH are seen to predict hypertension and SRH at later waves.

Research Highlights

- Correlations among social capital-related measures are patterned by gender.
- Trust, participation, and network diversity measures are distinct, especially in men.
- Trust, participation, and network diversity measures are stable over time.
- Generalized trust is an inadequate proxy for network social capital.
- Social capital measures did not consistently predict health measures over time.