



## Article

# A cohort longitudinal study of individual level social capital and depressive symptoms in the Wisconsin Longitudinal Study

Kyle A. Carr

Department of Sociology, Boston College, 140 Commonwealth Ave., Chestnut Hill, MA, 02467, USA



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## ABSTRACT

This study examined the association between two dimensions of social capital, structural and cognitive, and depression, as well as investigating their within- and between-effects. Using the Wisconsin Longitudinal Study, I applied a multi-level 2-wave longitudinal analysis, over a 7-year period, to examine these two dimensions of social capital influence on individual's depressive symptoms at both the between- and within-person levels. Results suggest both dimensions of social capital are negatively related with levels of depressive symptoms. The within-person changes for both self-efficacy and sense of belonging were larger than the estimates of between-effects, while trust and structural social capital effects were equal. These findings add to the growing body of literature examining depressive symptoms in late life, while also providing evidence for policymakers to hone in on key areas that can address depressive symptoms with social capital interventions.

## 1. Introduction

At present, the United States ranks as the third most “depressed” country in the world with one in every six Americans diagnosed with clinical depression in their lifetime (“WHO | Depressive symptoms,” n. d.). This high prevalence of clinical depression, as well as undiagnosed depression and subclinical depressive symptoms, is an increasingly important public health issue when considering the disabling components of the illness. In the most dire circumstances, depression can lead to suicide (Fergusson, Horwood, Ridder, & Beautrais, 2005). It is also a predictor of physical disability (Prince et al., 2007) and lifelong mental health problems (Fergusson et al., 2005). Older adults are at even greater risk for depression, which is estimated to affect 10%–15% of the community-dwelling population (Mohebbi et al., 2019). Therefore, it is imperative to understand the underlying mechanisms at play in combating depressive symptoms to better promote both the physical and mental health for an aging population.

Social capital, or the social resources embedded in interpersonal relationships, is paramount in understanding the high levels of depressive symptoms in older adults. As individuals age, the importance of social capital increases with many older adults becoming more reliant on their social networks for practical help (Forsman, Nyqvist, Schierbeck, Gustafson, & Wahlbeck, 2012). Beyond practical help, previous research posits one's social capital also influences physical health and mental health by providing individuals with social resources, such as

social connections or trust in their social networks, that supports them in later life (Forsman et al., 2012). Thus, social capital is an invaluable resource for older adults in both their day-to-day living and overall health. Yet, while reliance on social capital increases in later life, older adults have a higher probability of losing vital sources of social capital. These declining sources may come from the loss of a partner or friend, which can result in losing key components of social support. Furthermore, these dwindling levels of social capital in later life can have major health repercussions such as worsening mental health (Llopis & Gabi-londo, 2008). However, while social capital has been associated with mental health broadly in later life, this paper focuses on depressive symptoms specifically by examining how they are influenced by change in two dimensions of social capital – cognitive and structural. I aim to analyse whether cognitive and structural social capital are equally associated with depressive symptoms and whether one's overall level of social capital or experienced change in social capital is most effective in reducing depressive symptoms.

As public health policy gradually gains momentum, shifting discussions of depression away from a curative model towards a preventive route, understanding the social mechanisms at play will aid in identifying how social capital shapes some of this “global burden,” especially in the context of older adults. To understand how changes in social capital from mid-to-late life impact levels of depressive symptoms, this study examines cognitive and structural social capital over a 7-year period from 2004 to 2011 using data from the Wisconsin Longitudinal

E-mail addresses: [carrky@bc.edu](mailto:carrky@bc.edu), [carrky@bc.edu](mailto:carrky@bc.edu).

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Study (WLS).

### 1.1. Social capital: competing definitions, measurements, and pathways

The study of social capital and its connection to health and well-being dates at least to Durkheim's seminal work on suicide (1951). As Durkheim's theory suggests, social integration protects individuals against suicide. Suicide rates were low when there was high social integration and regulation, and high when individuals experienced isolation. While Durkheim never explicitly employed the concept of social capital in his work, Turner (Turner & Turner, 2004) examines how Durkheim's views of social solidarity evoke a parallel to social capital as they "refer to levels of social support that a person has and feelings of belonging that promote a sense of well-being."

The concept of social capital has expanded into numerous fields, especially social policy and sociology, which focus on determinants of health at the individual- and community-levels. Numerous studies support Durkheim's general hypothesis that larger social networks and higher levels of social support lead to better health (Berkman & Syme, 1979). However, debates surrounding the association between social capital and health remain, stemming from contention over the definitions of social capital, how social capital is quantified and measured, as well as pathways for how social capital influences health outcomes (Landstedt, Almquist, Eriksson, & Hammarström, 2016).

Bourdieu, Coleman, Portes, and Putnam, four major social capital theorists, vary in their definitions of social capital and how it accumulates (Bourdieu, 1986; Coleman, 1988; Portes, 1998; Putnam, 2000). Scholars focusing on either Bourdieu's, Coleman's or Portes's definition theorise social capital as the presence of networks, relationships, and associations that connect individuals (Webber, Huxley, & Harris, 2011). This dimension is known as structural social capital and has been theorised to influence health via a social support pathway. When individuals expand their social networks through involvement in group activities, such as volunteering or sports, they gain a broader social support system of people who affect their own health behaviours (Giordano & Lindström, 2011).

Researchers focusing on Putnam's definition understand social capital as one's perception of trust, sense of belonging, and self-efficacy from the community-level (Harpham, Grant, & Thomas, 2002). This dimension is known as cognitive social capital. Cognitive social capital has been theorised to influence health via a psychosocial pathway where the quality of relationships matters in influencing health through biological processes. Previously this pathway has been discussed by Wilkinson (2002) who found that low levels of trust can lead to increased levels of blood cortisol, resulting in poor health outcomes like depression.

Furthermore, social capital is a multidimensional concept and must be examined with both dimensions in the same analysis. These two dimensions of social capital and their pathways are not mutually exclusive, yet we need to distinguish between them to determine if one dimension is more or less effective in decreasing depressive symptoms. This will identify specific factors to target for change, providing policymakers with the information they need to construct policies to reduce depressive symptoms. However, previous research has typically modelled these dimensions of social capital separately, which inaccurately suggests they are independent of one another.

Many studies examining structural social capital have focused on only one variable, such as level of civic engagement (Hamano et al., 2010) or frequency of social contacts with family and friends (Forsman et al., 2012). In these papers, scholars focused on the social support pathway and how the size of social networks led to better mental health outcomes. However, this narrow focus may explain why inconsistent findings remain in the literature. Ehsan and Silva (2015) performed a systematic review and reported weak to non-significant associations among mental health, depressive symptoms and civic engagement. These competing results make it unknown whether the sole measure a

study identifies is most representative of structural social capital or if this measure is specific to the population or dataset.

Unlike studies examining structural social capital, many researchers measuring cognitive social capital used numerous variables to measure the concept. Cognitive social capital has been shown to have a strong association with self-rated health (Snelgrove, Pikhart, & Stafford, 2009) and a negative relationship with mental health (Hamano et al., 2010). When analysing cognitive social capital and depressive symptoms, Fujiwara and Kawachi (2008) reported trust of neighbours lowers the risk of developing depressive symptoms. Similarly, Forsman et al. (2012) concluded cognitive social capital lowers risks of depressive symptoms.

Yet, there remain inconsistent results even within this literature. Fujiwara and Kawachi (2008) reported an association between trust and depressive symptoms but no association for sense of belonging and mutual aid. Additionally, Harpham et al. (2002) examined social capital and mental health in Cali, Columbia and reported a significant association between trust and mental health, but not social cohesion. However, most of these studies used cross-sectional data, which limits conclusions to comparing individuals who have different levels of cognitive social capital at one point in time. It is advantageous to use longitudinal data to examine how changes in these dimensions of social capital, both across individuals and within individuals effect levels of depressive symptoms. Cross-sectional data restricts conclusions in only shedding light on changes across individuals and not change within. This limits actions by policymakers in creating policy to reduce depressive symptoms within individuals if studies only capture differences across people. Further research is needed to examine this association using a large longitudinal sample to understand if changes in social capital result in lower levels of depressive symptoms within an individual over time.

Longitudinal studies are pivotal to understanding how social capital affects depression both between people and the change an individual experiences over time (Curran & Bauer, 2011). While a plethora of prior studies provides valuable insights into the association between social capital and depressive symptoms cross-sectionally, there are limited longitudinal studies. I am aware of only four. Nakamine and colleagues (2017) studied 17,768 middle-aged adults in Japan over a 9-year period and examined the association between "bridging" (i.e., relationships among heterogeneous individuals) and "bonding" (i.e., relationships among homogenous individuals) social capital and depression. They used latent growth modelling and concluded increasing one's bonding social capital is related with diminished depression, while bridging had no association. A second study by Kim and colleagues (2012) analysed two measures of cognitive social capital in the Korean Welfare Panel Study (2006–2008). Using logistic regression, they reported low interpersonal trust is an independent risk factor for developing clinical depression one year later. Next, Landstedt et al. (2016) used cross-lagged structural equation modelling on a study of Northern Swedish individuals investigating the directional association between civic engagement and depressive symptoms. They concluded youth civic engagement was associated with declines in depression for men but no association for women. Finally, Cohen-Cline et al. (2018) used 1,586 same-sex two-wave twin data to examine social capital and neighbourhood characteristics to understand their effect on depressive symptoms. They reported only cognitive social capital variables as significantly associated with less depressive symptoms within-pairs.

Furthermore, only one of the four longitudinal studies previously mentioned scrutinized differences between persons versus intraindividual change over time, although a strength of longitudinal design is both estimates are available. By assuming these effects are equal, previous scholars assume levelling differences in social capital between individuals will result in reduction of depressive symptoms. Within-person effects, or intraindividual change, are of greatest interest from an interventionist perspective. While between-person effects suggest how one's current level of social capital is associated with one's current

level of depressive symptoms, within-person effects give insight into how changes in either dimension of social capital may affect depressive symptoms. Cohen-Cline et al. (2018) reported no association with structural social capital and depression, while cognitive social capital was associated with fewer depressive symptoms between-twin pairs and decreasing depressive symptoms over time within-twin pairs. Their findings identified the within-twin effects as significantly stronger than the between-twin effects. As such, it is possible social capital affects depressive symptoms differently when examining between- and within-person levels. For example, increasing levels of trust may decrease depressive symptoms for that individual, but individuals with high levels of trust may not have lower levels of depressive symptoms than individuals with lower levels of trust. The current study analyses these between- and within-person effects. I estimate the between-effects to examine how they correspond with the results of prior studies, and to determine whether any of the within-person effects are significantly different.

### 1.2. Aims

This study aims to address these gaps in the literature by estimating a multi-level 2-wave longitudinal model to examine the associations among cognitive and structural social capital and depressive symptoms for aging adults. A multi-level 2-wave longitudinal model allows me to investigate the differences, if any, that exist between the two dimensions of social capital at the level of between- and within-persons among cohort members, and intraindividual change across this 7-year period. The aims of this study were to examine whether (1) cognitive and structural social capital will both have a negative association with depressive symptoms at both the level of between- and within-persons; (2) analyse whether between-person and within-person effects are equal or unequal.

## 2. Methods

### 2.1. Data

The Wisconsin Longitudinal Study (WLS) is a random sample of one-third of the men and women who graduated from Wisconsin high schools in 1957 ( $N = 10,317$ ). The cohort was first surveyed in 1957 (age 18) and was followed up in 1964 (age 25), 1975 (age 36), 1992 (age 53), 2004 (age 65), and 2011 (age 72). The WLS used a combination of follow up techniques including in-person, telephone, and mail surveys. The data used in this longitudinal analysis come from the years 2004 and 2011 because 2004 was the first wave that included all six of the social capital variables. Overall, retention for the WLS is high, with response rates from the 2004 wave (86%) and 2011 wave (74%) at or above 74%, excluding deaths. For the present analyses, individuals who left the study before 2004 ( $N = 2,410$ ) and those whose participation continued but did not provide any valid responses to the depressive symptoms battery across the two waves ( $N = 1,167$ ) were omitted. The final analytic sample was 6,740.

The WLS reflects the population of Wisconsin in the 1950s; meaning less than 1% of the sample is non-white. Further, all respondents are high school graduates. Despite this, the WLS provides valuable data on white non-Hispanic high school graduates, who comprise two-thirds of Americans in this birth cohort (Piliavin & Siegl, 2007). Therefore, these data remain a valuable source of information for examining numerous life course questions.

### 2.2. Outcome variable

Depressive symptoms were measured by mail survey in 2004 and 2011 using the Center for Epidemiological Studies-Depression scale (CES-D) (Radloff, 1977). The WLS used a modified version of the original response scale. The WLS collapsed the response scale to range from

0 to 3 (less than 1 day, 1–2 days, 3–4 days, and 5–7 days). I created a sum score; the lowest reliability (Cronbach's alpha) was 0.83 in 2004. To reduce the positive skewness, I log transformed it for regression analyses.

### 2.3. Structural social capital variables

Number of volunteering activities, social support, and social integration were used as measures of structural social capital. Number of volunteering activities was measured by mail survey in 2004 and in-person in 2011 as a module asking about specific types of organizations the individual might have volunteered at over the past 12 months. These volunteer organizations included religious; school or educational; political group or labour union; senior citizen group or related organization; any other national or local organization; and any other volunteer activities. Each question was asked with a 'yes' or 'no' response. Previous studies have constructed an index measure to calculate the total number of volunteering activities (Morrow-Howell, Hinterlong, Rozario, & Tang, 2003); similarly, I added together the 'yes' responses to construct an index of the number of volunteering activities. Responses ranged between 0 and 10. This is a measure of general engagement in volunteering activities; unfortunately, the WLS did not have measures to determine intensity of volunteering in a single type of organization.

Social support was measured by mail survey in both waves as an index of two questions that asked whether a respondent had a person in 'your family' and then 'a friend' with whom they could 'share [your] very private feelings and concerns.' The items were measured dichotomously with either a 'yes' (1) or 'no' (0) response. I summed the values to create an index ranging from 0 to 2 with 2 referring to sources of social support both inside and outside the family, and 0 meaning no social support. Prior studies have also used these questions to measure social support in the WLS (Carr & Khodyakov, 2007).

Previous scholars have analysed social integration by determining how large an individual's social network is based on the number of social contacts (Forsman et al., 2012). Measures have included marital status, as well as time spent with family and friends (Berkman & Syme, 1979). Research suggests married individuals are more socially integrated than single individuals due to access to their spouse's network. Marital status was measured in-person in both waves as a simple indicator of either 'single' (0) or 'married' (1). Time spent with family, measured by mail survey in both waves, was ascertained with the question "How many times in the past four weeks have you gotten together with family?" Time spent with friends, also measured by mail survey in both waves, was ascertained with the question "How many times in the past four weeks have you gotten together with friends?" I scored each question as 'spent no time' (0); 'spent some time' (1) if they spent up to a total of four times in the past four weeks with their family/friends; and 'spent a lot of time' (2) if they spent more than four times in the past four weeks with family/friends.

### 2.4. Cognitive social capital variables

Self-efficacy, trust, and sense of belonging were measures for cognitive social capital. Each variable was measured by mail survey in both waves. Self-efficacy was measured using the environmental mastery dimension of the Ryff (1989) psychological well-being scale. This scale is comprised of five questions, including "To what extent do you feel in charge of the situation in which you live?" All items were measured on a 6-point Likert scale ranging from 'disagree strongly' to 'agree strongly.' Sum scores ranged from 0 to 30 with higher scores representing more self-efficacy; the lowest reliability was 0.72 in 2004.

Neither trust nor sense of belonging were included as multi-item scales in the WLS and therefore I selected a single item from the Ryff (1989) psychological well-being instrument for each concept. Both items were measured on a 6-point Likert scale ranging from 'disagree strongly' to 'agree strongly.' Trust was measured by asking 'To what

extent do you agree that you have not experienced any warm and trusting relationships with others?’ Sense of belonging was measured by asking respondents ‘To what extent do you agree that you often feel lonely because you have few close friends with to whom to share your concerns?’ Prior studies examining cognitive social capital have used similar measures of trust and sense of belonging (Ehsan & Silva, 2015).

### 2.5. Covariates

I controlled for potential confounders, including self-rated health, extraversion, educational attainment, sex of respondent and total assets, because of the possibility of associations with both depressive symptoms and social capital (Fujiwara & Kawachi, 2008; Webber et al., 2011). Self-rated health was measured by mail survey in both waves on a 5-point scale ranging from ‘very poor’ to ‘excellent.’ I dichotomized the item (very poor, poor, or fair vs. good or excellent) to account for skewness. Extraversion was also measured by mail survey in both waves on a 6-point scale with 6 questions (John, Naumann, & Soto, 2008). The 6-point Likert scale ranged from ‘disagree strongly’ to ‘agree strongly.’ 2011 had the lowest reliability at 0.75. Educational attainment was measured by phone in each wave as a continuous variable ranging from 12 to 21 years of education.

Additionally, sex of respondent and total assets were included as covariates. Total assets was measured by phone in both waves as an index of the respondent’s home equity; respondent’s and spouse’s retirement plans; respondent’s and spouse’s checking accounts, savings accounts, or money market funds; respondent’s and spouse’s CDs, government saving bonds, or treasury bills; and the total cash value of life insurance policies. Due to the skewness of total assets, I divided it into three roughly equal categories (33%) of ‘low,’ ‘medium,’ and ‘high’ assets, which ranged from 1 to 3.

### 2.6. Data analysis

**Statistical approach.** I conducted a multi-level 2-wave longitudinal analysis using the statistical software package Stata version 14.2 to test for both within- and between-person variance in depressive symptoms (Snidjers & Bosker, 1999). Each of the models had logged CES-D as the outcome variable while time was represented by age, centred at age 65. The model included random intercepts for each participant. All slopes were fixed; two-wave models do not have sufficient degrees of freedom to support the estimation of random slopes.

Model I included age. Model II contained all structural social capital variables and covariates. Model III contained all cognitive social capital variables and covariates. Model IV included structural and cognitive social capital variables, and covariates. Model V included structural and cognitive social capital variables, covariates, and examined whether any differences existed among the within- and between-person effects for social capital variables. This final model used the equation below, where a bar over the variable name indicates that the variable is calculated as the time-invariant average of each participant’s scores over the two waves.

$$Y_{it} = \gamma_{00} + \gamma_{10}age_{it} + \gamma_{20}(\overline{volunteeringactivities_{it}} - \overline{volunteeringactivities_{it}}) + \gamma_{30}(\overline{socialsupport_{it}} - \overline{socialsupport_{it}}) + \gamma_{40}(\overline{maritalstatus_{it}} - \overline{maritalstatus_{it}}) + \gamma_{50}(\overline{timespentwithfriends_{it}} - \overline{timespentwithfriends_{it}}) + \gamma_{60}(\overline{timespentwithrelatives_{it}} - \overline{timespentwithrelatives_{it}}) + \gamma_{70}(\overline{self - efficacy_{it}} - \overline{self - efficacy_{it}}) + \gamma_{80}(\overline{trust_{it}} - \overline{trust_{it}}) + \gamma_{90}(\overline{senseofbelonging_{it}} - \overline{senseofbelonging_{it}}) + \gamma_{N0}(\overline{othercovariates_{it}} - \overline{othercovariates_{it}}) + \gamma_{01}\overline{volunteeringactivities_{it}} + \gamma_{02}\overline{socialsupport_{it}} + \gamma_{03}\overline{maritalstatus_{it}} + \gamma_{04}\overline{timespentwithfriends_{it}} + \gamma_{05}\overline{timespentwithrelatives_{it}} + \gamma_{06}\overline{self - efficacy_{it}} + \gamma_{07}\overline{trust_{it}} + \gamma_{08}\overline{senseofbelonging_{it}} + \gamma_{02}sex_{it} + \gamma_{03}education_{it} + \mu_{0i} + \epsilon_{it}$$

Within-person effects are represented by the coefficient attached to the within-person deviation score; for example, with volunteering activities:

$$\text{Within} = \gamma_{20}$$

Between-person effects are represented by the coefficient attached to the person-level mean; for example, with volunteering activities:

$$\text{Between} = \gamma_{01}$$

As such, within-person effects represent the influence of intra-individual changes in volunteering engagement on depressive symptoms, while between-person effects represent the extent to which individuals who report high levels of social capital differ in their levels of depressive symptoms compared to individuals who report lower levels of social capital (Snidjers & Bosker, 1999).

Following each model, I assessed the fit indices to determine the best fitting model including Bayesian information criterion (BIC) (Schwarz, 1978) and Akaike information criterion (AIC) (Akaike, 1974).

**Attrition.** As with all longitudinal studies, attrition of respondents was present in the WLS. Analyses were consistent with documentation on dropout rates in the WLS where respondents who were male, had lower adolescent cognitive ability, lower parental SES in adolescence, and poorer self-reported health in adulthood had higher levels of dropout, as discussed by Herd, Carr, and Roan (2014). For respondents who attrited after 2004, I tested each of the key social capital variables as well as depressive symptoms, to determine whether they were predictive of dropout. None of these variables predicted dropout.

**Imputation.** Within the analytical sample of 6,740, 70% of cases had complete data on all the variables of interest, and 95% of participants provided valid responses to more than half. To account for missing data, I performed multiple imputation by chained equations separately for each wave. If an individual did not answer any questions in a wave, then data were not imputed for that individual in that wave. I included the dependent variable in the imputation phase and the analyses. The regression results presented here combine the estimates from the thirty imputed datasets using Rubin’s (1987) rules (Bodner, 2008).

## 3. Results

Table 1 provides the descriptive statistics pooled across waves. The average score for depressive symptoms logged was 2.38, which corresponds to low levels of depressive symptoms. Logged depressive symptoms increased on average 4.5% from wave 1 to wave 2. This suggests that at age 65 respondents experienced, on average, their lowest depressive symptoms scores over the 7-year period.

Table 2 displays correlations among all social capital variables and depressive symptoms. Correlations among the social capital variables were generally small to moderate in magnitude, with the largest correlation between sense of belonging and trust (0.494,  $p < .001$ ) followed by depressive symptoms and self-efficacy (-0.48,  $p < .001$ ) and sense of belonging and self-efficacy (0.47,  $p < .001$ ).

### 3.1. Multi-level 2-wave longitudinal models

Table 3 shows the results of the multi-level 2-wave longitudinal models. All coefficients were standardized for ease of interpretation.



**Table 1**  
Descriptive statistics.

Variable	Mean	Std. Dev.	Minimum	Maximum
Depression (logged) 0 = low; 4.88 = high	2.38	0.96	0	4.88
Volunteering activities 0 = no activities; 10 = 10 activities	1.13	1.29	0	10
Social support 0 = none; 2 = high	1.30	0.81	0	2
Marital status 0 = single; 1 = married	0.76	0.43	0	1
Time spent with friends 0 = none; 2 = high	1.10	0.61	0	2
Time spent with relatives 0 = none; 2 = high	1.09	0.58	0	2
Self-efficacy 2 = low; 30 = high	24.30	4.05	2	30
Trust 1 = low; 6 = high	4.74	1.44	1	6
Sense of belonging 1 = low; 6 = high	4.75	1.38	1	6
Self-rated health 0 = poor, 1 = good	0.85	0.36	0	1
Extraversion (mean scored) 1 = low; 6 = high	3.77	0.87	1	6
Education 12 = high school degree; 21 = post-doctorate degree	13.75	2.34	12	21
Sex of respondent 0 = male; 1 = female	0.53	0.50	0	1
Assets 0 = low; 2 = high	1.02	0.82	0	2

Model I included age, centred at age 65. The fixed slope was statistically significant (age:  $\gamma = 0.015, p < .001$ ).

Aim 1 seeks to determine if structural and cognitive social capital has a negative association with depressive symptoms. Model II included structural social capital variables. Four of the five variables measuring structural social capital – social integration (marital status, time spent with family and friends) and social support (from a family member and friend) – were significantly and negatively related to an individual’s level of depressive symptoms. Of the four significant coefficients, marital status was largest ( $\gamma = -0.166, p < .001$ ), followed by social support ( $\gamma = -0.065, p < .001$ ), time spent with friends ( $\gamma = -0.058, p < .001$ ), and time spent with relatives ( $\gamma = -0.035, p < .01$ ). I performed Wald tests between each pair of structural social capital variables to test equality among the standardized coefficients. All pairs were significantly different ( $p < .001$ ), except time spent with friends and time spent with relatives, which suggest their effects were equal contributors to a decrease in depressive symptoms.

Model III included cognitive social capital variables: self-efficacy, trust, and sense of belonging. Each of these variables was negatively associated with depressive symptoms ( $p < .001$ ). Self-efficacy had the largest coefficient of these three variables ( $\gamma = -0.305, p < .001$ )

**Table 2**  
Intercorrelations among depressive symptoms and social capital.

Variable	1	2	3	4	5	6	7	8
1. Depression (logged)	–							
2. Volunteering activities	–0.09	–						
3. Social support	–0.14	0.07	–					
4. Marital status	–0.11	–0.09†	–0.01†	–				
5. Time spent w/friends	–0.12	0.16	0.19	–0.07	–			
6. Time spent w/relatives	–0.06	0.05	0.12	0.03	0.22	–		
7. Self-efficacy	–0.48	0.10	0.18	0.01†	0.15	0.07	–	
8. Trust	–0.26	0.12	0.28	0.07	0.17	0.11	0.34	–
9. Sense of belonging	–0.39	0.11	0.27	0.09	0.20	0.09	0.47	0.49

Note: All correlations were significant at  $p < .001$  unless marked by † which indicates the correlation is non-significant  $p > .05$ .

followed by sense of belonging ( $\gamma = -0.178, p < .001$ ) and trust ( $\gamma = -0.049, p < .001$ ). Wald tests were performed to test coefficient equality between each of the cognitive social capital coefficient pairs. Each comparison produced significant results suggesting coefficients are unequal.

Model IV combined structural and cognitive social capital, as well as all covariates. This model was used to determine if any significance was lost from either dimension of social capital when including them in a single model. All variables retained their statistical significance, except social support and time spent with friends.

Aim 2 was tested in Model V. Model V combined both dimensions of social capital, all covariates, and tested the longitudinal random coefficient model’s assumption that longitudinal and cross-sectional effects are equal. Unlike the previous four models, Model V examined between- and within-person effects separately, whereas the previous models (Model I-IV) did not distinguish between these effects. When examining structural social capital variables in Model V, this assumption held true: The longitudinal and cross-sectional effects were equal. The overall effects of marital status ( $\gamma = -0.143$ ) and time spent with relatives ( $\gamma = -0.035$ ) were all statistically significant ( $p < .05$ ), while volunteering, social support, and time spent with friends remained statistically non-significant. The cognitive social capital variables in Model V showed a difference existed between- and within-person effects for sense of belonging (within:  $\gamma = -0.132$ ; between:  $\gamma = -0.052$ ) and self-efficacy (within:  $\gamma = -0.20$ ; between:  $\gamma = -0.172$ ) (all four effects:  $p < .05$ ). Model V also displayed the cross-sectional effect of trust was equivalent to the longitudinal effect of trust ( $\gamma = -0.042, p < .01$ ).

These findings show a negative association among both dimensions of social capital and depression. Furthermore, these results provide clarity in understanding if the effects for both dimensions of social capital are equal or unequal. Structural social capital variables were associated with depressive symptoms equally at the within- and between-person levels, while cognitive social capital had different effects on depressive symptoms at these two levels of measurement. Trust was equally associated with decreasing depressive symptoms at both levels of measurement while the other two cognitive social capital variables, self-efficacy and sense of belonging, presented a difference when analysing the between- and within-person levels. In both instances, the within-person effects were larger than the between-person effects. When comparing the coefficients from Model IV and V I note the importance of parsing out these between- and within-person effects. If I treated the longitudinal and cross-sectional effects as equal, then I would have lost this significant evidence of within-effects having a larger effect than between-person effects for these two cognitive social capital variables.

#### 4. Discussion

The purpose of this longitudinal study was to first examine whether structural and cognitive social capital were associated with depressive symptoms among aging adults. Results suggest both dimensions of social capital are negatively related with levels of depressive symptoms, even after controlling for several health determinants known to impact

**Table 3**  
Hierarchical linear models predicting depressive symptoms.

	Model I	Model II	Model III	Model IV	Model V
	$\gamma$ (SE)	$\gamma$ (SE)	$\gamma$ (SE)	$\gamma$ (SE)	$\gamma$ (SE)
<i>Fixed Components</i>					
Age 65	0.015*** (0.002)	0.015*** (0.002)	0.18*** (0.002)	0.016*** (0.002)	0.017*** (0.002)
<i>Structural Social Capital</i>					
Volunteering Activities 0 = no activities; 10 = 10 activities		-0.011 (0.01)		-0.008 (0.011)	
Within-Person Effects					-0.009 (0.014)
Between-Person Effects					-0.005 (0.018)
Social Support 0 = none; 2 = high		-0.065*** (0.011)		-0.016 (0.01)	
Within-Person Effects					-0.004 (0.013)
Between-Person Effects					-0.01 (0.017)
Marital Status 0 = single; 1 = married		-0.166*** (0.025)		-0.152*** (0.023)	
Within-Person Effects					-0.143** (0.052)
Between-Person Effects					0.012 (0.056)
Time spent with friends 0 = none; 2 = high		-0.058*** (0.011)		-0.014 (0.01)	
Within-Person Effects					-0.015 (0.015)
Between-Person Effects					-0.002 (0.019)
Time spent with relatives 0 = none; 2 = high		-0.035** (0.01)		-0.022* (0.009)	
Within-Person Effects					-0.035* (0.014)
Between-Person Effects					-0.022 (0.017)
<i>Cognitive Social Capital</i>					
Self-efficacy 2 = low; 30 = high			-0.305*** (0.011)	-0.305*** (0.011)	
Within-Person Effects					-0.20*** (0.018)
Between-Person Effects					-0.172*** (0.02)
Trust 1 = low; 6 = high			-0.049*** (0.01)	-0.042*** (0.01)	
Within-Person Effects					-0.042** (0.015)
Between-Person Effects					0.011 (0.02)
Sense of belonging 1 = low; 6 = high			-0.178*** (0.011)	-0.171*** (0.011)	
Within-Person Effects					-0.132*** (0.017)
Between-Person Effects					-0.052* (0.021)
<i>Covariates</i>					
Self-Rated Health 0 = poor; 1 = good		-0.46*** (0.026)	-0.301*** (0.024)	-0.30*** (0.025)	-0.283*** (0.025)
Extraversion (mean scored) 1 = low; 6 = high		-0.165*** (0.012)	-0.033** (0.011)	-0.026* (0.011)	-0.02 (0.012)
Education 12 = high school degree; 21 = post-doctorate degree		-0.031*** (0.005)	-0.016*** (0.004)	-0.017*** (0.004)	-0.015** (0.004)
Sex of Respondent 0 = male; 1 = female		0.083*** (0.021)	0.113*** (0.02)	0.10*** (0.18)	0.10*** (0.02)
Assets 0 = low; 2 = high		-0.079*** (0.014)	-0.046*** (0.012)	-0.033** (0.012)	-0.027** (0.012)
<i>Random Components</i>					
Person-level intercept	0.58 (0.012)	0.51 (0.013)	0.398 (0.013)	0.395 (0.013)	0.398 (0.013)
Observation-level intercept	0.773 (0.009)	0.745 (0.009)	0.71 (0.008)	0.708 (0.008)	0.702 (0.008)
<i>Fit Statistics</i>					
BIC	34603.08	27102.15	25771.74	25036.79	24947.43
AIC	34580.71	27007.71	25684.31	24920.64	24787.73
n	6,740	6,740	6,740	6,740	6,740

Note: Predictors are all standardized.

\*p < .05, \*\*p < .01, \*\*\*p < .001.

depressive symptoms. These results add further evidence to previous research examining the association between social capital and depressive symptoms while highlighting two forms of cognitive social capital – self-efficacy and sense of belonging – had larger effects in decreasing depressive symptoms within individuals (Fujiwara & Kawachi, 2008).

Unlike many of the previous studies, I examined whether there were any differences in the association among the two dimensions of social capital and depressive symptoms when considering the between- and within-person levels. Within persons, increases in structural social capital were associated with decreasing depressive symptoms. Additionally, when comparing people, individuals with higher levels of structural social capital had lower levels of depressive symptoms than individuals with lower levels of structural social capital. Both the cross-sectional and

the longitudinal effects for structural social capital are equal in size. These dual interpretations also held true for one of the three cognitive social capital variables, trust; however, the other two cognitive social capital variables, self-efficacy and sense of belonging, suggested a difference in their effects on depressive symptoms when analysing individual change versus differences between individuals. In both cases, change within an individual was stronger than differences between individuals. Although this study does not use causal methods, the result suggests an increase in an individual's own level of social capital might in fact be an effective way to decrease their depressive symptoms.

#### 4.1. Assessing structural and cognitive social capital

While all aspects of social capital have been shown to be associated with lower depression, both in separate analyses (Landstedt et al., 2016) and jointly (Cohen-Cline et al., 2018), it is crucial to determine which of these factors is most effective in decreasing depressive symptoms. Furthermore, due to social capital being a multidimensional concept, both dimensions must be examined simultaneously: These two dimensions of social capital are not mutually exclusive. Through including both dimensions, we can inform policymakers on how these elements of social capital each uniquely contribute to reducing depressive symptoms.

The current study suggests the three most effective social capital variables in decreasing depression are self-efficacy, marital status, and sense of belonging. Uncovering these variables as the most effective in reducing levels of depressive symptoms provides policymakers with both a route for possible targeted intervention and possible risk factors. For example, while marital status is not easily intervenable – especially for older adults, it does act as a potential risk factor policymakers can identify for those most at risk for depression in later life. Additionally, both self-efficacy and sense of belonging are prime areas of intervention. Coll-Planas and colleagues (2017) studied an intervention aimed at building a networks between primary healthcare centres, senior centres and other community assets in the neighbourhood. This intervention aimed to increase levels of social capital by connecting lonely older individuals with more active older adults who could introduce them to existing community assets. Through promoting these networks these scholars report reducing levels of loneliness and depressive symptoms while increasing levels of social participation. By policymakers disseminating the positive effects of these three effective social capital variables in decreasing depressive symptoms, health affiliates can more appropriately begin to manage this “global burden.”

Furthermore, this study suggests structural and cognitive social capital variables uniquely influence depressive symptoms. While all cognitive social capital variables remained associated with depressive symptoms, a consistent finding among scholars examining depression in older adults (Cao, Li, Zhou, & Zhou, 2015), measures of structural social capital variable were far more inconsistent in this study, which is consistent with prior literature (Ehsan & Silva, 2015). For example, in this current study spending time with friend became insignificant while spending time with relatives retained significance. This could be because aging adults become more reliant on those around them for activities of daily living, which typically result in stronger connections with family members (Forsman et al., 2012). Another structural social capital variable, volunteering activities, remained non-significant in all models, which is consistent with previous studies (Ehsan & Silva, 2015). Meanwhile, social support became non-significant when cognitive social capital variables were included in the model. This may have occurred because one’s sense of social support was likely captured in the cognitive social capital variables of trust and sense of belonging. Advancing our understanding of how these dimensions of social capital impact depressive symptoms in later life is essential in combating this burden of depression in later life.

#### 4.2. Between- and within-person effects

In this current study I also report key differences exist in the between- and within-person effects for cognitive social capital, while effects are equal for structural social capital. Previous scholars assumed the between and within effects in longitudinal random coefficient models are equal. However, this assumption may not be true in many cases, such as in this study. By neglecting to test this assumption, scholars may unintentionally present inaccurate findings. If this current study stopped with Model IV, then I would have assumed a standard deviation increase in self-efficacy reduces depressive symptoms by 0.31. However, when I tested this assumption, I found a within-person

increase in self-efficacy only reduces depressive symptoms by 0.20. While this difference does not appear large on face-value, when scaling this to a population intervention, this would equate to only getting 65% of the benefits from an anticipated intervention.

In parsing out the between- and within-person effects in Model V, this current study provides valuable insight to policymakers for possible areas of intervention. While between-effects suggest how high or low levels of social capital influence depressive symptoms, within-person effects indicate how a change in social capital will impact depressive symptoms. In the current study, all the structural social capital variables, as well as trust, had equal effects. However, two cognitive social capital results indicate the coefficients are higher for the within-person effects – self-efficacy and sense of belonging. As such, an increase in either of these two variables may result in a more substantial decrease in depressive symptoms compared to an individual having high levels of either variable. Thus, interventions targeting cognitive social capital, or one’s perception of relationships, could possibly decrease the burden of depressive symptoms in later life.

To my knowledge, Cohen-Cline et al. (2018) is the only other study that investigates social capital and depression at these two levels of measurement. In their study, researchers reported a significant association between and within-twin pairs, where the within-twin effects had a stronger association on depressive symptoms. In the present study, the same was true: The within-person changes for both self-efficacy and sense of belonging were larger than the estimates of between-effects. This suggests public health experts should create policies to increase individual’s quality of relationships rather than focus on the quantity of interactions (Ehsan & Silva, 2015).

#### 4.3. Limitations

This study has notable weaknesses. While such a homogenous sample helps to rule out unobserved bias, prior studies using the WLS have stated this sample is representative only of white high school graduates born in the 1930s and 1940s (Herd et al., 2014). This sample does represent two-thirds of the current U.S. population in this age group in terms of race/ethnicity and educational attainment (Piliavin & Siegl, 2007).

There are also limitations related to which social capital proxies were included and how they were measured. First, there is no agreed upon definition of social capital. Due to social capital being a multidimensional concept, scholars are uncertain about what measures comprise cognitive and structural social capital (Giordano & Lindström, 2011). Second, there are limits to how some variables were measured in the WLS. Having more thorough measures for volunteering involvement will aid in grasping if it is truly the level of involvement or the commitment.

#### 5. Conclusion

In conclusion, attempting to focus on either cognitive or structural social capital is inefficient and removes the nuances of how there are specific variables most effective in decreasing depressive symptoms. Furthermore, this study provides evidence of a negative relationship between both cognitive and structural social capital and depressive symptoms, but that a difference exists between their associations with depressive symptoms. Structural social capital (social support, marital status, time spent with friends, and time spent with family) is associated with depressive symptoms equally at the between- and within-person levels, whereas cognitive social capital (self-efficacy and sense of belonging) is associated with depressive symptoms unequally at the between- and within-person levels, where the cross-sectional effects had a stronger association.

These findings provide benefits for policymakers aiming to reduce levels of depression for aging adults living in the United States. Results from this study provide evidence for policymakers to target individuals’

marital status, self-efficacy and sense of belonging. Policymakers should continue integrating social capital, specifically these three variables, into their policies to assist in combating this “global burden.” This includes encouraging programs, such as the one Coll-Planas and colleagues (2017) used to promote social engagement and community activities. By discussing the negative association between these two dimensions of social capital and depressive symptoms, policymakers can begin enacting a proactive model rather than a reactive model. However, social capital is accumulated over several years and through presenting the positive benefits of social capital, with an emphasis on self-efficacy, marital status and sense of belonging, policymakers can propose their importance early in life so in mid-to-late life those needing to draw upon their social capital are able to do so.

## Ethics approval

The current study, *A Cohort Longitudinal Study of Individual Level Social Capital and Depressive Symptoms in the Wisconsin Longitudinal Study*, uses publicly available secondary data from the Wisconsin Longitudinal Study (WLS). I received ethics approval for this study and use of data from the institutional review board at Boston College.

## CRedit authorship contribution statement

**Kyle A. Carr:** Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing - original draft, Writing - review & editing, Visualization.

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