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Contextual generalized trust and immunization against the 2009 A(H1N1) pandemic in the American states: A multilevel approach

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A B S T R A C T

The aim of the study was to investigate the association between contextual generalized trust and individual-level 2009 A(H1N1) pandemic immunization acceptance. A second aim was to investigate whether knowledge about the A(H1N1) pandemic mediated the association between contextual generalized trust and A(H1N1) immunization acceptance. Data from the National 2009 H1N1 Flu Survey was used. To capture contextual generalized trust, data comes from an aggregation of surveys measuring generalized trust in the American states. To investigate the association between contextual generalized trust and immunization acceptance, while taking potential individual-level confounders into account, multilevel logistic regression was used. The investigation showed contextual generalized trust to be significantly associated with immunization acceptance. However, controlling for knowledge about the A (H1N1) pandemic did not substantially affect the association between contextual generalized trust and immunization acceptance. In conclusion, contextual state-level generalized trust was associated with A (H1N1) immunization, but knowledge about A(H1N1) was not mediating this association.

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1. Introduction

Social capital refers to features of social organization such as trust, norms, and networks facilitating collective action for mutual benefit (Putnam, 1993). Social capital can be understood as both individual-level characteristics and certain features of a community. Examples of individual social-capital indicators are norms of trust and reciprocity and membership in organizations. Examples of contextual-level measures of social capital are the density of organizations and aggregate levels of trust and reciprocity within a community (Putnam, 2000). Moreover, social capital is often claimed to have a *structural* component and a *cognitive* one. The structural side of social capital is the degree of civic participation, membership in associations, and formal and informal networks. The cognitive side of social capital are norms of generalized trust and reciprocity (Harpham et al., 2002).

The prior literature has been able to demonstrate that both individual-level generalized trust – defined as the belief that 'most people can be trusted' – and contextual generalized trust – the share in a community thinking, 'most people can be trusted' – are associated with health and healthy behavior. In other words, being a trustful individual and residing in a community characterized by trust among people influences health and health behavior (Hyyppä & Mäki, 2001; Kawachi et al., 1999; Kim et al., 2008; Rose,

2000; Subramanian et al., 2003). When it comes to empirical social capital indicators, trust is argued to be the most relevant. The reason is that trust is more probable to precede civic engagement than vice versa, because without trust, membership groups and associations are unlikely to be established at all (Rothstein, 2005).

Within the larger category of studies investigating the association between generalized trust and health, some studies focus specifically on health-related behaviors such as tobacco smoking, alcohol consumption, physical activity, and drug use (Lindström, 2008). Recently, Herian et al. (2014) investigated the link between contextual state-level trust and several aspects of health and health-related behaviors. They found state-level trust to be linked with health outcomes such as smoking, BMI, and general health.

The current paper investigates the association between contextual state-level generalized trust and individual 2009 A(H1N1) pandemic immunization in the American states. Some prior studies have investigated the association between social capital/generalized trust and immunization. To start with Ronnerstrand (2013) found an association between two aspects of trust – generalized trust and trust in health care – and intentions to accept vaccination against the 2009 A(H1N1) in Sweden. Jung and colleagues found that the degree of neighborhood social capital mediated the association between 2009 A(H1N1) pandemic knowledge among parents and immunization acceptance for their children (2013). Nagaoka and colleagues investigated the association between two measures of contextual social capital – voting rate and volunteer rate – and uptake of a measles-containing

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vaccine. They found that the voting rate was associated with higher levels of immunization coverage rates in large municipalities in Japan (2012). Chuang, Huang, Tseng, Yen, and Yang (2015) found that social capital might influence the response to influenza pandemic in Taiwan, for example the intention to receive a vaccine.

Social capital has also been linked with the substantial state-level variation in A(H1N1) immunization coverage rates in the American states. In a cross-sectional, ecologic study, an association between three measures of contextual social capital and state-level immunization uptake was found (Rönnerstrand, 2014). All three contextual state-level social capital measures – Putnam's social capital index, contextual generalized trust, and volunteer rate – were very strongly positively correlated with immunization coverage rates. In a regression model including the confounders – state-level health care spending per capita, state population, population per square mile, and median age in the American states – the association between contextual social capital and immunization coverage rates was found to be persistent and strong.

There are theoretical arguments for using states as geographical unit of analysis when investigating the link between contextual social capital and immunization. Putnam argues that social capital is beneficial from a societal perspective because it stimulates collective action and the provision of public goods (1993). In lager scale geographical units, such as states, immunization contributes to the provision of the public good of herd immunity, or at least to a reduction of disease transmission in society. This dynamic is less relevant in smaller geographical units.

Similarly to Rönnerstrand (2014) the present study investigates the link between U.S. state-level contextual social capital and immunization against the 2009 A(H1N1) pandemic. But contrary to the above-mentioned study, by making use of multilevel statistical procedures, the aim of this paper is to investigate the association between contextual generalized trust and individual immunization against the A(H1N1) pandemic. It is hypothesized that contextual state-level generalized trust is associated with individual acceptance of vaccination against the 2009 A(H1N1) pandemic, also when controlling for individual-level and state-level confounders.

Although the link between social capital and health is well studied, there is much less knowledge about the causal pathways linking social capital with health (Kim et al., 2008). Several potential causal pathways have been suggested. Scholars separate between vertical, policy-oriented pathways and behavioral-mediated pathways. The former of these pathways links social capital with health through civic engagement and participation in the political process. Behavior-mediated pathways include rapid circulation of health information, healthy norms, lower crime rates, emotional support within a network, and control over deviant health behavior in the community (Kawachi et al., 1999; Kawachi & Berkman, 2000; Kim et al., 2008).

With regard to pandemic vaccination acceptance in general (Zijtregtop et al., 2009) and of the 2009 A(H1N1) flu immunization in particular (Maurer et al., 2010), it has been argued that knowledge of and information about disease and vaccination from family, friends, and co-workers increased the probability of pandemic immunization acceptance. Hypothetically, information about pandemic influenza and the possibility to vaccinate was more easily circulated in states characterized by high levels of trust. In turn, information about the pandemic and vaccinations was presumably a factor stimulating vaccination acceptance in those high-trusting states.

A second aim of this study is to investigate whether knowledge about the 2009 A(H1N1) pandemic mediated the association between contextual generalized trust and A(H1N1) immunization acceptance. It is hypothesized that a substantial part of the association between contextual generalized trust and immunization acceptance was mediated through knowledge about the 2009 A(H1N1) pandemic. Put differently, the claim will be tested that the reason for a potential association between contextual levels of trust and immunization acceptance is due to information about the A(H1N1) pandemic and the possibility to vaccinate being transmitted more easily in states characterized by high levels of trust among its inhabitants.

Many prior studies have investigated individual-level predictors of 2009 A(H1N1) pandemic vaccination acceptance. For example older age, higher education, belonging to an ethnic majority, belonging to a priority group, receiving recommendations from a health professional, receiving information from friends and co-workers, having correct information about pandemic influenza vaccination, being aware of the recommendations, acceptance of previous vaccinations, and having trust in institutions and health care all increased the probability of having the intention to vaccinate or having accepted vaccination against the 2009 H1N1 pandemic (Lau et al., 2010; Maurer et al., 2010; Prati et al., 2011; Rodríguez-Rieiro et al., 2010; Rubin et al., 2009; Schwarzinger et al., 2010; Torun et al., 2010; Vaux et al., 2011; Velan et al., 2011; see Bish et al., 2011; Brien et al., 2012 and Nguyen et al., 2011 for reviews). However, although the predictors investigated in the referred studies account for a substantial part of the individual-level variation in immunization uptake, these predictors are unlikely to account for the state-level variation in uptake.

Apart from Rönnerstrand (2014), only a few studies have investigated factors accounting for the state-level variation in immunization uptake. Davila-Payan and colleagues (2014) investigate the impact of system factors on immunization coverage in the American states. In their study they found that state-level A(H1N1) immunization coverage rates were associated with shorter time between allocation and ordering and shipping, as well as the number and types of ship-to sites. Baum (2011) adopts a quite different perspective and couples state variation in immunization uptake with partisan support and news consumption.

The results from this paper provide a unique contribution to the literature because no prior study, known to me, has investigated the independent effect of both individual-level factors and state-level contextual factors on 2009 A(H1N1) pandemic immunization acceptance. Using multilevel logistic regression, with individuals on the first level and state of residence on the second level, the present paper investigates if contextual generalized trust was associated with individual immunization acceptance, taking individual-level confounders into account.

2. Methods and materials

2.1. Study population

The data for the present study comes from the public-use data file of the National 2009 H1N1 Flu Survey (NHFS). The NHFS is a random digit dialing telephone survey. The objective of the survey was to collect data on the uptake of the A(H1N1) and the seasonal influenza vaccines. It was conducted by the NORC at the University of Chicago on behalf of the Centers for Disease Control and Prevention. The survey operated from October 2009 through June 2010 and included separate strata for all the 50 states and the District of Columbia. The survey questions concerned influenza immunization status, opinions about influenza vaccine safety, recent respiratory illness, risk factors, as well as knowledge, attitudes, and practices in relation to the 2009 A(H1N1) pandemic and seasonal influenza. In addition, questions were asked to survey a number of household and individual demographic characteristics.

The target population was all persons in the United States aged 6 months and older. From each household, a randomly selected

member was interviewed. If a child were selected, a parent or guardian who knew about the health of the child was asked the same questions. The Council of American Survey Research Organization (CASRO) response rate was 34.7% for landline telephones and 27.0% for cell phones. At least eight attempts were made to contact respondents. The survey included 56,656 adults and 14,288 children, but my study includes only adults, aged 18 years and above.

The analysis of data was restricted to the NHFS interviews conducted from January 2010 and onwards, because a new question was added to the NHFS survey from January 2010. The number of survey participants who answered all the NHFS survey questions required to be included in the analysis of data was 28,798.

2.2. The dependent variable

The dependent variable in this study is A(H1N1) immunization acceptance. In the survey, immunization acceptance was measured by the question, 'There were two ways to get the H1N1 flu vaccination, one is a shot in the arm and the other is a spray, mist or drop in the nose. Since September 2009, have you been vaccinated either way for the H1N1 flu?' The response alternatives were 'Yes', 'No', and 'Don't know'. Respondents answering 'Don't know' consisted of 0.6% of the sample population, and this group was not included in the analysis of data.

2.3. Individual-level predictors

The individual-level predictors age, sex, education, marital status, race, health care insurance, and chronic medical condition were included in the logistic multilevel model, the reason being that they are likely to be associated with both generalized trust (Uslaner, 2002; Rothstein, 2005; Kawachi et al., 1999) and immunization acceptance (see Introduction). Also, several of them are commonly considered to be important controls in studies investigating the link between social capital and health (Harpham et al., 2002). In the final model, knowledge about the 2009 A (H1N1) pandemic was introduced in order to investigate the potential mediating effect of knowledge in the association between contextual generalized trust and immunization.

In the data analysis, age was divided into five age intervals: 18–34, 35–44, 45–54, 55–64, and 65 and above.

The education variable was based on the self-reported level of education. The answers were divided into four different categories, including (1) less than 12 years education, (2) 12 years education, (3) some college education, and (4) college graduate.

The race variable consists of the following three categories: (1) white only, (2) black or African American only, and (3) all other races or multiple races.

Health care insurance was measured using the following question: 'Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare?' The response alternatives were 'Yes', 'No', and 'Don't know'. Respondents answering 'Don't know' were of 0.1% of the sample population, and this group was excluded from the analysis of data.

To measure the variable chronic medical condition, the interviewer asked the survey respondents if they had any of the following chronic medical conditions: asthma or some other lung condition, diabetes, a heart condition, a kidney condition, sickle cell anemia or some other anemia, a neurological or neuromuscular condition, a liver condition, or a weakened immune system caused by a chronic illness or by medicines taken for a chronic illness. This variable was dichotomous, consisting of respondents who said that they suffer from one or several of these chronic

conditions, and respondents who said they suffered from none of them.

The variable knowledge about the A(H1N1) pandemic was measured using the following survey question: 'How much, if anything, do you know about the 2009 H1N1 flu? Would you say that you know a lot, a little, or nothing about the 2009 H1N1 flu?' The response alternatives given were 'A lot', 'A little', 'Nothing', or 'Don't know'. Due to the composition of the data in the public file, respondents maintaining to know 'A little' and 'Nothing' about the 2009 H1H1 flu had to be analyzed jointly. This means that this variable was a dichotomized measure of whether respondents maintain that they 'Know a lot' or 'Don't know a lot' about the 2009 H1H1 flu. To check the robustness of the knowledge variable, an additional model was built (but not reported in detail) consisting of a dichotomized measure of whether respondents maintain that they 'Know nothing' as one category and 'A lot' and 'A little' in the other category. Survey respondents answering 'Don't know' (0.3%) were excluded.

2.4. State-level predictor

Estimations of state-level contextual generalized trust have been a widely used measure in the literature about social capita (Putnam, 2000; Uslaner, 2002) and the literature about social capital and health specifically (Kawachi et al., 1997, 1999; Subramanian et al., 2001). These estimations are most often based on the proportion of the total population within each state having answered affirmatively (or negatively) to the question 'Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?' The current study utilizes estimations based on the aggregation of several different nationwide surveys (Neville, 2012). What speaks in favor of this measure is that it is highly correlated with Putnam's (2000) social capital index (Pearson's $r=0.810$), and furthermore, it is even more recent.

In the multilevel logistic regression analysis, the variable was centered on its mean and standardized to vary between 0 and 1. This was done to enhance the interpretation of the contextual generalized trust coefficients."

2.5. State-level confounder

For the state-level confounders were health care spending per capita, median age, population size, and population density (Rönnerstrand 2014). Data on health care spending per capita 2009 was obtained from Cuckler et al. (2011). Data on state-level population size 2009 and population density 2010, and median age 2009 comes from the U.S. Census Bureau.

2.6. Statistics

It is well established that multilevel modeling is a useful statistical procedure for investigating the effect of place on individual health (Bingenheimer & Raudenbush, 2004; Merlo et al., 2012) and particularly in relation to the effect of contextual social capital on individual health (Murayama et al., 2012). Multilevel modeling makes it possible to estimate the share of variance in the outcome variable that can be accounted for by contextual and individual-level predictors, respectively.

In the present paper, a multilevel logistic regression model, with individuals at the first level and state of residence at the second level, was estimated. The study analyzes the effect of contextual state-level generalized trust on individual immunization behavior, after adjustment for the contextual factors state-level health care spending per capita, median age, population size, and population density as well as the individual-level factors age,

marital status, sex, education, race, health care insurance, chronic medical condition, and knowledge about the 2009 A(H1N1) pandemic.

In the first model (*the zero multilevel model*), only a constant term in the fixed and random part was included. This model only provided information about how the likelihood of vaccination acceptance was distributed across the American states. In the second model, the individual-level predictors age, marital status, sex, education, race, health care insurance and chronic medical condition were added. In the third model (*random-intercept model*), the random contextual generalized trust variable was inclu`ded. In model four (*random-intercept model*), the state-level confounders were introduced.

In order to investigate if knowledge about the 2009 A(H1N1) pandemic mediated a potential association between social capital and immunization, Model 5 included the variable 'Knowledge about H1N1 pandemics'. Comparing the odds ratios for contextual generalized trust in Model 4 (not including the knowledge variable) and Model 5 (including the knowledge variable) should reveal whether knowledge is a mediating variable between generalized trust and immunization. Thus, this approach is different from the four-step approach suggested by Baron and Kenny (1986). Instead, the analytical strategy to test mediation closely follows Poortinga (2006) and utilizes the indirect effect approach.

Individual odds ratios and 95% confidence intervals were calculated for the fixed and random parts of the models. Also, between-state variance and fit statistics (log likelihood and Aikike's information criteria, AIC) were calculated. The deviance test was used to investigate the difference between log likelihood estimates between Model 2 and Model 3. To enable a direct comparison between the fixed effects and the level 2 between-state variation, median odds ratios (MOR) were calculated. The MOR is computed with the following formula: $MOR=exp[\sqrt{(2 \times V_A)} \times 0.6745]$, where V_A is the area-level variance and 0.6745 is the seventy-fifth centile of the cumulative distribution function of the normal distribution with mean 0 and variance 1 (Larsen & Merlo, 2005).

In multilevel linear regression, the intraclass correlation coefficient (ICC) is informative with regard to the proportion of total variance that is accounted for by the area level. A difference in multilevel logistic regression is that the individual-level variance and the area-level variance are not directly comparable. To address these difficulties, alternative approaches for estimating ICC in logistic multilevel modeling have been developed. The Latent Variable Method ICC is calculated as the following: $ICC=V_A/(V_A+\pi^2/3)$, where V_A denotes the area-level variance. The ICC quantifies clustering within areas (Merlo et al., 2005) and may be interpreted as an estimation of the discriminatory accuracy of the area level (Merlo, 2014).

The proportional change in variance (PCV) in area-level variance is computed to estimate the change in area variance when more variables are added to the model. The equation for the proportional change in variance is $PCV=(V_A-V_B)/V_A \times 100$, where V_A is the area variance in the initial model, and V_B is the area variance in the model with more terms (Merlo et al., 2005).

The sample weights provided in the NHFS data were not used. This implies the limitation that the state-level vaccination rate loses strength to predict the likelihood of vaccination acceptance across all the states. However, the decision not to use the sample weights is the results of two considerations. Firstly, applying sample weights would distort the estimates of the standard errors (Asparouhov, 2004). Secondly, the aim of the multilevel model was not to predict the overall likelihood of vaccination acceptance in all the states, but rather to estimate the fixed and random effects on vaccination acceptance. The models have been run with *gllamm* in Stata13 (Rabe-Hesketh & Skrondal, 2005).

Table 1
Number of observations and prevalence (%) of demographic variables, health care insurance, chronic medical condition, and knowledge about the A(H1N1) pandemic. $N=28,797$. *Source*: The National 2009 H1N1 Flu Survey.

Variable	Observations	%
Age		
18–34	5518	19.16
35–44	4004	13.90
45–54	5556	19.29
55–64	6090	21.15
65+	7629	26.49
Marital status		
Married	15,145	52.59
Not married	13,652	47.41
Sex		
Female	11,606	40.30
Male	17,191	59.70
Education		
< 12 years	2674	9.29
12 years	6766	23.50
Some college	7963	27.65
College graduate	11,394	39.57
Race		
White only	24,784	86.06
Black only	2480	8.61
Multiple or other races	1533	5.32
Health care insurance		
Yes	25,443	88.35
No	3354	11.65
Chronic medical condition		
Yes	20,314	29.46
No	8483	70.54
Know a lot about H1N1 flu		
Yes	9826	34.12
No	18,971	65.88

3. Results

Table 1 summarizes the number of observations and prevalence (%) of the sample population. The results in the table show that 88% of the respondents answered that they had a health care insurance. About one-third stated that they had at least one chronic medical condition (29%). Also, about one out of three said that they knew a lot about the 2009 A(A1H1) pandemic (34%).

From the two bottom rows in Table 2, it is evident that the models (Models 1–5) were being improved gradually, as random- and fixed-effect predictors were added. Fit statistics – log likelihood and the Aikike's information criteria – show that the inclusion of the fixed-effect predictors (Model 2), the random-effect predictor contextual generalized trust (Model 3), the random-effect state-level confounders (Model 4) and the fixed-effect 'knowledge' variable (Model 5) all improved the model fit. Most importantly, a deviance test shows that the inclusion of the random effect significantly improved Model 3, as compared to the fixed effect in Model 2. The deviance value was 18.22 ($df=1$, $p < 0.005$).

As expected, the data analyses indicated state-level variation in A(H1N1) immunization acceptance in the American states. Table 2 shows that the crude state-level variance was 0.122 (0.017). This specifies the between-state variation in the likelihood of vaccination acceptance. In Model 1, the Latent Variable Method ICC

Table 2
Odds ratios and 95% confidence intervals of vaccination acceptance in 28,797 individuals from 49 American states, state-level variance and standard errors, PCV, ICC, MOR, and fit statistics (log likelihood and the Aikike's information criteria) for Models 1–5. *Source*: The National 2009 H1N1 Flu Survey and Neville (2012).

	Model 1	Model 2	Model 3	Model 4	Model 5
Individual level					
Age					
18–34		1.000	1.000	1.000	1.000
35–44		0.913 (0.829–1.006)	0.913 (0.829–1.006)	0.913 (0.829–1.005)	0.889 (0.806–0.980)
45–54		0.881 (0.805–0.963)	0.881 (0.805–0.963)	0.880 (0.805–0.962)	0.843 (0.770–0.922)
55–64		1.234 (1.133–1.343)	1.234 (1.134–1.344)	1.234 (1.133–1.343)	1.194 (1.096–1.301)
65+		1.202 (1.106–1.321)	1.203 (1.107–1.307)	1.234 (1.133–1.343)	1.240 (1.140–1.348)
Marital status					
Married		1.000	1.000	1.000	1.000
Not married		0.837 (0.792–0.884)	0.837 (0.793–0.884)	0.836 (0.791–0.884)	0.861 (0.815–0.910)
Sex					
Male		1.000	1.000	1.000	1.000
Female		1.050 (0.995–1.108)	1.050 (0.996–1.108)	1.050 (0.996–1.108)	1.003 (0.950–1.059)
Education					
< 12 years		1.000	1.000	1.000	1.000
12 years		1.081 (0.960–1.205)	1.079 (0.968–1.203)	1.079 (0.968–1.203)	1.029 (0.922–1.147)
Some college		1.187 (1.067–1.321)	1.185 (1.066–1.319)	1.185 (1.066–1.319)	1.068 (0.959–1.189)
College graduate		1.585 (1.444–1.772)	1.585 (1.429–1.757)	1.582 (1.426–1.755)	1.335 (1.202–1.484)
Health care insurance					
Yes		1.000	1.000	1.000	1.000
No		0.506 (0.457–0.562)	0.506 (0.457–0.562)	0.507 (0.457–0.563)	0.529 (0.477–0.588)
Chronic med. condition					
No		1.000	1.000	1.000	1.000
Yes		1.648(1.557–1.744)	1.648 (1.556–1.744)	1.648 (1.557–1.745)	1.645 (1.554–1.743)
Race					
White only		1.000	1.000	1.000	1.000
Black only		0.710 (0.636–0.793)	0.714 (0.640–0.798)	0.711 (0.637–0.794)	0.753 (0.674–0.841)
Multiple or other races		1.020 (0.905–1.150)	1.021 (0.906–1.150)	1.021 (0.906–1.150)	1.041 (0.923–1.174)
Know a lot about H1N1 flu					
No					1.000
Yes					1.822 (1.723–1.926)
Intercept level 1	0.421 (0.013)***	0.679 (0.073)***	0.546 (0.073)***	0.860 (0.455)	0.884 (0.460)
State level					
Generalized trust (0–1)			1.506 (1.120–2.024)	1.274 (1.018–1.594)	1.248 (1.000–1.557)
Median age				0.963 (0.931–0.996)	0.959 (0.928–0.992)
Population size				0.987 (0.973–0.996)	0.987 (0.979–0.995)
Population density				0.999 (0.999–1.000)	0.999 (0.999–1.000)
Health care spending per capita				1.176 (1.088–1.273)	1.179 (1.092–1.273)
Random part					
Intercept level 2	0.122 (0.017)***	0.115(0.017)***	0.050(0.012)***	0.093(0.016)***	0.088 (0.016)***
PCV (proportional change in variance)	Ref.	5.7%	59.0%	23.8%	27.9%
ICC (latent variable method)	0.036	0.034	0.015	0.027	0.026
MOR (median odds ratio)	1.39	1.39	1.24	1.34	1.32
Observations					
Individuals	28,797	28,797	28,797	28,797	28,797
States	49	49	49	49	49
Log likelihood	− 17,330.97	− 16,788.29	− 16,779.17	− 16,782.54	− 16,561.73
AIC	34,665.94	33,606.57	33,590.63	33,605.08	33,165.47

Table comment: Levels of significance * $p < 0.05$; ** $p < 0.005$.

*** $p < 0.0005$.

turned out to be moderate in strength (0.036). This means that even though intraclass homogeneity exists, the state-level was only moderate in accuracy when it comes to discriminating between immunization acceptance and non-acceptance.

In Model 2, the fixed effects have been introduced. Comparing Model 1 to Model 2, the PCV was only 5.7%. This indicates that state-level differences with regard to the composition of control variables – age, sex, education, marital status, race, health care

insurance, and chronic medical condition – can only explain a very limited share of the state-level differences in immunization uptake.

In Model 3 the random part of the model has been added, that is, the state-level contextual generalized trust measure. The inclusion of this variable leads to a substantial reduction in state-level variance. The PCV between Model 2 and Model 3 was 59.0%. This reduction signifies that state-level contextual generalized trust accounted for a large share of the state-variation in immunization acceptance.

In Model 4, the random-effect state-level confounders were included. The model shows that contextual generalized trust was associated with immunization, also when state-level health care spending per capita, median age, population size, and population density was taken into consideration. However, when these controls are included, the association between contextual trust and immunization becomes weaker.

In Model 5, the individual-level factor knowledge about the H1N1 pandemic was introduced in order to investigate if knowledge about the pandemic actually was a mediating causal pathway linking contextual social capital with immunization. However, the inclusion of this variable only resulted in a very limited increase in PCV (from 23.8.0% to 27.9%).

Apart from the results obtained by comparing state-level variance in the five different models, interesting results were also obtained from the odds ratio of the random and fixed predictors. The results obtained in Model 5 show differences in vaccination acceptance among different age groups. The odds ratio (OR) was significantly higher for the group of respondents 65 years and above (OR=1.240, 95% confidence interval (CI) 1.140–1.348), as compared to the reference category of respondents aged 18–34. The age group 54–64 also displayed significantly higher ORs than the reference category (OR=1.194, CI 1.096–1.301), but the ORs for the group of respondents between 34 and 44 (OR=0.889, CI 0.806–0.980) and 45 and 54 (OR=0.843, CI 0.770–0.922) were significantly lower compared to the reference category of respondents aged 18–34.

Table 2 displays differences in vaccination acceptance depending upon marital status. There was a significant difference in ORs for vaccination acceptance between the categories 'Married' and 'Not Married'. The OR for the category 'Not Married' was 0.861 (CI 0.815–0.910), as compared to the reference category 'Married'.

According to the results obtained, women and men were equally likely to accept vaccination. There was no significant difference in ORs for vaccination acceptance between men and women. The OR for 'Women' was 1.003 (CI 0.950–1.059), as compared to the reference category 'Men'.

The results show some significant difference in the likelihood of vaccination acceptance depending upon level of education. The OR for the category 'College graduate' was 1.335 (CI 1.202–1.484), as compared to the reference category ' < 12 years of education'. There were no significant differences in ORs for the categories '12 years' (OR=1.029, CI 0.922–1.147) and 'Some college' (OR=1.068, CI 0.959–1.189), as compared with the reference category.

Results show that health care insurance was a factor strongly linked with vaccination acceptance. The OR for the group of respondents having health care insurance was significantly higher compared with respondents not having health care insurance. The OR for vaccination acceptance was 0.529 (CI 0.477–0.588) for the 'No' insurance category, compared to the reference category consisting for respondents in the 'Yes' category.

Further, prevalence of having one or several chronic medical conditions was highly associated with immunization acceptance. Respondents stating that they have a chronic medical condition were more likely to accept vaccination against the A(H1N1)

pandemic. The OR was 1.645 (CI 1.554–1.743) for respondents in the group of respondents having at least one chronic medical condition, as compared with the reference category of respondents having no chronic medical conditions.

There were differences in the ORs for vaccination acceptance between the categories 'White only' and 'Black only'. The ORs were significantly lower in the 'Black only' category (OR=0.753, CI 0.674–0.841), as compared to the 'White only' reference category. There were no differences in OR for vaccination acceptance registered for members of the category 'Multiple and other races', when compared with the reference category (OR=1.041, CI 0.923–1.174).

Results show that knowledge about the A(H1N1) pandemic was strongly linked with immunization. When it comes to knowledge about the A(H1N1) pandemic, the OR for immunization acceptance was 1.822 (CI 1.723–1.926) in the category of respondents that maintain that they knew a lot about the 2009 A(H1N1) pandemic, which is significantly higher compared to the reference category consisting of respondents who did not know a lot about the pandemic.

A look at the random part of the model reveals interesting results. The random predictor state levels of generalized trust were significantly associated with immunization acceptance. In Model 4 (without the mediation knowledge variable), the OR for vaccination acceptance was 1.274 (CI 1.018–1.594). The contextual generalized trust variable was standardized to vary between 0 and 1. This implies that when going from the state with the lowest levels of generalized trust to the state with the highest, the odds of vaccination acceptance increases by about 27%.

When it comes to the state-level confounders introduced in Model 4, both state-level median age and population size was significantly and negatively associated with immunization. Health care spending per capita was significantly and positively associated with immunization. No significant association was found for population density.

When comparing the ORs for the random predictor contextual generalized trust in Model 4 and Model 5, it is evident that the inclusion of the knowledge variable did not substantially affect the association between contextual generalized trust and immunization acceptance. The OR for vaccination acceptance was only reduced slightly, from 1.274 (CI 1.018–1.594) in Model 4 to 1.248 (CI 1.000–1.557) in Model 5.

There were no notable differences in the results when the same model was implemented using the alternative knowledge variable (see section about individual-level predictors).

4. Discussion

The results obtained in this study show that the likelihood of vaccination acceptance was highest among elderly, married, non-black, college graduates, with health care insurance, one or many chronic medical conditions, who knew a lot about the 2009 A (H1N1) pandemic. These results are largely in line with variables found to predict A(H1N1) immunization acceptance in prior research (Bish et al., 2011; Brien et al., 2012; Nguyen et al., 2011). Among the state-level confounders, median age and population size was significantly and negatively associated and health care spending per capita significantly positively associated with immunization.

The empirical analysis was specifically targeting two hypotheses regarding the relationship between contextual generalized trust and individual immunization acceptance. Using a multilevel logistical procedure, the empirical analysis supports the hypothesis that contextual generalized trust was associated with immunization acceptance, also when controlling for possible individual and state-

level confounders. This finding corresponds well with prior studies linking individual-level social capital and immunization (Jung et al., 2013; Rönnerstrand, 2013) and contextual social capital and immunization (Nagaoka et al., 2012; Rönnerstrand, 2014).

To my knowledge, this study is the first to investigate the link between contextual social capital and 2009 A(H1N1) immunization acceptance, utilizing multilevel statistical procedures. In doing so, the results of this study add to the literature about social capital and health, and to the emerging literature about social capital and immunization. Moreover, to my knowledge, this may be one of the first studies considering both individual- and contextual-level predictors in explaining 2009 A(H1N1) pandemic immunization acceptance. For this reason, this study provides important contributions to the field of vaccinations and health policy.

The empirical investigation found that contextual generalized trust seems to have been linked to immunization. When the contextual generalized trust variable was added, the state-level variance was reduced substantially. However, it is important to keep in mind that the discriminatory accuracy of the state-level was quite moderate. It could be called into question if state of residence is the most appropriate unit of analysis (Duncan et al., 1993; Merlo et al., 2012; Giordano et al., 2011). Other bodies of the collective, such as neighborhoods, might provide better discriminatory accuracy with regard to immunization acceptance.

The empirical investigation tested the hypothesis that knowledge about the A(H1N1) pandemic mediated the association between contextual generalized trust and immunization acceptance. However, empirics failed to support this claim. Controlling for knowledge in the multilevel model did not substantially influence the association between the contextual generalized trust variable and immunization acceptance. In other words, the study renders no support for the claim that generalized trust was associated with immunization acceptance because information about the A(H1N1) pandemic was being transmitted more easily in states with high levels of trust. Even so, the study shows that knowledge about the 2009 A(H1N1) pandemic was strongly linked with immunization acceptance in itself.

One potential explanation for the absence of support for knowledge as a mediating variable could be that the data available only permitted an analysis of dichotomous measures of knowledge about the A(H1N1) pandemic. It is possible that a more fine-grained measure would have provided a more generous test of the hypothesis that knowledge mediated the relationship between contextual generalized trust and immunization acceptance. What speaks against this claim is that, as mentioned before, knowledge about the 2009 A (H1N1) pandemic, in itself, was found to be strongly linked with immunization acceptance. Perhaps it all boils down to that the effect of knowledge as mediator is influenced by the aggregation level, namely that the reason for the lack of support for knowledge as a mediator, could be that such knowledge is a more important mediator at the neighborhood level (Kawachi & Berkman, 2000). In addition, it is worth noting that the knowledge variable is relatively strongly correlated with other individual level variables, e.g. age and education. This may have reduced the effect of the inclusion of the knowledge variable into the model, because these variables may already account for some of the "knowledge" factor.

In the absence of support for knowledge as a mediator linking generalized trust with immunization, other causal pathways must be considered. One factor possibly capable of accounting for part of the association between generalized trust and immunization is the link between generalized trust and trust in institutions, in particular health care. Prior research has found institutional trust to be associated with A(H1N1) immunization acceptance (Velan et al., 2011; Rubin et al., 2009; Prati et al., 2011). One explanation for the relationship between contextual generalized trust and immunization could be due to the fact that in states where levels of generalized trust are high, people will also tend to have confidence in the authorities responsible for the immunization campaign. In relation to immunization, Yaqub and colleagues (2014) argue that the credibility of institutions matter even more than the information content itself (2014). Despite this, prior individual-level studies have shown individual generalized trust to be independently positively associated with immunization, taking trust in health care into account (Rönnerstrand, 2013).

An important feature of social capital and generalized trust is that they are claimed to facilitate the solution to dilemmas of collective action by improving levels of voluntary cooperation (Putnam, 1993). When short-term individual gains are in conflict with longer-term collective interests, members of societies characterized by high levels of trust often tend to prioritize the common good. Immunization against transferable diseases is a textbook example of the kind of situation where individual and collective objectives sometimes collide. High vaccination uptake in a community may provide an incentive for individuals to benefit from the herd immunity generated by others being vaccinated in their place, without being exposed to any potential side effects of the vaccination. But the other-regarding consequences of the vaccination decision can also motivate people to accept vaccination, for altruistic reasons. Recent studies have demonstrated the significance of altruism in the vaccination decision as a motive for immunization acceptance (Skea et al., 2008; d'd'Alessandro et al., 2012; Shim et al., 2012) This study was not designed to investigate altruism as a mediating variable, but it seems probable that contextual generalized trust might have been a factor stimulating concern about the way in which their vaccination decision would influence disease transmission in the wider community.

5. Strengths and limitations

This study has several strengths. By using multilevel statistical procedures, it adds to the existing literature about social capital and immunization by indicating that contextual generalized trust was associated with individual 2009 A(H1N1) pandemic immunization acceptance, taking individual-level confounders into account. Moreover, the present study adds to the literature about social capital and health-related behaviors by studying information diffusion as a causal pathway.

Despite its strengths, the study has several limitations. Firstly, aggregate levels of generalized trust are based on the combination of several different nationwide surveys, in which the wordings of the survey questions about trust varied slightly (Neville, 2012).

Secondly, the data analysis is restricted to NHFS survey responses gathered between January and June 2010, the reason being that one variable in the statistical models (health care insurance) was added to the NHFS survey in January 2010. However, concerning the main findings in this study, the results are largely similar if this variable is excluded and the analysis is carried out on cases gathered from October 2009 and onwards.

Thirdly, the response rate in the survey used was quite low, reaching only 34.7% for landline telephones and 27.0% for cell phones. Selection bias could be a problem because immunization acceptance might be lower among survey non-participants as compared to participants. Moreover, it is likely that high-trusting individuals are over-represented among survey respondents, as compared to survey non-respondents. But since contextual generalized trust was measured on the aggregated level, selection bias due to low response rate in the NHFS survey has not influenced on the association between contextual generalized trust and immunization.

Fourthly, even though quite a strong association between contextual generalized trust and individual-level immunization has been established, because of the study design, the question about causality cannot be addressed in the present paper.

Fifthly, the empirical analysis assumes that state of residence and the stat where the vaccination was obtained is overlapping. This assumption is not necessarily valid in all cases.

Finally, the present paper is incapable of separating between the compositional and contextual effect of generalized trust. In other words, it would have been an advantage to be able to control for individual-level generalized trust in the multilevel model.

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