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Social capital and self-rated health of residents of Gauteng province: Does area-level deprivation influence the relationship?

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ABSTRACT

Although social capital has been linked to population health, there is a dearth of studies on the phenomenon especially in sub-Saharan Africa. We investigated the individual and contextual effects of social capital indicators (group membership, registered to vote, perception towards safety in community and generalised trust) on the self-rated health (SRH) of the residents of Gauteng province. We used data from the 2015 Quality of Life (QoL) survey, which included a random representative sample of 27476 residents (level 1) in 508 administrative wards (level 2). We employed a multilevel logistic regression to examine the association of social capital and SRH (good vs poor). After adjusting for individual and area-level factors, no main effect of group membership (Adjusted OR: 0.93: 95% CI: 0.85–1.02), generalised trust (Adjusted OR: 1.01: 95% CI: 0.89–1.49) and registered to vote (Adjusted OR: 0.95; 95% CI: 0.82–1.10) was observed. However, if respondents were positive in their perception towards safety in community, there was a positive association with good SRH (Adjusted OR: 1.15; 95% CI: 1.01–1.31); while if residents reported a negative perception towards safety in community, a strong negative association with good SRH (Adjusted OR: 0.70; 95% CI: 0.62–0.79) was observed. Both ward variance and median odds ratio (MOR) indicate significant differences in good SRH by wards. A strong positive joint effect on the multiplicative scale was observed between satisfied with safety and the ward-level South African Multiple Deprivation Poverty Index (SAMPI), while a strong negative joint effect was also observed on a multiplicative scale between dissatisfied with safety and the SAMPI. Perception of safety in community is the core domain of social capital that significantly impacts the SRH of residents of Gauteng. Although the effect of perception towards safety in community on good SRH is influenced by ward deprivation,the effect is not dependent on the level of deprivation. Contextual factors as evidenced by the persistent MOR, in addition to individual factors, explain variation in reporting good SRH in the study area.

1. Introduction

Available literature on social capital suggest some ambivalence with respect to its conceptualization and definition (Buijs et al., 2016; Lynch, Due, Muntaner, & Davey Smith et al., 2000; Musalia 2016; Subramanian, Kim, and Kawachi 2002). This notwithstanding, the relationship between social capital and population health is increasingly receiving attention in public health. This is due to the growing evidence linking social capital and health outcomes (Murayama, Fujiwara, & Kawachi, 2012; Musalia et al., 2016; Rodgers, Valuev, Hswen, & Subramanian, 2019; Tomita & Burns, 2013). Social capital can be conceptualized at both group and individual level. In this study, we conceptualize social capital at the invidiual level based on the conceptual framework that presupposes that social capital consists of two dimensions: the structural and cognitive components (Hibino et al., 2012; Lau & Ataguba, 2015; Musalia et al., 2016).

The structural dimension of social capital refers to facets of social organization and networks like associational activity and group membership that contribute to cooperation such as participation in voluntary or civic organizations (Hibino et al., 2012; Subramanian et al., 2002).

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Cognitive social capital manifests as attitudes and perceptions, including trust and reciprocity among individuals (Buijs et al., 2016; Musalia et al., 2016; Rodgers et al., 2019).

Although the benefits of social capital are well known, knowledge of its impact on health is still limited (Rodgers et al., 2019). It has been shown that people with more social capital tend to have better health and/or live longer (Buijs et al., 2016). For example, Subramanian et al. (2002) observe that higher levels of community social trust were associated with decreased probabilities of reporting poor health. However, studies on the relationship between social capital and health have concentrated on the industrialised country context (Lau & Ataguba, 2015; Musalia et al., 2016; Novak et al., 2017; Novak, Emeljanovas, et al., 2018; Novak, Štefan, et al., 2018; O'Doherty, French, Steptoe, & Kee, 2017; Park and Youngho 2014; Snelgrove, Pikhart, & Stafford, 2001; Story, 2013; Yamaoka, 2008). Not enough attention has been given to the concept in low-developed countries, especially in sub-Saharan Africa, with weak health infrastructure (Story, 2013). A systematic review of the association between social capital and mental health found that out of 21 studies, only two were in developing countries (Story, 2013). Lau and Ataguba (2015) and Olamijuwon, Clifford Odemigwe, and De Wet (2018) have attributed this dearth of studies to lack of data. Yet, given their robust associational life, these countries could benefit more from the potential social capital offers to improve the health of their populations (Musalia et al., 2016; Olamijuwon et al., 2018; Story, 2013).

Self-rated health (SRH) as a measure of well-being is based on subjective evaluation of the overall quality of one's life (Buijs et al., 2016). It has proved to be a reliable indicator of the health status of respondents (Musalia et al., 2016; Tomita & Burns, 2013). Furthermore, SRH has a high predictive validity for mortality and morbidity, and in longitudinal studies, it is able to predict the onset of disabilities (Subramanian et al., 2002).

People are deprived when they lack what is customary (i.e., diets, housing, clothing and environmental and educational conditions). Statistics South Africa has designed the South African Multidimensional Poverty Index (SAMPI) which can be used to measure the level of poverty and deprivation in the country including the degree to which individuals or neighbourhoods are deprived (Statistics South Africa, 2014). Investigation of social capital and population health should routinely consider neighbourhood effects such as soci-economic status (SES), poverty or deprivation levels (Subramanian et al., 2002). Studies have shown that SES or deprivation levels affect both social capital and health. Poortinga, Dunstan, and Fone (2008) have suggested that neighbourhood deprivation have impact on the health of individuals. In light of the legacy of racial and geographic segregation of the apartheid era (i.e. a period when different racial groups were made to live and develop separately, and were grossly unequal), South Africa presents a good example of the role of neighbourhoods in health outcomes (SA History Online, 2018; Tomita & Burns, 2013). Moreover, the South African population is characterised by weak social cohesion rooted in racial and gender discrimination, an ever-widening income inequality gap, extreme violence, xenophobic attacks on foreign nationals and criminal victimization (Olamijuwon et al., 2018). South Africa with a Gini coefficient of income inequality of 63.4, is one of the most unequal societies. According to Kawachi et al. (1997), the degree of income inequality in a society is related to the society's level of health. Moreover, the South African society has been associated with declining trust in political institutions, poor interpersonal trust and declining public safety. All these impact social cohesion and thus social capital (Olamijuwon et al., 2018).

Past studies in South Africa that explored the impact of social capital on health mostly consider health outcomes such as HIV/AIDS, depression, tuberculosis and social cohesion – and not subjective well-being (Cramm, Møller, & Nieboer, 2012; Pronyk et al., 2008; Tomita & Burns, 2013). Only three studies that assessed the relationship between social capital and SRH could be sourced (Lau & Ataguba, 2015; Maluccio, Haddad, & May, 2000; Olamijuwon et al., 2018). However, these studies did not consider the influence of area deprivation level on the relationship between social capital and SRH. Moreover, these studies looked at social capital and general subjective well-being in provinces other than Gauteng. Therefore, studies that provide a contrast of how social capital operates to influence health in most SES unequal communities such as in Gauteng province are needed (Gauteng Provincial Government, 2014).

Our study investigates the contribution of social capital to the well-being of residents of Gauteng province. We first consider the relationship between individual-level social capital and SRH, then adopt a multilevel regression analysis to investigate the role of the individual social capital indicators on SRH. The study also investigates how area-level deprivation impacts the relationship between social capital and SRH.

2. Conceptual framework

The theoretical justification of the relationships we investigate is presented in the conceptual framework in Fig. 1 (Supplementary Material Fig. 1).

3. Methods

3.1. Research design

The present study adopted a cross-sectional study design used by the Gauteng City Region Observatory (GCRO) and described in the GCRO Technical Report (Ask Africa, 2016).

3.2. Study setting

Gauteng province is situated in the central north-eastern part of the country and is the smallest of the nine provinces of South Africa (Gauteng Provincial Government, 2014; Statistics South Africa, 2012). According to the 2019 mid-year population estimates, Gauteng has a population of 15,176,115 people, which constitutes 25.82% of South Africa's entire population (Department of Statistics South Africa, 2019), living on 18,178 square kilometres (Statistics South Africa, 2012).

4. Study population

The study population consisted of a representative sample of residents of Gauteng included in the 2015 QoL survey of the GCRO.

5. Data sources

5.1. Individual-level data

The present study used individual data collected during the 2015 QoL survey of adults aged 18 years and older, using an improved questionnaire used in previous surveys. The questionnaire was first piloted by the GCRO and the results of the pilot study were worked into the final questionnaire (Ask Africa, 2016).

The QoL survey used stratified multistage random sampling using the 2011 wards (n = 508) as the stratification variable. The enumerator areas (EAs) were selected using probability proportional to size (PPS) and the power allocation rule. The minimum number of respondents selected per ward (determined by PPS) was 30 from non-metro wards and 60 from metro wards with no ceiling. Details of the sampling and how representativity at ward level was achieved are described in the GRCO Technical Report (Ask Africa, 2016).

A structured questionnaire with a total of 228 questions (224 closed and four open-ended questions) was used to collect the data. A Computer Aided Personal Interviewing (CAPI) method, which is a face-to-face interviewing method that utilises a portable electronic device

such as a tablet, was used during fieldwork to collect the data. This methodology involves an interviewer reading the survey questions and then capturing the responses on the electronic device (Ask Africa, 2016).

The GCRO closely monitors data collection in real-time, ensuring that the collected data are of the highest possible quality and integrity. In addition, the GRCO implements rigorous checking and quality control processes that help to ensure that the data is of a very high quality (Bulbula, 2018; de Kadt, Götz, Culwick, Parker, & Hamann, 2019).

5.2. Ward-level data

In 2011, Gauteng province had 508 wards. Wards were chosen as the geographical units of analyses, and this is because it was the smallest area at which Statistics South Africa computes the SAMPI. The SAMPI was included in the analysis as a ward-level variable.

6. Data management and analysis

6.1. Data management

The data was processed using the software Stata IC V.14.2 (StataCorp, Texas, USA). The SAMPI drawn from the 2011 census data was merged with the QoL survey data to create ward-level variable. The SAMPI was converted into a categorical variable by generating quartiles.

6.1.1. Definition of key variables

The primary health outcome was SRH, captured on a four-point Likert scale and assessed by the question "How would you describe your own health status in the past 4 weeks? (excellent = 1 and 4 = very poor)". SRH was reclassified as described by Subramanian et al. (2001) into a dichotomous variable (0 = poor health and 1 = good health) by collapsing the original categories (poor or very poor) into poor SRH (coded 0), with the remaining original categories (excellent, good) into good SRH (coded 1).

The structured dimension of social capital was measured using civic participation, assessed by the respondent's participation in activities of any club or society (e.g. sports club), and if they were registered to vote or not. Participants responded yes (= 1) or no (= 0).

The cognitive dimension of social capital was assessed by generalised trust and perception towards safety in the community. Generalised trust was measure by the question; "Generally speaking, do you think that most people in your community can be trusted or that you need to be careful when dealing with people in your community?", requiring a response on a three-point scale (1 = Most people can be trusted, 2 = You need to be very careful, and 3 = Don't know). "Don't know" was considered a no response and was thus excluded from the analysis. This dropped the study population from 30,002 to 27,476 individuals nested within 508 wards. Perception of safety was assessed by the question "How satisfied are you with safety and security services provided by government where you live?", requiring a response on a five-point scale (1 = very satisfied and 5 = very dissatisfied). This variable was recoded into three levels as follows: 0 = neutral (neither satisfied nor dissatisfied), 1 = satisfied and 2 = dissatisfied.

The individual-level explanatory variables extracted from the data included demographic and socioeconomic variables (i.e., age, gender, population grouping, place of birth, employment status, education level and being a grant recipient). The area level deprivation was assessed using the ward-level SAMPI.

6.2. Justification of the analytical approach and data analysis

6.2.1. Justification of the analytical approach

Since the data used in this study was of a hierarchal nature, with individuals/household (Level 1) nested within communities (Level 2), a multilevel approach was adopted for the analysis (Wendel-Vos et al., 2008). Furthermore, since the outcome (SRH) was reclassified into a dichotomous variable, a multilevel binary logistic regression model was fitted to the data to investigate the association between social capital variables and the outcome. Area level deprivation is known to influence the health of residents. We therefore assessed the impact of the interaction between the SAMPI and social capital indicators on the outcome (SRH).

6.2.2. Data analysis

Descriptive statistics were computed to estimate the proportions and 95% confidence intervals of respondents reporting good SRH by social capital variables and covariates. A two-level multilevel model was fitted to investigate the association between social capital and SRH.

Three multilevel models were fitted, with Model 1 (null model) an empty model fitted to serve as a benchmark for other models (Buijs et al., 2016). The first step in multilevel regression analysis (Fitting Model 1), consists of a decomposition of the variance of the dependent variable into the different levels. The variance of the individual SRH was decomposed into two components: the within-ward variance and the between-ward variance. These two variance components were obtained with a multilevel regression Model 1.

The multilevel regression equation for Model 1 is equal to:

$$\Upsilon_{ij} = \beta_{0j} + \varepsilon_{ij}$$

$$\beta_{0j} = \gamma_{00} + U_{0j}$$

With Υ_{ij} representing SRH in ward j, β_{0j} the intercept for the ward j, ε_{ij} the individual residual, γ_{00} the overall intercept and U_{0j} the ward departure from the overall intercept. This model predicts the individual SRH by the average SRH of his/her ward and the ward SRH is predicted by the grand mean. Since the regression model has no predictors, the ward intercepts (i.e. β_{0j}) will therefore be equal or close to the ward means. The variance of U_{0j}, usually denoted T00, will be equal to between-ward variance. As each individual will be assigned his/her ward mean as predicted SRH, the variance of ε_{ij} (usually denoted S2) will be equal to the within-ward variance.

Model 2 (unadjusted model) included SRH (outcome) and the four social capital variables as explanatory variables. Model 2 investigated the extent to which area-level differences were explained by the individual composition of the areas. With the introduction of the individual-level variable social capital in Model 2 as a fixed effect, the equation is as shown below:

$$Y_{ij} = \beta_{0j} + \beta 1j\ (\text{Social Capital})ij + \varepsilon_{ij}$$

$$\beta_{0j} = \gamma_{00} + U_{0j}$$

$$\beta 1j = \gamma_{10}$$

This model has two random components – i.e. (i) the variance of ε_{ij}, denoted S2; and (ii) the variance of U_{0j}, denoted T00 – and two fixed parameters, i.e. γ_{00} and γ_{10}.

The full model (Model 3) accounted for all covariates at individual and ward levels (i.e. the demographic and socioeconomic variables, and the SAMPI). This was as Maluccio et al. (2000) observed, to account for fixed effects. In Model 3, the respondents' demographic variables, denoted COV were added as random factors to the previous model (Model 2). The equation is written as follows:

$$Y_{ij} = \beta_{0j} + \beta_{1j}\ (\textit{Social Capital})ij + \beta_{2j}\ (\textit{COV})ij$$

$$\beta_{0j} = \gamma_{00} + U_{0j}$$

$$\beta_{1j} = \gamma_{10} + U_{1j}$$

$$\beta_{2j} = G20 + U2j$$

Interaction on the multiplicative scale for the unadjusted (Model 2) and fully adjusted (Model 3) models was assessed by including an interaction term between the social capital variables and the SAMPI.

Interaction on the additive scale was assessed by computing the relative excess risk due to interaction (RERI), attributable proportion (AP) and synergy index (S) (de Jager et al., 2011; Knol et al., 2011). The intra-class correlation coefficient, median odds ratios (MORs) and estimates of variance were computed to explain the proportion of total variance due to neighbourhood influence.

All the models were adjusted by the post-stratification weights as estimated by the GCRO to ensure that the sample represents the target population as closely as possible and to account for the differences in the different populations. The Akaike information criteria (AIC) and Bayesians information criteria (BIC) were computed to assess model fit. Significance for all the statistical analyses was set at $P<0.05$.

7. Results

7.1. Descriptive statistics

Table 1 presents SRH among respondents (n = 30,002) hierarchically clustered into wards (n = 508) by demographic and socioeconomic characteristics.

Table 1
Demographic and socioeconomic characteristics by SRH (n = 3002).

Variable	Level	Poor SRH		Good SRH	
		n	%	n	%
Education level	No education	121	24.64	370	75.36
	Primary education	690	20.93	2,607	79.07
	Incomplete secondary	897	10.00	8,076	90.00
	Matric	523	5.28	9,377	94.72
	More than matric	232	3.44	6,519	96.56
	Unspecified	49	8.31	541	91.69
Age category	18–35	663	4.72	13,394	95.28
	36–49	529	6.28	7,895	93.72
	50–64	756	13.85	4,704	86.15
	> = 65	564	27.37	1,497	72.64
Gender	Male	1,000	7.17	12.953	92.83
	Female	1,512	9.24	14,537	90.58
Race	African	2,148	8.89	22,017	91.11
	Coloured	90	7.87	1,054	92.13
	Indian/Asian	28	4.42	605	95.58
	White	241	6.12	3.697	93.88
	Other	5	4.10	117	95.90
Place of birth	Born in Gauteng	1,720	8.97	17,461	91.03
	Migrated from another province	680	7.99	7,829	92.01
	Migrated from another country	112	4.84	2,200	95.16
Employment status of respondent	Employed	649	4.45	13,922	95.55
	Unemployed	655	8.04	7,493	91.96
	Other	1,208	16.59	6,075	83.41
SAMPI quartile	1st Quartile	962	8.57	10,263	91.43
	2nd Quartile	612	8.17	6.877	91.83
	3rd Quartile	315	8.34	3,463	91.66
	4th Quartile	623	8.30	6,887	91.70
Anyone in household receives grant?	No	867	5.01	16,429	94.99
	Yes	1,645	12.95	11,061	87.05
Membership of any club in last 12 months?	No	1,293	7.66	15,581	92.34
	Yes	1,219	9.29	11,909	90.71
People in your neighbourhood can be trusted?	Most people can be trusted	355	8.21	3,971	91.79
	You need to be careful	1.950	8.42	21,200	91.58
	Don't know	207	8.19	2,319	91.81
How do you feel about safety and security?	Neutral	485	7.51	5,971	92.49
	Satisfied	771	6.50	11,087	93.50
	Dissatisfied	1,256	10.75	10,432	89.25
Are you a registered voter?	No	366	6.00	5737	94.00
	Yes	2146	8.98	21753	91.02

7.1.1. Education

The education level "More than matric" had the highest proportion (96.56%) reporting good SRH. This was followed by those who had attained matric (94.72%). Respondents who had no education had the lowest proportion reporting good SRH (75.36%) (Table 1).

7.1.2. Age

Although the different age strata had more respondents reporting good SRH, the proportion reporting good SRH decreased with increasing age. The youngest age category (18–35 years) had the largest proportion (95.28%) reporting good SRH, while age group $\geq$ 65 years had the lowest proportion reporting good SRH (Table 1).

7.1.3. Gender and race

Slightly more males (92.83%) reported good SRH compared to females (91.11%). Across each race group, the majority reported good SRH. However, among Indians/Asians and those classified as "Other", 96% reported good SRH. Among whites and coloureds, 93.88% and 92.13% respectively reported good SRH. Africans had the lowest proportion (91.11%) reporting good SRH (Table 1).

7.1.4. Place of birth

With respect to "Place of birth", far more individuals reported good SRH (Table 1). Immigrants from outside South Africa to Gauteng recorded the highest proportion (95.16%) reporting good SRH, followed by immigrants from other provinces other than Gauteng province (92.01%). Respondents born in Gauteng recorded the lowest proportion (91.11%) reporting good SRH (Table 1).

7.1.5. Employment status

In each category of employment status, the majority reported good SRH (Table 1), with more employed respondents reporting good SRH (95.55%), followed by the unemployed (91.96%). The category "Other" had the lowest proportion (83.41%) reporting good SRH.

7.1.6. Grant recipient and SAMPI

The category with no member of the household receiving a grant had more people reporting good SRH (94.99%), compared to 87.05% with a member in the household receiving a grant (Table 1). Each category of the SAMPI had more respondents reporting good SRH (Table 1); however, on average, each SAMPI quartile had the same proportion (92%) reporting good SRH.

7.1.7. Group membership

Among those who responded to the question "Were you involved with any club in last 12 months?", the majority reported good SRH irrespective of whether they had participated in a club in the last 12 months or not (Table 1). However, respondents who had not participated in a club in the last 12 months had a slightly higher number (92.34%) reporting good SRH, compared to those who had participated (90.71%) in club activities in the past 12 months.

7.1.8. Trust for community members

The majority of those who responded to the question on whether people in the community could be trusted reported good SRH. On average, 92% reported good SRH irrespective of whether they responded to the question in the negative (91.79%) or affirmative (91.58%) or were neutral (91.63%) (Table 1).

7.1.9. Perception of safety and security in the community

With respect to how they perceived safety and security in the community, the majority reported good SRH. However, more who were satisfied with safety and security (93.50%) reported good SRH compared to those who were dissatisfied with safety and security (89.25%) (Table 1).

Table 2
Measures of association between individual and area characteristics and the outcome, and measures of variations and clustering in the reporting of good SRH among residents of Gauteng city region, 2015, obtained from multilevel logistic models[a].

Variable SRH	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)
Individual level:	12.04 (11.26–12.87)		
Cognitive social capital			
People can be trust (No)		1(reference)	1(reference)
Yes		0.98(0.87–1.11)	1.01(0.89–1.49)
Neither dissatisfied nor satisfied with safety in community (0)		1(reference)	1(reference)
Satisfied with community safety (1)		1.16(1.02–1.32) **	1.15(1.01–1.31) **
Dissatisfied with community safety (2)		0.69(0.61–0.77) ***	0.70(0.62–0.79) ***
Structural social capital			
Registered to vote (No)		1(reference)	1(reference)
Yes		0.64(0.56–0.72) ***	0.95(0.82–1.10)
Membership (No)		1(reference)	1(reference)
Yes		0.83 (0.76–0.91) ***	0.93(0.85–1.02)
Variance and clustering components:			
Level 2 variance	0.26(0.20–0.34)	0.22(0.17–0.30)	0.14(0.10–0.20)
Level 2 intra-class correlation	0.07(0.06–0.09)	0.06(0.05–0.08)	0.04(0.03–0.06)
Level 2 MOR	1.63	1.57	1.43
Sensitivity analysis:			
AU ROC curve	0.69(0.68–0.70)	0.69(0.68–0.70)	0.78(0.77–0.79)
Model fit			
AIC	15671.3	15498.90	13871.01
BIC	15687.74	15556.45	14101.2
P		<0.01	<0.01

AIC = Akaike information criterion.
BIC = Bayesian information criterion.
Reference category in bracket.
MOR = Median odds ratio.
AU ROC: Area under the curve.
**p ≤ 0.05, ***p ≤ .01.
[a] Multilevel models were estimated with mixed effects regression models implemented in Stata (version 14). All regression results are using survey weights. The regression is across 508 neighbourhoods.

7.1.10. Registered to vote

The majority who responded to the question "Are you registered to vote?" reported good SRH. This was irrespective of their response (Table 1).

7.2. Multivariable associations between SRH and social capital while accounting for individual-level variables and area-level deprivation (SAMPI)

The results of the three multilevel models are presented in Table 2. Model 1 shows that 26% (95% CI: 20–34%) of the observed variance in SRH is at ward level. The grand mean (average likelihood) of reporting good SRH by respondents (n = 27,476) within the wards (n = 508) is 12.04% (95% CI:11.26–12.87%).

Out of the two measures of cognitive social capital, only perception of safety and security in the community was associated with SRH (Model 2). Compared to the referent category (Neither satisfied nor dissatisfied with safety in the community), a strong positive main effect of satisfied with safety in community on SRH was observed (Unadjusted OR: 1.16; 95% CI: 1.02–1.32). Dissatisfied with the safety in community was strongly negatively associated with SRH (Unadjusted OR: 0.70; 95% CI: 0.61–0.77).

Both measures of structural social capital had a very strong negative association with good SRH in Model 2 (Table 2), with respondents who had group membership having lower odds (Unadjusted OR: 0.83; 95% CI: 0.76–0.91) of reporting good SRH compared to those who did not belong to a club. Likewise, respondents who were registered to vote had lower odds (Unadjusted OR: 0.64; 95% CI: 0.56–0.72) of reporting good SRH in comparison to the referent group.

After accounting for social capital variables, the amount of variance in reporting SRH attributed to ward level reduced slightly to 22% (95% CI: 0.17–0.30) (Model 2). The ICC reduced from 0.08 (95% CI: 0.06–0.94) in the null model to 0.06 (95% CI: 0.05–0.08) in Model 2. The MOR also reduced from 1.63 in the null model to 1.57 in Model 2. This implies that the variance in reporting good SRH attributed to ward level reduced when social capital variables were accounted for.

The AIC and BIC for Model 2 were lower than for Model 1. Therefore, accounting for social capital variables in the model led to a better model fit for the data.

In the fully adjusted model (Model 3) we accounted for the SAMPI, demographic and socioeconomic variables. No main effect measure was observed for both membership and registered to vote. While no effect measure was observed for trust, a strong association with SRH was observed for community perception towards safety. If respondents were dissatisfied with security in the neighbourhood, they had lower odds of reporting good SRH (Adjusted OR 0.70; 95%CI: (0.62-0.79). But if respondents were satisfied with safety in the community, they had higher odds (Adjusted OR: 1.15; 95% CI: 1.01–1.31) of reporting good SRH.

The variance in SRH attributed to ward level in Model 3 decreased to almost half of the variance in SRH in the null model. Thus, slightly over half of the variance in SRH at ward level (14% 95% CI:10–20) was explained by the SAMPI, demographic and socioeconomic variables.

The ICC also dropped in Model 3 to just over half (0.04; 95% CI: 0.03–0.06) of the ICC of the null model (0.07; 95% CI: 0.06–0.9). Likewise, the MOR for Model 3 reduced to 1.43 compared to 1.63 for the null model. Since the ICC measures variability within the ward, it means that by accounting for the SAMPI, demographic and socioeconomic variables, the variability within the wards reduced drastically.

The MOR (a measure of the evidence of clustering) reduced in value, suggesting that the extent to which an individual reporting good SRH depended on the area they live in reduced drastically when all covariables were accounted for in the full Model 3. But since the MOR remained large (MOR = 1.43), it means that reporting of good SRH among residents of Gauteng to a great extent is depended on the area of residence.

Model 3 yielded the smallest AIC (113871.01) and BIC (14101.2). Therefore, the full model was the best fit for the data.

7.3. Interaction between area-level deprivation and social capital

While a strong joint effect on the multiplicative scale was observed between the 2nd quartile of the SAMPI and feeling neutral towards safety in community on reporting good SRH (Adjusted OR 1.31; 95% CI: 1.05–1.62), this was not the case on the additive scale as interaction failed to reach significance (RERI: 0.19; 95% CI: -0.13–0.51). On the contrary, interaction between each of the 1st, 3rd and 4th quartiles of the SAMPI and feeling neutral towards safety in community failed to reach significance on both the multiplicative and additive scales (Table 3).

A strong positive joint effect (Adjusted OR = 1.38 (1.19–1.59) was observed between satisfied with safety and the 1st quartile of the SAMPI on the multiplicative scale (Table 4). However, this was not true for the same variables on the additive scale (Adjusted OR: -0.09 (95% CI: -0.35–0.17).

A similar trend was also observed, with a strong joint effect observed on the multiplicative scale between the 2nd, 3rd and 4th quartiles of the SAMPI and satisfied with safety in the community, but not on the additive scale for the same variables.

The effect measures for interaction between dissatisfied with safety in community and the SAMPI on the multiplicative and additive scales are presented in Table 5. Apart from the 2nd quartile for which a strong positive joint effect was observed, a strong negative joint effect was observed on the multiplicative scale between the rest of quartiles of the SAMPI and dissatisfied with safety in community in the fully adjusted model. There was no interaction effect on the additive scale observed between dissatisfied with safety and all four levels of the SAMPI.

Interaction between all four quartiles of the SAMPI and the social capital variable trust did not reach significance on both the multiplicative and additive scales (Table 6; Supplementary material B).

In Table 7 (Supplementary material C), apart from the joint interaction between the 3rd quartile and group membership that did not reach significance, the joint effect between each of the 1st, 2nd and 4th quartiles with group membership in the unadjusted model was significant. However, this effect was attenuated and ceased to exist when the socioeconomic variables were accounted for in Model 3. Therefore, no interaction on both the multiplicative and additive scale between group membership and all four SAMPI quartiles in Model 3 was observed.

Table 8 (Supplementary material D) shows a strong joint effect between each of the four quartiles of the SAMPI with registered to vote in the unadjusted model. But as was the case with group membership (Table 7; Supplementary material C), this effect was attenuated and disappeared when demographic and socioeconomic variables were accounted for in Model 3. Therefore, no interaction effect between "Registered to vote" and the four levels of the SAMPI on both the multiplicative and additive scales was observed in the final model.

8. Discussion

Researching social capital and well-being can potentially identify opportunities for policy makers to improve the health of individuals and communities (Buijs et al., 2016). This study presents important findings on the association between social capital and SRH of residents of Gauteng. It evaluates the effect of interaction between the SAMPI and social

Table 3
Assessing interaction between neutral to safety in community and SAMPI on the additive and multiplicative scale.

Summary measures		Unadjusted model[a]		Fully adjusted model[b]	
Interaction between perception of safety in community and SAMPI quartile		OR (95% CI)	p-value	OR (95% CI)	P-value
Neutral to safety in community and 1st Quartile					
Neutral to safety in community	1st Quartile				
No	No	1 (reference)		1(reference)	
No	Yes	1.16 (1.01–1.34)	0.036	1.19(1.02–1.37)	0.022
Yes	No	0.95 (0.86–1.04)	0.257	0.96(0.86–1.06)	0.382
Yes	Yes	1.10(0.93–1.30)	0.288	1.07(0.90–1.28)	0.422
	RERI	-0.01(-0.26-0.23)	0.924	-0.07(-0.32-0.19)	0.609
	AP	-0.01 (-0.24-21)	0.925	-0.06(-31-0.18)	0.618
	S	0.89(0.08–9.92)	0.924	0.53(0.04–7.55)	0.637
Neutral to safety in community and 2nd Quartile					
Neutral to safety in community	2nd Quartile				
No	No	1(reference)			
No	Yes	1.15(1.02–1.31)	0.025	1.12(0.98–1.27)	0.104
Yes	No	1.05(0.94–1.17)	0.384	1.00(0.89–1.12)	0.989
Yes	Yes	1.24(1.01–1.52)	0.044	1.31(1.05–1.62)	0.015
	RERI	0.03(-0.27-0.33)	0.840	0.19(-0.13-0.51)	0.242
	AP	0.03(-0.21-0.26)	0.838	0.15(-0.08-0.37)	0.196
	S	1.15(0.30–4.45)	0.838	2.67(0.41–17.56)	0.306
Neutral to safety in community and 3rd Quartile					
Safety in community	3rd Quartile				
No	No	1(reference)			
No	Yes	1.14(1.02–1.28)	0.026	1.14(1.01–1.29)	0.033
Yes	No	0.98 (0.85–1.13)	0.797	0.99(0.86–1.15)	0.927
Yes	Yes	1.28(0.95–1.72)	0.102	1.31(0.96–1.78)	0.085
	RERI	0.16(-0.26-0.57)	0.461	0.17(-0.26-0.61)	0.436
	AP	0.12(-0.17-0.41)	0.415	0.13(-0.17-0.43)	0.385
	S	2.26(0.29–17.77)	0.437	2.30(0.32–16.60)	0.410
Neutral to safety in community and 4th Quartile					
Safety in community	4th Quartile				
No	No	1(reference)			
No	Yes	1.19(1.05–1.35)	0.008	1.21(1.06–1.38)	0.004
Yes	No	1.03(0.92–1.15)	0.557	1.06(0.95–1.19)	0.294
Yes	Yes	1.12 (0.91–1.38)	0.290	1.08(0.87–1.34)	0.496
	RERI	-0.10(-0.39-0.18)	0.485	-0.20(-0.49-0.10)	0.187
	AP	-0.09(-0.36-0.18)	0.507	-0.18(-0.49-0.12)	0.232
	S	0.54(0.07–4.11)	0.550	0.28(0.01–5.48)	0.403

[a] Unadjusted Model 2: Covariates adjusted for included social capital and SAMPI.
[b] Fully adjusted Model 3: Covariates adjusted for included social capital, demographic and socioeconomic variables and SAMPI.

Table 4
Assessing interaction between satisfied with safety in community and SAMPI on additive and multiplicative scales.

Summary measures		Unadjusted model[a]		Fully adjusted model[b]	
Interaction between satisfied with safety in community and SAMPI quartile		OR (95% CI)	P-value	OR (95% CI)	P-value
Satisfied with safety in community and 1st Quartile					
Satisfied with safety in community	1st Quartile				
No	No	1 (reference)		1(reference)	
No	Yes	1.57 (1.40–1.77)	0.000	1.50(1.32–1.69)	0.000
Yes	No	0.96 (0.86–1.07)	0.464	0.97(0.87–1.08)	0.567
Yes	Yes	1.46(1.27–1.68)	0.000	1.38(1.19–1.59)	0.000
	RERI	-0.07(-0.33-0.19)	0.575	-0.09(-0.35-0.17)	0.503
	AP	-0.05 (-0.23-0.13)	0.582	-0.06(-0.26-0.13)	0.514
	S	0.86(0.51–1.45)	0.571	0.81(0.44–1.50)	0.499
Satisfied with safety in community and 2nd Quartile					
Satisfied with safety in community	2nd Quartile				
No	No	1(reference)			
No	Yes	1.54(1.38–1.71)	0.000	1.44(1.29–1.62)	0.000
Yes	No	1.03(0.92–1.17)	0.559	1.01(0.89–1.14)	0.930
Yes	Yes	1.66(1.40–1.96)	0.000	1.55(1.30–1.84)	0.000
	RERI	0.08(-0.23-0.40)	0.606	0.10(-0.21-0.41)	0.527
	AP	0.05(-0.13-0.23)	0.595	0.06(-0.13-0.26)	0.511
	S	1.14(0.69–1.90)	0.603	1.22(0.66–2.26)	0.525
Satisfied with safety in community and 3rd Quartile					
Satisfied with safety in community	3rd Quartile				
No	No	1(reference)			
No	Yes	1.53(1.38–1.28)	0.000	1.46(1.32–1.62)	0.000
Yes	No	0.97 (1.83–1.13)	0.707	1.02(0.87–1.20)	0.792
Yes	Yes	1.71(1.35–1.72)	0.000	1.54(1.21–1.97)	0.005
	RERI	0.21(0.23–0.57)	0.348	0.06(-0.36-0.48)	0.782
	AP	0.12(-0.11-0.41)	0.300	0.04(-0.23-0.30)	0.776
	S	1.42(0.72–17.77)	0.316	1.12 (0.51–2.49)	0.777
Satisfied with safety in community and 4th Quartile					
Satisfied with safety in community	4th Quartile				
No	No	1(reference)			
No	Yes	1.58 (1.42–1.76)	0.000	1.47(1.32–1.65)	0.000
yes	No	1.03(0.92–1.17)	0.594	1.02(0.90–1.16)	0.727
yes	Yes	1.52 (1.29–1.78)	0.000	1.48(1.25–1.75)	0.000
	RERI	-0.10(-0.39-0.20)	0.516	-0.02(-0.31-0.28)	0.917
	AP	-0.06(-0.27-0.14)	0.530	-0.01(-0.21-0.19)	0.918
	S	0.84(0.49–1.43)	0.522	0.97(0.53–1.78)	0.917

[a] Unadjusted Model 2: Covariates adjusted for included social capital and SAMPI.
[b] Fully adjusted Model 3: Covariates adjusted for included social capital variables, demographic variables, socioeconomic variables and SAMPI.

capital on reporting good SRH for Gauteng residents from a population-based survey. Overall, the proportion of respondents reporting good SRH was higher for each category of the demographic and socioeconomic variables. This was true for all the categories of the SAMPI and social capital variables, suggesting that the majority of respondents generally exhibited good subjective health. In the full model (Model 3), only community perception of safety and security was strongly associated with reporting good SRH. It is worth noting that although the variance in SRH attributed to area reduced drastically when individual covariates were accounted for, it did not completely disappear. This means that area influences a respondent's chances of reporting good or poor SRH. This is supported by the fact that the MOR remained high in the final model, which suggests evidence of clustering of SRH at ward level. Finally, our findings confirmed the existence of significant joint effects between perception of safety in community and area deprivation level on reporting good SRH. However, no significant interaction between the SAMPI and all social capital variables on reporting good SRH was observed on the additive scale.

While a strong association was observed between perception of safety in community and SRH, this was not the case with other social capital variables (i.e. registered to vote, generalised trust and group membership). Lack of association between trust and reporting good SRH in the present study is contrary to the findings of Subramanian et al. (2001) who observed that the extent of interpersonal (mis)trust between citizens was one of the social capital measures that constituted the core domain of social capital. Furthermore, the findings reported here contradict findings of a second study by Subramanian et al. (2002), in which they reported a strong correlation between the proportion of respondents who reported social mistrust and the proportion of residents in various US states who rated their own health as only "fair or poor", as opposed to "excellent, very good or good". Our findings also contrast with the observation by Sapag et al. (2008), who reported that neighbourhood social cohesion as measured by trust and reciprocity is associated with higher SRH. The fact that our findings differed with those of other researchers was surprising. However, it has been noted that the impact of social capital on health outcomes varies with study setting, population studied and the health outcome studied (van Hooijdonk, Droomers, Deerenberg, Mackenbach, & Kunst, 2008). The authors are of the view that the declining trust in political institutions, poor interpersonal trust and declining public safety among South Africans (Olamijuwon et al., 2018) could explain why trust does not constituted the core domain of social capital in the study area.

A strong main effect for perception of safety in the community on reporting good SRH was consistently observed for individuals in the study area. If a respondent was positive about safety, they were more likely to report good SRH – which was not the case if they were dissatisfied with safety in the area. This finding is consistent with findings of other researchers who concluded that how one feels about the quality of their neighbourhood is substantial for health (Olamijuwon et al., 2018). In Canada, subjective perceptions of neighbourhood security have also been associated health outcomes (Auger et al., 2008). The fact that if a respondent was dissatisfied with safety in the area, they were less likely to report good SRH has also been reported by Warr, Feldman, Tacticos, and Kelaher (2009), who observed that lower perceptions of

Table 5
Assessing interaction on additive and multiplicative scale between dissatisfied with safety in community and SAMPI.

Summary measures		Unadjusted model[a]		Fully adjusted model[b]	
Interaction between dissatisfied with safety in community and SAMPI		OR (95% CI)	p-value	OR (95% CI)	P-value
Dissatisfied with safety in community and 1st Quartile					
Dissatisfied with safety in community	1st Quartile				
No	No	1 (reference)		1(reference)	
No	Yes	0.60 (0.53–0.67)	0.000	0.62(0.55–0.69)	0.000
Yes	No	0.93 (0.82–1.05)	0.260	0.91(0.80–1.40)	0.173
Yes	Yes	0.58(0.51–0.65)	0.000	0.62(0.54–0.70)	0.000
	RERI	0.05(-0.09-0.18)	0.500	0.08(-0.06-0.23)	0.264
	AP	0.08 (-0.16-0.32)	0.500	0.13(-0.10-0.37)	0.264
	S				
Dissatisfied with safety in community and 2nd Quartile					
Dissatisfied with safety in community	2nd Quartile				
No	No	1(reference)			
No	Yes	0.61(0.56-68)	0.000	0.67(0.60–0.74)	0.000
Yes	No	1.07(0.93–1.24)	0.319	1.11(0.96–1.28)	0.178
Yes	Yes	1.62(0.54–0.72)	0.000	1.62(0.53–0.72)	0.000
	RERI	-0.06(-0.24-11)	0.466	-0.16(-0.34-0.03)	0.108
	AP	-0.10(-0.38-0.18)	0.471	-0.25(-0.56-0.06)	0.117
	S				
Dissatisfied with safety in community and 3rd Quartile					
Dissatisfied with safety in community	3rd Quartile				
No	No	1(reference)			
No	Yes	0.62(0.56–0.68)	0.000	0.65(0.59–0.71)	0.000
Yes	No	1.12 (0.92–1.35)	0.254	1.09(0.89–1.32)	0.417
Yes	Yes	0.58(0.48–1.69)	0.000	0.64(0.53–0.77)	0.000
	RERI	-0.16(-0.40-0.08)	0.184	- 0.09(-0.33-0.15)	0.468
	AP	-0.28(-0.71-0.15)	0.200	-0.14(-0.53-0.25)	0.478
	S				
Dissatisfied with safety in community and 4th Quartile					
Dissatisfied with safety in community	4th Quartile				
No	No	1(reference)			
No	Yes	0.59(0.53–0.65)	0.000	0.62(0.56 -0.69)	0.000
Yes	No	0.96(0.83–1.10)	0.537	0.97(0.84–1.12)	0.645
Yes	Yes	0.64(0.55–0.73)	0.000	0.68(0.58–0.78)	0.000
	RERI	0.09(-0.07 0.25)	0.265	0.09(-0.08-0.26)	0.296
	AP	0.14(-0.10-0.39)	0.258	0.13(-0.11-38)	0.288
	S				

[a] Unadjusted Model 2: Covariates adjusted for included social capital and SAMPI.
[b] Fully adjusted Model 3: Covariates adjusted for included social capital variables, demographic variables, socioeconomic variables and SAMPI.

neighbourhood safety were associated with poorer health. This is an important finding given that two-thirds of South Africans feel unsafe in their neighbourhoods (Olamijuwon et al., 2018).

A strong negative association was observed in the unadjusted model between group membership (OR: 0.83; 95% CI: 0.76–0.91) and registered to vote (OR: 0.64; 95% CI: 0.56–0.72). However, after adjusting for socioeconomic and demographic variables, no effect measure was observed in the final model for both variables. This contradicts the findings of Sapag et al. (2008), who observed that social participation was associated with lower odds (OR: 0.89, 95% Cl: 0.89–1.06) of reporting good health. Lack of association between group membership and registered to vote, and SRH in the fully adjusted model, suggests that once the full influence of socioeconomic, demographic variables and area-level deprivation are considered, group membership and registered to vote may have less influence on the health of the respondents in the study area. Given that Sapag et al. (2008) have observed that group membership as a measure of social capital can have a deleterious effect on reporting good SRH, the fact that when the full influence of socioeconomic, demographic variables and area-level deprivation were considered, group membership and registered to vote had no influence on reporting SRH among respondents in the study area is good news.

While the association between higher individual income and better health status is well established, the influence of relative wealth on individual/population health is only now beginning to receive prominence (Sundquist & Ahlen, 2006). Over and above individual income, 'relative income' (society's income distribution) does impact the individual's health. This is confirmed by Kavanagh, Turrell and Subramanian (2006), who noted that area-level disadvantage was associated with poor SRH. Subramanian et al. (2001) also observed that the probability of reporting poor health decreased as state per-capita income increased. In view of this, we anticipated a negative interaction between the 4th quartile of the SAMPI (the most deprived areas) and social capital. This is consistent with the hypothesis that income inequality impacts health by eroding social capital (Subramanian et al., 2001). However, contrary to our expectations, the findings reported here failed to confirm the hypothesis that high deprivation levels erode the impact of social capital on health.

According to Subramanian et al. (2001), in terms of health while the place of residence matters for all income groups, it matters relatively more for low-income groups. On the contrary, our findings show that there was no strong effect measure due to interaction between trust, registered to vote and group membership, and all four levels of the SAMPI, suggesting that the area level of deprivation does not influence the impact of these measures of social capital on the health of individuals.

Generally, a strong negative joint effect existed between the SAMPI and dissatisfied with safety, while a strong positive joint effect was observed between satisfied with safety and the SAMPI on reporting good SRH. These findings suggest that perception of safety in the community and area-level deprivation work jointly to heighten or dampen the impact of social capital on the chances of reporting good or poor SRH. More importantly, they suggest that a positive perception of safety in the community promotes the health of the community. In view of this, Auger et al. (2008) recommend that public health strategies to improve foetal growth should be aimed at neighbourhoods with low perceived security.

One way in which income distribution in communities affects the health of individuals is by diminishing social capital, which in turn manifests as erosion of social cohesion, increased social exclusion and conflict (Subramanian et al., 2001). Living in an area that falls in the most socioeconomically deprived is associated with lack of control, hopelessness and loss of respect attributed to inequality (Subramanian et al., 2001). We therefore had anticipated that high levels of deprivation would have a stronger interaction effect with social capital on both the multiplicative and additive scales. However, in this study, we only observed a joint effect on the additive scale across all four levels of the SAMPI and the perception towards safety in the community. Moreover, this interaction tended to be in the same direction (i.e. negative if perception towards safety was negative and vice versa) for all four levels of the SAMPI. Hence, our findings contradict those of Buijs et al. (2016) and Auger et al. (2008), who are of the view that by improving social capital (more specifically perception of safety by the community), the most socioeconomically deprived would benefit most from the exercise.

After accounting for social capital variables, although the variation between wards remained high, it reduced to 23% (Model 2) from 27% (Model 1). Likewise, when socioeconomic and demographic variables were accounted for, the variance between wards decreased but this time it reduced drastically from 23% (Model 2) to 13% (Model 3). Since it did not completely disappear, it implies that variations in SRH in the study area is explained by both individual and contextual factors. This is consistent with findings of a US study in which the authors observed that both individual and contextual factors explained SRH (Subramanian et al., 2001). Findings of our study are also supported by Sundquist and Ahlen (2006), who concluded that neighbourhoods are important in the efforts to enhance the health of communities.

There is a view that the existence of unequal societies could have implications for individual health (Olamijuwon et al., 2018; Subramanian et al., 2001). For instance, Chaix et al. (2008) observe that neighbourhood environments influence blood pressure. In addition, the incidence of crime and extreme poverty do erode social capital (Maluccio et al., 2000). Therefore, Gauteng being one of the most unequal societies with a high crime rate, we postulated that the majority of people living in the province would report poor SRH. However, as shown in Table 1, this was not the case as most people in the study area reported good SRH by each socioeconomic and demographic variable. Could this be attributed to high social capital among the residents of Gauteng or is it that the respondents are using whatever stocks of social capital available to them for physical survival? Investigation of the stock of social capital among the respondents was outside the scope of the present study.

9. Limitations

Firstly, the study used secondary data and was thus limited to variables collected during the primary survey. Secondly, although the data was weighted to reflect the distribution of the census population in terms of demography and other biometric characteristics for the year of sampling, the results may not reflect the current situation in the study area due to high movement of people in Gauteng. Thirdly, it was not possible to determine a composite index for social capital because of the limited number of measures of social capital in the data set. Lastly, as is the case with observational studies that use questionnaires to collect data, non-response could have led to selection bias in this study.

10. Concluding remarks

The aim of the preceding analysis was to improve understanding of the impact of social capital on individual health, and how deprivation at area-level impacts this relationship. Our findings elevate perception of safety and security in the community as the core domain of social capital in the study area. We show that variation in health in society cannot be accounted for only by individual factors, as ward context is important. Given the strong joint interaction between perception of safety in the community, a social capital variable and the SAMPI, the findings of the present study suggest the existence of a psycho-social pathway of relative income on the health of residents. However, our findings also show that this is not dependent on the level of area deprivation. From a policy perspective, managers interested in ascertaining the level at which interventions should be targeted, our findings support the idea of increasing the confidence in the level of safety in the area. This is likely to result in residents reaping the most benefits of the impact of social capital on the health of residents of Gauteng. To explain the high proportions of people reporting good SRH, we recommend a study to investigate the level of the stock of social capital in the study area.

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Ethics approval

Ethics approval was obtained from the Human Research Ethics Committee of the University of Witwatersrand (Ref M180144) before the study commenced. Permission to use the secondary de-identified data (data without personal identification information for purposes of keeping respondents anonymous) was secured from the GCRO.

Declaration of competing interest

None.

CRediT authorship contribution statement

James W. Oguttu: Conceptualization, Methodology, Formal analysis, Writing - original draft, Project administration. **Jabulani R. Ncayiyana:** Supervision, Conceptualization, Methodology, Writing - review & editing.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssmph.2020.100607.

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