RESEARCH REPORT

Does gender modify associations between self rated health and the social and economic characteristics of local environments?

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Objectives: To examine whether area level socioeconomic disadvantage and social capital have different relations with women's and men's self rated health.

Methods: The study used data from 15 112 respondents to the 1998 Tasmanian (Australia) healthy communities study (60% response rate) nested within 41 statistical local areas. Gender stratified analyses were conducted of the associations between the index of relative socioeconomic disadvantage (IRSD) and social capital (neighbourhood integration, neighbourhood alienation, neighbourhood safety, political participation, social trust, trust in institutions) and individual level self rated health using multilevel logistic regression analysis before (age only) and after adjustment for individual level confounders (marital status, indigenous status, income, education, occupation, smoking). The study also tested for interactions between gender and area level variables.

Results: IRSD was associated with poor self rated health for women (age adjusted p<0.001) and men (age adjusted p<0.001), however, the estimates attenuated when adjusted for individual level variables. Political participation and neighbourhood safety were protective for women's self rated health but not for men's. Interactions between gender and political participation (p=0.010) and neighbourhood safety (p=0.023) were significant.

Conclusions: These finding suggest that women may benefit more than men from higher levels of area social capital.

M ultilevel studies are increasingly used to disentangle the relative importance of individual characteristics, such as socioeconomic position, and area characteristics, such as mean levels of area disadvantage, on health outcomes. However, most researchers "average" the effect of area level variables across population subgroups, despite some evidence that area effects may be heterogeneous across social categories such as gender, ethnicity/race, and socioeconomic position. Studies that have explored interactions between individual and area level effects have shown: variation in the effects of state income inequality on individual self rated health in the USA by race and socioeconomic position, stronger associations for women than men between income inequality and cardiovascular risk factors[2]; and that high levels of individual social involvement protects against the negative effect of neighbourhood poverty on mammography utilisation in Canada.[3]

Two area characteristics that have received considerable attention in multilevel studies are area socioeconomic disadvantage and social capital. Area disadvantage has associated with less health promoting behaviours,[4–7] higher morbidity,[8–10] and higher rates of cardiovascular, respiratory, and all cause mortality.[11] Multilevel studies of area social capital have also shown associations between area social capital and health behaviours,[12] self rated health,[8 10 13 14] health service use,[16] and use of prescription medicines.[17 18] However, our previous analyses have not shown demonstrable effects of social capital (using seven measures) on self rated health[19] or mortality[20] in Tasmania, Australia.

There is some evidence that the effects of social capital may vary by gender. An ecological study in Hungary found that male mortality rates were closely associated with lack of help from civic organisations, and female mortality rates were associated with perceptions of reciprocity[21] and a multilevel study in the UK found that measures of social cohesion (levels of neighbourhood trust, integration into wider society) showed stronger protective effects on self rated health for women than for men.[22]

We believe that gender differences in the health effects of area social capital and socioeconomic disadvantage are plausible because men and women may occupy their local environments in different ways. Put simply women may be more likely to spend more time in the local area as they spend more time at home with children,[23] are more apt to work part time,[4] conduct more of the domestic work including activities such as shopping[25 26] and are more likely to be primary carers for elderly or disabled relatives.[27] In addition, it is possible that women may be more vulnerable to the health effects of local environments. For example, if neighbourhoods have poor reputations and are less safe this may affect women's locally based activities (for example, leisure time physical activity).

Women may also contribute to, and benefit from, social capital in different ways than men. Evidence from research about social networks shows that the characteristics of social ties, and the resources that flow from them, differ for men and women. Women may be more likely to be part of networks that are characterised by plentiful bonding (relationships between socially similar people) and perhaps bridging ties (relationships that occur between socially heterogeneous people) but have fewer linking ties (relationships between people or groups who are explicitly recognised as unequal). They are also more likely to experience strain from tightly bonded networks because of their responsibility for emotional labour.[28 29]

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Abbreviations: IRSD, index of relative socioeconomic disadvantage; SLA, statistical local area; HCS, healthy communities survey

Given the possibility that men and women experience, and participate, differently in their local environments, exploring whether the effects of area social capital and disadvantage vary by gender will enable us to postulate about the pathways through which location influences health. In addition, if area social capital and socioeconomic disadvantage influence the health of women and men in distinctive ways, public policy investments that improve the quality of local environments may not have uniform effects for men and women.

We use self rated health as the outcome—a measure that is associated with objective measures of morbidity[30] [31] as well as mortality[32–34]—and examine whether associations between area based socioeconomic disadvantage and area based social capital differ for men and women.

METHODS
Setting
The study is based in Tasmania, an island state of Australia, which in 1996 had a population of 459 658.[31] Tasmania is divided into administrative units known as statistical local areas (SLAs), which broadly correspond with council boundaries defined by local government areas. Tasmania comprises 43 SLA that range in geographical area (28.5–9575 km^2) and in population size from 914 to 59 618 persons. Two pairs of contiguous SLA (Hobart inner and Hobart remainder; Launceston inner and Launceston Part B) were combined because of very small population sizes.

Table 1 Data definition, structure, and frequencies (%)* for individual and area level variables for men and women in Tasmanian health communities study, 1998

	Women	Men
Response		
Self rated health		
Excellent/very good/good	81.7	81.4
Fair/poor	18.3	18.6
Level 1: participants (n = 14945)		
Age (years)	45.7	44.6
Indigenous status		
Non-ATSI	95.1	95.7
ATSI	2.2	2.4
Missing	2.7	1.9
Marital status		
Married/defacto	64.5	70.2
Separated/divorced	9.2	6.8
Widow	10.0	2.4
Single	16.4	20.6
Education		
Primary education	6.9	5.7
≤Year 10	36.8	31.1
≤Year 12	11.8	10.1
Tafe/apprenticeship	25.5	35.4
University degree	14.1	13.9
Other	1.8	0.9
Missing	3.2	3.0
Occupation		
Professional	26.3	35.1
White collar	40.3	13.3
Blue collar	16.6	42.3
Other occupation	1.9	1.6
Never in paid work	4.1	1.5
Missing	11.0	5.9
Household income		
Lowest quintile ($0–180 per week)	15.7	11.7
2nd quintile ($181–$310 per week)	10.7	9.4
3rd quintile ($311–$500 per week)	17.3	19.0
4th quintile ($501–$900 per week)	15.7	19.0
Highest quintile (>$900 per week)	19.4	24.1
Missing income	21.2	16.7
Smoking		
Non-smoker	53.2	41.6
Past smoker	23.4	31.8
Current smoker	23.4	26.6

*Weighted by sample weights.

The Tasmanian healthy communities survey
All variables were derived from individual responses to the Tasmanian healthy communities survey (HCS) (conducted in 1998) with the exception of a measure for area based socioeconomic disadvantage. Details of the survey have been published elsewhere.[36] Briefly, the HCS was a postal survey of 25 000 Tasmanian adults aged 18 years or older selected from the state electoral roll (the electoral roll provides near complete coverage of the resident adult population). The sampling frame consisted of 516 strata that were defined by age groups (18–24, 25–34, 35–44, 45–54, 55–64, 65–74, 75+), gender, and SLA. The sample was selected from these strata using a two stage process. Firstly, the sample size for each age by gender group was determined based on optimal allocation technique that optimises sample selection to ensure that design variables (physical activity, alcohol intake, smoking, diabetes, self assessed health) can be estimated with small standard errors. In the second stage people were selected from age by gender strata within SLAs using proportional allocation. The sample was weighted to adjust for sampling probability and non-response. The survey was accompanied by a publicity campaign and surveys were individually addressed and mailed to respondents with an addressed prepaid return envelope to encourage as many recipients as possible to respond. A telephone helpline was established and reminder cards were sent to non-respondents after two weeks and a second survey was sent to respondents with the lowest response rate (men aged 18–30 years) after one month. The survey achieved a 60% response rate (n = 15 112).[36]

Outcome variable
Respondents were asked "In general, would you say your health is excellent, very good, good, fair or poor?". The responses were recoded to a binary outcome (1 = fair/poor; 0 = excellent, very good, good). Respondents who did not answer this question (n = 295) were excluded from the analysis.

Compositional variables
Individual variables that may be important predictors of self rated health were included. These were: age in years (centred at age 50), Indigenous status, marital status (married, separated/divorced, widowed, single), education (highest level achieved), current occupation or, if not currently working, the most recent occupation (professional, white collar, blue collar, never in the paid workforce), household income (separated into quintiles) and smoking status (current smoker, past smoker, non-smoker). Income was measured using a 14 category scale with response options ranging from nil to $2000 per week or more. Respondents were asked about their income and their partner's income (if they had a partner). Household income was then estimated by taking the midpoint of each category (zero if no income and $2000 per week if in the highest income bracket) and summing the respondent and partner income. Household income was then subdivided into quintiles. We fitted missing value categories for the variables indigenous status, occupation, education, and household income, which had between 2.3% and 19.0% missing values.

Area level social capital
We used questions from the HCS to create individual summary scores (using principal component analysis) for five social capital variables. These were aggregated within each SLA to produce a mean value for each SLA for each variable. We have described in detail the methods we used to construct these measures[20] and a brief description of the

Table 2 Area level variables by self rated health (mean values and standard deviations), men and women combined, Tasmanian healthy communities study 1998

	Fair/poor		Good/very good/excellent		
	Mean	SD	Mean	SD	Range
SE disadvantage	4.41	2.08	3.94	2.27	0,10
Neighbourhood integration	6.42	1.69	6.39	1.61	0,10
Neighbourhood alienation	5.94	1.71	6.13	1.78	0,10
Neighbourhood safety	3.00	2.12	3.03	1.99	0,10
Social trust	5.60	1.59	5.81	1.58	0,10
Trust in public/private institutions	5.90	2.09	6.06	2.10	0,10
Political participation	1.43	0.22	1.45	0.23	1.16, 2.95

methods and factors derived is also included in an online appendix (http://www.jech.com/supplemental).

Five factors were obtained, two for trust (social trust and trust in public/private institutions) and three for neighbourhood perceptions (neighbourhood integration, neighbourhood alienation, and neighbourhood safety) and standardised scoring coefficients were calculated for the factors and these were used to derive factor scales for each of the constructs. These scales were re-scored to range from 0 to 10, with higher scores indicating greater average levels of the factor (for example, higher levels of social trust) in the SLA.

A sixth measure of social capital—political participation— was derived from the stem question ''In the past 12 months have you done any of the following? with seven possible political activities such as signed a petition or contacted a state or federal MP (coded 0 = no and 1 = yes). Individual responses were summed (potential range 0 to 7) and then averaged over each SLA.

Area level socioeconomic disadvantage

Area level socioeconomic disadvantage for each SLA was measured using its index of relative socioeconomic disadvantage (IRSD) score. IRSD scores are derived by the Australian Bureau of Statistics using PCA to reflect the overall level of socioeconomic disadvantage of an area's population measured on the basis of attributes such as low income, low educational attainment, high levels of public sector housing, high unemployment, and jobs in relatively unskilled occupations.[37] The IRSD scores used in this study were calculated using data from the 1996 Australian census

and were scaled across the 41 SLA to have values from 0 to 10, with higher scores indicating greater levels of socioeconomic disadvantage.

Analysis

We applied multilevel logistic regression analysis[38 39] to model the association between area level variables and poor self rated health. Specifically we calibrated a two level weighted binary logistic model with a nested structure: 7802 women and 7015 men nested within 41 SLAs.

To test whether there were gender differences in the relations between area socioeconomic disadvantage and social capital we fitted separate age adjusted models for men and women for each of the seven variables (models 1). To explore whether individual characteristics affected the estimates of area variables, we added all of the individual variables to each of the models (models 2). We further tested whether there were differential effects of the seven area variables by including both men and women in each of the seven models and fitting a cross level interaction between the area variable and gender (models 3).

Fixed and random parameter estimates and their standard errors are quasi-likelihood based with Taylor series expansion,[38] as implemented within the MLwiN program.[39] The statistical significance of the estimates was tested using the Wald statistic and is reported using the t ratio with a t ratio $\geqslant |2|$ being significant at an α level of 0.05.

The study was approved by the La Trobe University Human Ethics Committee.

Table 3 Model 1: multilevel logistic regression of poor self rated health and area level variables for men and women, Tasmanian healthy communities study 1998

	Models 1*				Models 2†			
	Estimate	SE	t ratio	p value	Estimate	SE	t ratio	p value
Men								
SE disadvantage	0.096	0.023	4.17	<0.001	0.028	0.014	2.00	0.053
Neighbourhood integration	−0.016	0.026	−0.62	0.532	−0.020	0.019	−1.05	0.302
Neighbourhood alienation	−0.076	0.033	−2.30	0.021	−0.027	0.027	−1.00	0.314
Neighbourhood safety	0.038	0.030	1.27	0.194	0.014	0.025	0.56	0.586
Political participation	0.028	0.189	0.15	0.882	−0.020	0.184	−0.11	0.913
Social trust	−0.070	0.030	−2.33	0.009	−0.059	0.023	−2.57	0.010
Trust in public/private institutions	0.002	0.021	0.10	0.916	0.001	0.018	0.06	0.964
Women								
SE disadvantage	0.108	0.009	12.00	<0.001	0.054	0.010	5.40	<0.001
Neighbourhood integration	−0.034	0.027	−1.26	0.303	−0.028	0.022	−1.27	0.210
Neighbourhood alienation	0.024	0.030	0.80	0.427	0.041	0.028	1.46	0.142
Neighbourhood safety	−0.048	0.020	−2.40	0.014	−0.052	0.013	−4.00	<0.001
Political participation	−0.526	0.171	−3.08	0.002	−0.563	0.127	−4.43	<0.001
Social trust	−0.049	0.025	−1.96	0.051	−0.023	0.018	−1.28	0.182
Trust in public/private institutions	0.022	0.023	0.96	0.341	0.020	0.017	1.18	0.251

*Age adjusted only. †Includes age, marital status, household income, education, occupation, indigenous status, and smoking.

Table 4 Models 3: β estimates, standard errors, *t* ratio, and p value for each of the gender (women compared with men) by area level variable interactions in multilevel logistic regression analyses of poor self rated health*, Tasmanian healthy communities study 1998

	Estimate	SE	*t* ratio	p value
SE disadvantage	0.011	0.017	0.65	0.510
Neighbourhood integration	−0.010	0.028	−0.36	0.723
Neighbourhood alienation	0.065	0.032	2.03	0.042
Neighbourhood safety	−0.057	0.025	−2.28	0.023
Political participation	−0.506	0.196	−2.58	0.010
Social trust	0.043	0.025	1.72	0.083
Trust in public/private institutions	0.023	0.024	0.96	0.335

*Age, sex, marital status, smoking, occupation, income, education. †β coefficients for the area×sex term in the regression models.

RESULTS

The sample contained 51.2% women and 48.8% men. Table 1 shows the distribution of individual characteristics by gender. Women were more likely than men to be widowed, separated, or divorced (p<0.0001); working in a white collar occupation (p<0.0001); be in the lower quintiles for household income (p<0.0001); be a non-smoker (p<0.0001) and were, on average, slightly older (female mean age 45.7 years, 95% CI 45.2 to 46.1 compared with male mean age 44.6 years, 95% CI 44.2 to 45.0).

Table 2 shows the averages of area level variables according to whether respondents rated their health as fair/poor or good/very good/excellent. Higher mean levels of IRSD were found in respondents who rated their health as fair/poor than respondents who rated their health as good/very good/excellent.

After adjusting for individual SES (income, education, occupation), marital and indigenous status and smoking, women were less likely than men to rate their health as fair or poor (OR 0.89, 95% CI 0.80 to 0.99).

Area based socioeconomic disadvantage

In models 1 (age adjusted only, table 3) area based socioeconomic disadvantage was associated with poorer self rated health and had similar size β estimates for men (β = 0.096, p<0.001) and women (β = 0.108, p<0.001). After adjustment for individual level variables, area disadvantage was significantly associated with poorer self rated health for women marginally non-significant for men (table 3).

An interaction between gender and IRSD (in model 3, table 4) was not significant.

Neighbourhood integration

Neighbourhood integration was not a predictor of women's or men's health in the age and fully adjusted models (models 1 and 2, table 3) and there was no evidence of an interaction between gender and neighbourhood integration (model 3, table 4).

Neighbourhood alienation

Neighbourhood alienation reduced the likelihood of poor self rated health for men (age adjusted β = −0.076, p = 0.021), an association that became non-significant when adjustment was made for other individual level covariates (model 2, table 3). Neighbourhood alienation was not a significant predictor of women's self rated health.

An interaction between gender and neighbourhood alienation (model 3, table 4) suggests that increasing neighbourhood alienation is relatively worse for women's health than it is for men's (β = 0.065, p = 0.042).

Neighbourhood safety

Increasing levels of neighbourhood safety reduced the likelihood of poor self rated health for women (age adjusted β = −0.048, p = 0.014) (model 1, table 3), an association that remained unchanged when adjusted for other individual level covariates (model 2, table 3). Neighbourhood safety was unrelated to men's self rated health.

In model 3 (table 4) it seems that neighbourhood safety is associated with a relatively reduced likelihood of poor self rated health for women compared with men (β = −0.057, p = 0.023).

Political participation

While political participation was not associated with poor self rated health for men, higher levels of participation were associated with a reduced risk of poor self rated health for women (age adjusted β = −0.526, p = 0.002) and this estimate remained significant in the fully adjusted model (model 2, table 3). Furthermore, an interaction between gender and political participation was significant showing that women are more likely to benefit from high area levels of political participation (β = −0.506, p = 0.010).

Social trust

In the age adjusted model (model 1, table 3) social trust was protective against poor self rated health for men (β = −0.070, p = 0.009) but was marginally non-significant for women (β = −0.049, p = 0.051). Further adjustment for individual level covariates did not substantially affect the estimate for men (model 2, table 3). The interaction between gender and social trust was non-significant (model 3, table 4).

Trust in public/private institutions

Trust in public/private institutions was not related to self rated health for women or men in any of the models and there was no evidence of an interaction between gender and trust in public/private institutions (model 4, table 4).

What this paper adds

This paper provides strong evidence that area based social capital may have difference influences on men and women's health. This suggests that women and men interact with their local environments in different ways and that these differences have flow on effects for subjective health. We emphasise that future multilevel studies do not assume that men and women are homogenous with respect to neighbourhood effects. Such assumptions may obscure important differences.

DISCUSSION

To our knowledge this is one of the first papers to address whether area characteristics have different effects for men and women, and we present evidence to support this. Political participation and neighbourhood safety reduce the prevalence of poor self rated health among women but not for men. The results for neighbourhood alienation are more difficult to interpret, partly because they seem to be more sensitive to adjustment for compositional variables than the other area variables. None the less, neighbourhood alienation was, if anything, deleterious for women's self rated health while it has either no influence, or is slightly beneficial, for men. After adjustment for compositional variables, area disadvantage was significantly associated with poorer self rated health for women but not for men. However, the interaction between gender and area disadvantage was not statistically significant.

Political participation and neighbourhood safety—the two social capital variables that were beneficial for women's self rated health—might be conceptualised as social capital resources that theoretically flow from high levels of social capital infrastructure including social networks, and high levels of trust and reciprocity in areas.[41] Political participation may improve a community's capacity to gain improvements in the neighbourhood environment (for example, public transport). Given that women are likely to spend more time in their local area, and are more apt to be part of their neighbourhoods' social networks, it is plausible that they would benefit more than men from higher levels of political participation.

Gendered ways of relating to a local environment may affect health in other ways. Women are more fearful of being assaulted in their local environments than men.[42] Hence, higher levels of neighbourhood safety may enable women to engage with their environment through activities such as walking (which have been associated with perceptions of neighbourhood safety for women but not for men[43 44]) and these activities may have flow on effects on women's physical and mental health.[41]

It seems that area social trust may be relatively beneficial for men's self rated health, but that the effect is weaker or absent for women (tables 3 and 4). However, the interaction between gender and social trust was non-significant. Women are more likely to be part of tightly bonded social networks that are the source of trusting relationships captured by the variable social trust. However, they are also more likely to be the key "nodes" in these networks, the people who can be relied upon to provide support to other network members.[28] The engagement in networks can place significant demands on women as well as conferring benefits and these two countervailing health effects may cancel each other out. Men, on the other hand, may be linked into networks through their female partners and may gain the benefits of bonded networks without having to experience the same levels of relational strain.

Future studies could explore more fully why gender differences in area effects seen in this study can be explained

Policy implications

Our research suggests that interventions that improve perceived neighbourhood safety and increase political participation rates may result in improvements in women's subjective health. However, it is unlikely that such interventions will have a major impact on men's self rated health and other context based interventions (for example, workplaces) may be more appropriate for men.

by women and men's varying exposure to local environments as well as the patterns of their social ties and networks. This might entail further multilevel analyses and detailed social network analyses and qualitative research.

Our findings are similar to those described by Stafford *et al* in the United Kingdom who used postcode sectors (with about 5000 respondents per sector) as area units. They report stronger protective effects for women than men of variables that measure some components of social capital including trust and social integration.[32]

Methodological issues

There are a number of methodological and analytical issues that may affect how we understand and interpret the findings. Firstly, we compared the effects of area level variables on men's and women's health using two related approaches. Initially, we conducted gender specific analyses and estimated the effects of the area level variables, before and after adjustment for compositional variables. Then, in models with both genders, we fitted cross level interactions between gender and each area level variable to obtain an estimate of the relative difference in the effects of the area variables for women relative to men. These approaches are not directly comparable because the gender specific models include estimates for the main effects and covariates averaged across one gender only, while the models that include both women and men produce estimates that are "averaged" over both genders. However, there were not major differences. The main difference was that in the stratified analyses neighbourhood alienation had null effects for men and women (table 3) but the estimates for men were slightly protective and for women slightly harmful so the interaction was significant (table 4).

Secondly, the meaning of self rated health varies may vary by gender. Mortality is more closely linked to men's self rated health than to women's.[45] Thirdly, this analysis is cross sectional making it impossible to establish the temporal order of events or to investigate possible lag times. Fourthly, SLAs may not correspond with spatial units that are representative of neighbourhoods; none the less they do mostly correspond with one or more local government areas and so are a logical unit in terms of administration and governance. However, SLAs are likely to be larger than people's perceptions of their local areas. This will make them less homogeneous with respect to area characteristics and reduce our ability to discern area effects.[46 47] Fifthly, social capital measures were derived from the same survey as the individual data and will correlate with individual self rated health if individual reports of the items used to derive the social capital variables are associated with self rated health. However, Subramanian *et al* have shown that individual cognitive characteristics (such as, levels of trust) are not only a function of individual variables (such as socioeconomic position) but vary between areas.[48] In addition, it seems that area social capital is associated with self rated health independent of individual level social capital.[49] Sixthly, we had considerable missing data on key sociodemographic variables and the response rate was only 60%. However, we fitted models with missing data removed and did not find substantively different results. In addition, the sample did not differ substantially from the Tasmanian population except that there was a higher level of non-response to the income question (16.4%) in the TCS than in the census (5.3%).[36] Finally, while we included a range of measures that captured social capital our analysis of other area variables was restricted to a single commonly used Australian measure of area disadvantage and that measure was based on census data collected two years before the date of the survey.

Summary

This study provides further weight to the evidence that gender matters when thinking about area effects, at least when in comes to social capital. We have proposed potential mechanisms for the ways in which area social capital may come to be expressed in individual health such as levels of exposure to the local environment and the patterns and functionality of individual social networks. Importantly, this study also has implications for public health policy and practice. Investments in improving the social and cultural qualities of local environments may not benefit all population subgroups uniformly. When it comes to social capital, it seems that women are more likely to reap the benefits of such investments than men.

Appendix available on line (http://www.jech.com/supplemental).

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