RESEARCH REPORT

Covariation in the socioeconomic determinants of self rated health and happiness: a multivariate multilevel analysis of individuals and communities in the USA

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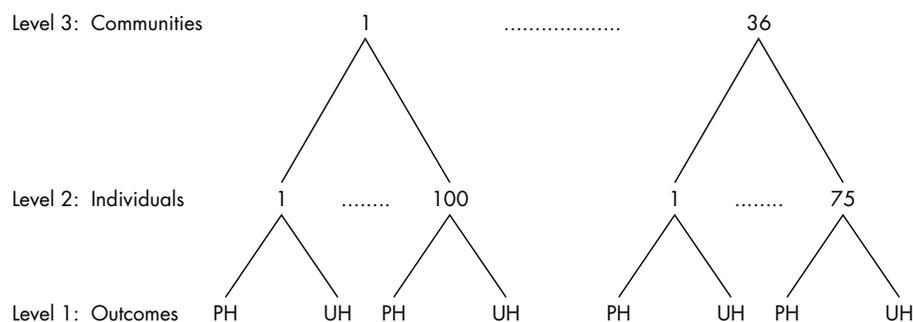
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Figure 1 Multivariate multilevel structure of responses (PH, poor health; UH, unhappy) at level 1 nested within individuals at level 2 nested within communities at level 3

world values survey, the Japanese are among the unhappiest people among industrialised countries,[11] yet it is also well known that the Japanese have the highest life expectancy in the world.[5]

There is, therefore, considerable merit to the notion of exploring the covariation of health and happiness, at the individual and community levels. Using a multivariate multilevel analytical approach, the aim of this study was (1) to describe the covariation in health and happiness within individuals, focusing on both their shared determinants, as well as differences in the strength of specific predictors (such as age, sex, race, marital status, and socioeconomic status); and (2) to describe the covariation in health and happiness across communities, focusing on the question of whether healthy communities are also happy communities, after accounting for the individual level relations between demographic and socioeconomic markers and health/happiness.

METHODS
Sources of data
The analysis was based on the 2000 social capital benchmark survey, developed by the Saguaro Seminar at Harvard University. The purpose of this survey was to characterise levels of civic engagement, voluntarism, and social connectedness (or "social capital") across diverse communities of the USA, and to establish benchmarks for future monitoring.[12] Each community sample ranged between 500 and 1500 interviews. In terms of selecting the communities, all community foundations attending the annual meeting of USA community foundations in 1999 were invited to apply.

From the communities that applied, 34 local community foundations were selected that broadly represented the diversity of communities across the country (smaller and bigger towns, regions of the country, etc) (T Sander, personal communication, Harvard University, Cambridge, MA, 2002). Each sponsoring community organisation then decided what specific area(s) to be surveyed, how many interviews to conduct, and if specific areas or ethnic groups were to be over-sampled. The survey was conducted by telephone by TNS Intersearch using random digit dialling (RDD) within 40 US communities in the year 2000 and in early 2001. Some community foundations operated in more than one community. The participation rates within community samples (that is, the proportion of those eligible who responded to the survey) ranged from a low of 30.2% (Denver, CO) to a high of 57.2% (Newaygo County, MI).[12] All survey data were provided by The Roper Center for Public Opinion Research. In most cases, the survey area was a single county or a cluster of contiguous counties. Community samples ranged from municipalities to entire states (Montana, Indiana, New Hampshire, Delaware), suggesting a pronounced variation in the ways communities were identified and defined.

Outcome measures
This study considered self reported responses to single items inquiring about health and happiness.

Self reported health status of individuals was determined by people's response to a five scale question, "…how would you describe your overall state of health these days? Would say it is excellent, very good, good, fair, or poor?" Thus, self

Table 1 Descriptive information on the individual sample considered for the analytical multilevel models from the 2000 social capital benchmark survey showing the multivariate outcomes, frequency of different individual level demographic and socioeconomic markers, and the three level structure of the sample

Level 1: multivariate outcomes (n = 43144)		
Fair/poor health	Yes (n = 2543, 11.8%)	No (n = 19029, 88.2%)
Unhappy	Yes (n = 1113, 5.2%)	No (n = 20459, 94.8%)
Level 2: individuals (n = 21572)	Reference category	Contrast categories
Individual level exposures		
Age (y)	Mean = 45	Range = 18–89
Sex	Male (n = 9031, 41.9%)	Female (n = 12541, 58.1%)
Ethnicity/race	White (n = 16775, 77.8%)	Black (n = 2703, 12.5%)
		Other (n = 2094, 9.7%)
Marital status	Married/partnered (n = 10947, 50.7%)	Single (n = 5547, 25.7%)
		Separated/divorced (n = 3601, 16.7%)
		Widowed (n = 1477, 6.8%)
Educational attainment	College up (n = 7458, 34.6%)	Less than high school (n = 1483, 6.9%)
		High school (n = 5587, 25.9%)
		Some college (n = 7044, 32.7%)
Income ($)	$100000 and above (n = 2626, 12.2%)	$20000 and less (n = 3254, 15.1%)
		$20000–30000 (n = 3228, 15%)
		$30000–50000 (n = 5612, 26%)
		$50000–75000 (n = 4426, 20.5%)
		$75000–100000 (n = 2426, 11.2%)
Level 3: communities (n = 36)		

reported health was defined as the individual's personal evaluation of their overall health, integrating all aspects of health, without specific reference to any one component of physical, social, mental, or functional health. Public health research has typically used this measure as a proxy for other more ''objective'', but often difficult to measure, health outcomes.[13] The construct validity of self reported health comes from its demonstrated power to consistently predict mortality or survival in longitudinal studies.[14] Meanwhile, the test-retest reliability of self rated health has also been shown to be high, across population subgroups by age and sex.[15] We collapsed the categories to form a dichotomous outcome of self rated health: 0 for excellent, very good or good and 1 for fair or poor.

Happiness was assessed by people's response to the question ''In general, are you very happy, happy, not very happy and not happy at all?'' As a construct, happiness refers to people's overall evaluation of their own lives and/or it could capture momentary feelings of pleasure. Because of the multiplicity of meanings that are associated with happiness, it has been referred to as ''subjective wellbeing'', even though subjective wellbeing is a more inclusive construct that combines aspects related to ''life satisfaction'', ''pleasant affect'', and ''cognitive evaluations''.[9] The happiness measure, used in this study, most probably, relates to ''overall happiness'' (that is, a general judgment of how life is for that individual) rather than specific components of it such as ''hedonic level of affect'' (that is, the degree to which various affects that people experience are pleasant in character) or ''contentment'' (that is, the degree to which a person perceives their aspirations to be met).[16 17] Results of the external validation of self report measures of happiness with ratings by friends, family members, and spouses have been consistent,[18 19] and the test-retest reliability of subjective wellbeing measures has been shown to be high.[20] We dichotomised the four categories of the happiness measure to 0 if very happy or happy; 1 if not very happy or not happy at all.

Thus, we simultaneously modelled the individual probabilities of reporting being unhealthy and unhappy. We assumed that these two measures capture distinct, though related, constructs, in that self rated health and happiness were considered to be valid measures of objective health and subjective wellbeing, respectively. In the final sample, about 12% responded being in poor health while about 5.3% reported not being happy.

Predictors

We considered key individual demographic (age, sex, race, marital status) and socioeconomic (educational attainment, household income) markers as predictors in our analyses. As shown in table 1, except for age, other individual predictors were specified as categorical variables, with a reference category and a set of contrasted dummies. Age was centred about its mean, 45 years. We also considered the effect of local communities on self rated poor health and being unhappy. We did so, not by specifying them as fixed dummy predictors, but by considering them as a level within our analytical framework.[21 22] However, four local communities (Montana, Indiana, New Hampshire, and Delaware) in the survey corresponded to entire states. Because our interest was in modelling local community differences in health and happiness, communities that spanned entire states were considered to lack statistically exchangeable properties with the rest of the sample (most of which were defined at the county or metropolitan level). Consequently, we based our third level on 36 local communities (fig 1), and modelled the four ''state size'' communities as a single fixed indicator variable (referred to as ''state community'').

Statistical analyses

Multilevel statistical models[23] offer an appropriate framework to model the structure illustrated in figure 1—that is, the anticipation that the individual perceptions of health and happiness are nested within individuals who in turn are nested within their local communities. While the concept and

Table 2 Odds ratios (OR) and 95% confidence intervals (CI) from the fixed part of a multivariable three level binomial logit model for outcomes, self rated poor health and being unhappy, conditional upon community level random effects

	Poor health		Unhappy	
	OR	95%CI	OR	95%CI
State communities	1.05	(0.88 to 1.25)	0.78	(0.61 to 1.00)
All communities (reference)	1.00		1.00	
Age (centred around 45)	1.24	(1.21 to 1.28)	0.98	(0.94 to 1.03)
Sex				
Female	0.99	(0.90 to 1.08)	0.68	(0.60 to 0.78)
Male (reference)	1.00		1.00	
Race				
Black	1.26	(1.11 to 1.43)	1.52	(1.29 to 1.79)
Other	1.40	(1.21 to 1.61)	1.71	(1.42 to 2.05)
White (reference)	1.00		1.00	
Marital status				
Single	1.16	(1.02 to 1.31)	1.77	(1.49 to 2.11)
Widowed	0.93	(0.79 to 1.09)	1.47	(1.12 to 1.92)
Separated/divorced	1.25	(1.11 to 1.41)	2.32	(1.96 to 2.75)
Married/partnered (reference)	1.00		1.00	
Education				
Less than high school	3.58	(3.03 to 4.21)	2.68	(2.14 to 3.36)
High school	1.90	(1.67 to 2.17)	1.60	(1.33 to 1.93)
Some college	1.64	(1.44 to 1.86)	1.20	(1.00 to 1.44)
College up (reference)	1.00		1.00	
Household income				
<$20000	4.05	(3.25 to 5.03)	3.86	(2.79 to 5.33)
$20000–30000	2.43	(1.95 to 3.02)	2.60	(1.88 to 3.59)
$30000–50000	1.72	(1.40 to 2.12)	1.71	(1.25 to 2.35)
$50000–75000	1.31	(1.05 to 1.63)	1.43	(1.03 to 1.99)
$75000–100000	1.26	(0.98 to 1.62)	1.13	(0.76 to 1.66)
$100000 and above (reference)	1.00		1.00	

Odds ratios for age based on for every 10 year increase in age.

Table 3 Variation and covariation in self rated health and happiness at the individual and community level

	1	2	3
Poor health	0.045 (0.014)	0.044 (0.014)	*0.012 (0.007)
Unhappiness	0.063 (0.023)	0.041 (0.018)	*0.017 (0.013)
Covariance	0.038 (0.015)	0.039 (0.013)	*0.011 (0.007)
Community correlation	0.719	0.907	*0.758
Individual correlation	0.201	0.191	0.163

Figures in parentheses represent standard errors. All estimates are significant at 0.01 probability level or smaller, except those marked by *. Column 1 is a model with only state dummy; 2 is 1 but includes individual age, female, race, marital status; 3 is 2 but includes education and income.

application of multilevel statistical models are comparatively well known,[21 22 24 25] this study focuses on a comparatively novel extension related to treating multiple outcomes within multilevel models.[26] We calibrated a multivariate three level binomial logistic regression that had a structure of 48 236 responses (two for each individual) at level 1 nested within 24 118 individuals at level 2 nested within 36 USA communities at level 3. The important advantage from treating two outcomes together in a multivariate multilevel statistical framework is the estimation of the "covariance" between health and happiness at the community level. When two variables are allowed to be random at the community level not only can we estimate distinct variance terms to summarise the degree to which outcome varies across communities, but we can also estimate a joint covariance to assess the degree and the manner in which they covary across local communities. The fixed and random parameter estimates (along with their standard errors) for the multivariate three level binomial logit link model were calibrated using predictive/penalised quasi-likelihood (PQL) procedures with second order Taylor series expansion,[27] as implemented within the MLwiN program.[28]

Table 2 presents the fixed part results (expressed as odds ratios and their 95% confidence intervals) for individual self rated poor health and unhappiness, modelled simultaneously, as a function of fixed individual demographic and socioeconomic markers and the random effect associated with local communities.
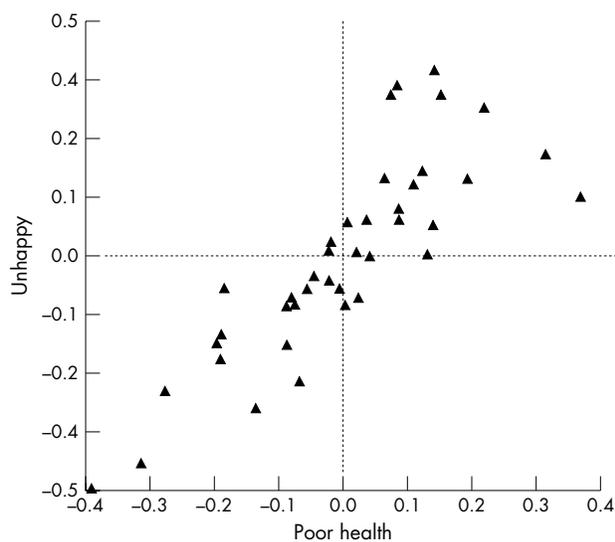

Figure 2 Scatter plot of the community specific residuals (in logits) for self rated poor health (x axis) and unhappiness (y axis).

RESULTS
The reference group in table 2 is a 45 year old white married man with some college education and income over $100 000. The probability of reporting poor health and being unhappy for this "most advantaged" socioeconomic group, across all communities except the "state communities", was 3.4% and 1.5%, respectively.

Age
Age was linearly and positively associated with self rated poor health such that older people were more likely to report poor health as compared with the young. However, there was no statistically significant relation between age and being unhappy.

Sex
No sex differences were seen for self rated poor health suggesting that men and women were equally likely to report poor health. On the other hand, women were about 32% less likely to be unhappy as compared with men.

Marital status
Married people reported being happier and healthier than people who are single, widowed, or separated/divorced. Both unmarried and separated/divorced groups reported higher odds ratios for being unhappy (compared with married groups) than for being unhealthy.

Race
Statistically significant race differentials were seen for self rated poor health as well as for being unhappy with the magnitude being substantially different on the two outcomes. While black people were 25% more likely to report poor health than white people, black people were 51% more likely to report being unhappy. Stronger differences in the magnitude of the effect were also seen for the other category of non-white and non-black race/ethnic group, with this group being 39% and 70% more likely to report poor health and being unhappy, respectively. Thus, the race differentials seemed to be much stronger for happiness than for health.

What this paper adds

- Individual education and income are strong positive predictors of both self rated health and happiness—that is, money and education do buy both health and happiness.
- Healthy individuals are likely to be happy individuals, and healthy communities are likely to be happy communities, with the latter covariation being stronger than the former.

Policy implications

There is a need for evaluative assessments of wellbeing to consider the different components that are distinct, yet related, simultaneously, both from an etiological as well as a descriptive standpoint.

Education

We saw a gradient in the relation between educational attainment and self rated health and happiness, with the educational gradient being somewhat stronger for poor health as compared with being unhappy. People with low levels of education were 3.57 times more likely to report poor health while they were only 2.68 times more likely to be unhappy, as compared with people with very high levels of education. People with middle levels of education as well as high levels of education were both more likely to report being in poor health (the former about 1.90 times more likely and the latter 1.63 times more likely). They also were found to have a greater risk of being unhappy with 1.60 and 1.19 times greater odds for the middle and high levels of education, respectively, than for the reference group.

Income

A strong income differential exists for both health and happiness, with the income differential being more or less similar for both the outcomes. Comparing the worst off income category (households making less than $20 000) to the best group (households earning more than $100 000 per year), we found that the worst off were some four times more likely to report poor health and about 3.85 times more likely to report being unhappy. Other income categories also showed significant differentials (compared with the reference group) for both poor health and being unhappy.

Table 3 provides the magnitude of between community variation in the outcomes, poor health and being unhappy, under three different model specifications. The aim was to ascertain to what extent individual socioeconomic and demographic markers account for the between community variation in poor health and being unhappy; and to what extent the community variations in the two outcomes correlated.

Two distinct patterns emerged in the results presented in table 3. Firstly, between community variation was significant even after controlling for individual demographic exposures, and became attenuated only with the inclusion of individual education and income. This would suggest that any clustering of the poor health and being unhappy (by communities) is strongly related to the clustering of individuals (within communities) with respect to their education and income. Consequently, adjusting the model for clustering in individual education and income accounts for the clustering in poor health and being unhappy. Secondly, the patterning of between community variation in poor health seemed to be positively correlated with the patterning of between community variation in being unhappy (correlation coefficient about 0.70). Thus, as shown in figure 2, conditional on individual predictors, communities that are unhealthy are also likely to be unhappy and vice versa. Individual level covariation, however, was relatively less pronounced (correlation coefficient about 0.20), across the three models.

DISCUSSION

This paper presented cross sectional evidence on the correlated nature of two components of wellbeing, health and happiness, at the individual as well as the local community level. The key findings of this study are as

follows. Firstly, age and sex differentially predict self reported poor health and being unhappy. While age is a strong positive predictor of self rated poor health (that is, older people are more unhealthy), it is a statistically weak negative predictor of happiness (that is, older people are less unhappy). Sex differences were not statistically significant for self rated poor health, but men reported being less happy as compared with women. Secondly, race was a strong predictor of both poor health and being unhappy, but the black/white differential was greater for unhappiness. Thirdly, marital status based differences were stronger for being unhappy than they were for poor health. Fourthly, educational and income gradient ran in the same direction for both the outcomes. We found that the education gradient was stronger for self rated poor health than for being unhappy, with less education leading to greater odds of being unhealthy and unhappy. The income differentials in health and happiness were somewhat less pronounced. In contrast with previous reports that found only a weak relation between income and happiness,[29] money does seem to buy happiness.

A novel aspect of our paper was to empirically estimate the covariation in health and happiness at the individual and community levels. While individuals who are unhealthy are likely to be unhappy too, the covariation between self rated poor health and unhappiness was positive and some three times stronger at the community level, even after taking account of individual demographic and socioeconomic factors, than at the individual level.

It may be noted that while individual level demographic and socioeconomic markers accounted for the between community variation in health and happiness, the patterning in the covariation in health and happiness was not explained. This would suggest that while there are common influences on health and happiness, there is also a need to explore a differential and unique set of predictors to account for the individual and local community level covariation in health and happiness.

Besides the well known inferential limits that arise from analysing cross sectional observational data, it is important to add a few caveats regarding the outcome measures applied in this study. Defining and measuring health and happiness is clearly a complex task. For the purpose of the analysis, health and happiness were considered as capturing distinct, though related, constructs (that is, self rated health was viewed as a summary measure for objective health, while happiness was viewed as a critical component of subjective wellbeing). However, given that both are self reported measures there is a potential that the two responses reflect different facets of a common underlying construct such as general physical and mental wellbeing.[30 31] Thus, the assessment of self rated health and happiness may have been jointly contaminated by psychological traits such as negative affectivity, or optimism.[32] However, some of our empirical findings, particularly the differential predictive power of some of the variables, seem to offset this threat. For instance, self rated health declined with advancing age, whereas happiness did not. Furthermore, the comparatively small individual covariation in health and happiness suggests that it is probably not uncommon for healthy individuals to be unhappy and vice versa. Indeed, it is worth acknowledging that for an evaluative assessment of wellbeing—either for normative purposes or for policy reasons—subjective information, particularly happiness (but also self rated health in poorer communities and societies), may obscure the true extent of inequalities in wellbeing.[33 34]

Drawing upon multilevel perspectives, this study presented an approach to examining health and happiness as multiple outcomes that simultaneously co-occur and coexist within individuals, with both, additionally, being influenced by the

contextual setting of the individuals. Further research, using longitudinal study designs, as well as better specification of community level variables, will be required to explain the potential covariation of health and happiness at the individual as well as at the community levels.

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