RESEARCH REPORT

Social capital and leisure time physical activity: a population based multilevel analysis in Malmö, Sweden

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Objective: To investigate the influence of social capital and individual factors on the level of leisure time physical inactivity in the neighbourhoods.
Methods: The public health survey in Malmö 1994 is a cross sectional study. A total of 5600 people aged 20–80 years were invited to answer a postal questionnaire. The participation rate was 71%. A multilevel logistic regression model, with individuals at the first level and neighbourhoods at the second, was performed. The effect (intra-area correlation, cross level modification, and odds ratios) was analysed of individual and neighbourhood (the 1993 migration out of an area as a proxy for social capital) factors on leisure time physical inactivity after adjustment for individual factors.
Results: Neighbourhood factors accounted for 5.0% of the crude total variance in physical inactivity. This effect was significantly reduced when the individual factors, especially country of origin, education, and social participation, were included in the model. In contrast, it was not reduced by the introduction of the contextual social capital variable.
Conclusion: This study suggests that in the neighbourhoods of Malmö leisure time physical inactivity is mainly affected by individual factors.

Leisure time physical activity is an important health determinant. Low levels of leisure time physical activity are associated with low income,[1 2] low education[1–3] and low socioeconomic status.[4–8] In Malmö in southern Sweden, low levels of leisure time physical activity are also associated with immigrant minority group status.[9] Different segments of the population experience different difficulties and barriers to leisure time physical activity. Internal barriers, for example, lack of motivation, and lack of leisure time are more common among people in higher educational groups, non-manual social class groups, and those with employment. External barriers, for example, lack of money, lack of transport, and illness/disability are more common in lower educational groups, among manual workers, and among the unemployed.[10]

Environmental factors also seem to be associated with physical activity. Environmental factors that impede leisure time physical activity include lack of hills in the neighbourhood, absence of enjoyable scenery, and infrequent observation of others exercising in the neighbourhood.[11] Improvements of the physical environment may thus promote physical activity in a population.[12] It has been shown that community and workplace policies may promote physical activity.[13] Social capital and social networks are also regarded as important determinants of the fitness level of the population in the USA, mainly because social activities entail more physical activity than social isolation. In recent decades there has been a stagnation in fitness in the USA in terms of average time per year spent walking for exercise, attendance in exercise classes, and jogging.[14] High levels of social capital may also prevent crime. Lack of important social network and social capital environmental factors may impede physical activity by making residents insecure because of the risk of being exposed to violence, crime and juvenile delinquency.[15] Older urban neighbourhoods often had a plentiful stock of social capital embedded in the relationships among families, shopkeepers, and other business owners in the neighbourhood.[15 16] In the 1950s and the 1960s, these neighbourhoods were replaced with single use tracts that kept working people out of residential areas during the day.[15 17] Migration is an important factor that indirectly affects social capital in such a way that increased in-migration and out-migration of a geographical area weakens the social ties within that area, because there is less time to build social ties and thus less continuity. Informal social networks and formal organisations that promote leisure time physical activity become fewer and weaker.[18] The strong associations of concentrated disadvantage and residential instability with violent crime are also largely mediated by collective efficacy—that is, the linkage of mutual trust and the willingness to intervene for the common good.[19] We regard out-migration as a contextual variable and a contextual measure of social capital, because it reflects the entire population. We regard social participation as an individual measure of social capital, because it is based on the answers of individual respondents that answered the postal questionnaire.

The aim of this study is to test the influence of social capital measured as social participation and as migration out of the area as a proportion of the total population of the area on individual leisure time physical inactivity in the city of Malmö, Sweden, using a multilevel model.

METHODS

Study population

The Public Health Survey in Malmö 1994 is a cross sectional study. A total of 5600 persons born in 1913, 1923, 1933, 1943, 1953, 1963, 1968, and 1973 (80, 70, 60, 50, 40, 30, 25, and 20 years old) was randomly selected from the general Malmö population and invited to answer a postal questionnaire in the spring of 1994. In each age group, 700 persons (350 men and 350 women) were interviewed. Four letters of reminder were also sent to the respondents. A total of 3861 persons answered the questionnaire, although 73 were incomplete. As 3% (178) were abroad during the time of the investigation, a total of 5422 persons had the opportunity to answer the questionnaire. Consequently, the participation rate was 71%.

A total of 74 administrative areas (neighbourhoods) that comprised 3377 participants of the 3861 persons were included in this study. The other 484 participants were excluded because they either lived in the 25 administrative

areas with less than 20 participants in the study or because of incomplete data.

Definitions

The extent of leisure time physical activity is assessed by a multiple choice question with four alternatives. The first alternative is a completely sedentary leisure time physical activity status. The second alternative involves at least four hours of light leisure time physical activity (walking, bicycling, etc) per week. The third alternative comprises regular physical exercise and training, and the fourth hard and regular training at the élite level. In this study, leisure time physical activity is dichotomised into active in physical activities (the three latter alternatives) and physical inactivity (the first alternative). The leisure time physical activity variable refers to the activity level at the point in time when the questionnaire was answered by the respondents.

Age was categorised from the outset by selecting only the birth years 1913, 1923, 1933, 1943, 1953, 1963, 1968, and 1973 for the random selection.

Country of origin: the variable was dichotomised and participants born in other countries than Sweden were merged into a single category.

Education was categorised by length of education. The respondents were classified into four groups: (a) more than 12 years, (b) 10–12 years, (c) 9 years of education or less, and (d) others.

Social participation describes how actively the person takes part in the activities of formal and informal groups as well as other activities in society during the past 12 months. It was measured as an index consisting of 13 items (study circle/course at work place, other study circle/course, union meeting, meeting of other organisations, theatre/cinema, arts exhibition, church, sports event, letter to editor of a newspaper/journal, demonstration, night club/entertainment, big gathering of relatives, private party) and dichotomised. If three alternatives or less were indicated, the social participation of that person was classified as low. The validity and reliability of the social participation variable was tested in a previous study, and the κ coefficient was 0.70, indicating an acceptable reliability. Furthermore, the construct validity analysed by Cronbach's α was 0.61 for the social participation index variable. The analysis of construct validity indicated that the social participation index variable measured other aspects of the psychosocial environment than other social network and social support variables.[20] The social participation variable was used as a proxy for social capital at the individual level in this study, because it had been assessed by individual responses to the public health survey questionnaire. This social participation index variable has also been used in Sweden in the investigations conducted by the National Bureau of Statistics since the late 1960s and the 1970s.[21]

Neighbourhoods

The city of Malmö is administratively divided into 99 neighbourhoods (in all 130 administrative areas, of which only 99 have a total of >80 inhabitants).[22] In this study all 74 neighbourhoods with 20 respondents or more in the public health survey in Malmö 1994 were included. The administrative areas are very homogeneous regarding housing. Some only contain privately owned one family houses, others exclusively contain blocks of flats owned by tenant owners societies, and still others blocks of flats with appartments for rent in privately owned blocks of flats. The administrative areas are also large enough—that is, they contain 3000–6000 inhabitants—to be defined as separate neighbourhoods.

Contextual variable

The proportion of the total population within each neighbourhood that migrated from the neighbourhood in 1993 was used as a contextual variable. This measure has been used in the social capital literature as an indirect measure of the stability and the maintenance of the social context within a particular neighbourhood.[18]

Statistics

Simple variance components multilevel logistic regression models[23] with individuals (first level) nested within neighbourhoods (second level) were fitted to the data. In the first model, no variables were entered (the empty model). In the second model, age and sex, together with one other variable were also included. In the third model, all individual level variables were added together. In the final model, the contextual variable (mobility) was included together with all the individual variables. The dependent variable is a dichotomous outcome (low compared with high physical activity).

To study the influence of the neighbourhood on individual associations (cross level effect modification), random coefficients models were fitted.[23 24] In these models we analysed the covariance between the slopes of the associations between individual physical inactivity in the neighbourhood and the other individual variables in each neighbourhood, and the level of the physical inactivity in the neighbourhoods (that is, intercepts). In these models age and sex were always included.

The percentage of the total variance in physical inactivity that was related to the neighbourhood (that is, intra-neighbourhood correlation) was also used as a measure of the contextual effects. Intra-neighbourhood correlation was approximated as: neighbourhood variance/(neighbourhood variance+$\pi^2/3$).[25] The percentage of between neighbourhood variance explained by the introduction of variables in the model was indicated ($Model_0$-$Model_1$/$Model_0$%).

Individual odds ratios (95% confidence intervals) were obtained from the β coefficient (standard error) in the fixed part of the model. Parameters were estimated using the Iterative Generalized Least Square (IGLS) and RIGLS methods.[22 23] Extra-binomial variation was allowed for while estimating the coefficients. The MlwiN, version 1.1 software package[24] was used to perform the analyses.

RESULTS

Characteristics of the population

Table 1 shows the properties of the neighbourhoods included in the analysis (n=74). The neighbourhood mean proportion of inhabitants that reported leisure time physical inactivity was 11.3% in the lowest quartile according to the proportion of respondents with leisure time physical inactivity, and 18.9%, 25.2%, and 37.8% in the following quartiles. The proportion of participants that reported leisure time physical inactivity in the study was 22.8%.

Individual determinants of physical inactivity in the neighbourhood

The age and gender adjusted odds ratio of physical inactivity in the neighbourhood was 1.55 (95% 1.31 to 1.84) times higher among women than among men. The odds ratio of physical inactivity was even higher for the group born in other countries than Sweden, 2.35 (1.95 to 2.84). The odds ratios of physical inactivity were significantly higher in all lower educational level categories compared with the reference group with the higher educational levels. The odds ratio of physical inactivity was much higher in the group with low social participation compared with the high social participation reference group, 3.59 (2.95 to 4.35). Mobility, when adjusted for age and sex composition in the neighbourhoods, was not associated with physical inactivity, 1.00 (0.99 to 1.01) (table 2).

Neighbourhood determinants of physical inactivity in the neighbourhood

Direct cross level effect

The crude second level (neighbourhood) variance was 0.171 (0.053). Table 2 shows that the age and sex adjusted second

Table 1 Characteristics of the population according to aggregated data (that is, neighbourhood) and according to individual data

	Small city areas (n=74) according to ordinal scale for each variable (means at the area level within four groups by quartiles)				Individuals (n=3377)
	First group	Second group	Third group	Fourth group	Proportion
Leisure time physical inactivity	11.3	18.9	25.2	37.8	22.8
Number of individuals (mean)	22	32	48	79	–
Sex (male)	38.8	46.3	51.6	59.3	49.3
Country of origin (not Sweden)	12.4	22.3	32.6	54.2	30.2
Educational level					
High	12.2	18.3	28.7	40.5	24.5
Medium	16.0	20.9	22.0	22.3	20.1
Low	31.2	42.2	51.9	62.6	47.4
Other	6.1	7.8	8.2	9.2	7.9
Social participation (low)	18.5	25.4	36.0	47.0	32.0
Mobility (contextual)	6.3	10.8	17.0	30.3	–

All data shown as percentages unless otherwise stated.

level variance was 0.175 (0.054)—that is, a minor increase. Further addition of the individual country of origin variable decreased the second level variance in physical inactivity by 44% to 0.098 (0.040) compared with the age and sex adjusted model. When the individual education level variable was included in the age and sex adjusted model the second (neighbourhood) level variance in physical inactivity decreased by 15% to 0.153 (0.050). The individual social participation variable also significantly reduced the second level variance in physical inactivity by 36% to 0.114 (0.044).

The percentage of the total variance in physical inactivity in the neighbourhood that was explained by the area of a person's residence (that is, intra-neighbourhood level correlation) was 5.0% in the empty model. This neighbourhood effect slightly increased to 5.2% when the age and sex components were taken into consideration. Adjustment for country of origin significantly reduced the intra-neighbourhood correlation to 2.9%. Adjustment for educational level also affected the estimates. Adjustment for individual social participation reduced the intra-class correlation to 3.3%. In contrast, the intra-class correlation in physical inactivity in the neighbourhoods was only reduced to 4.9% when the contextual mobility variable was introduced in the model together with age and sex.

When all the individual variables were introduced simultaneously in the model, the second level (neighbourhood) effect on physical inactivity in the neighbourhood was reduced to 0.070 (0.036), intra-class correlation 1.9%. The percentage of the total variance in physical inactivity in the neighbourhood that was explained by all the country of origin, educational level, and social participation factors was 63%—that is, (5.2 to 1.9)/5.2.

Finally, when the contextual mobility was introduced into the final model (including all the individual variables), the

Table 2 Individual level odds ratios (OR) and 95% confidence intervals (95% CI) of leisure time physical inactivity, and neighbourhood effect on individual leisure time physical inactivity in 3377 people from 74 neighbourhoods in the city of Malmö, in function of different individual characteristics. The 1994 public health survey in Malmö

		Neighbourhood effect	
	OR (95% CI)	Neighbourhood level variance (standard error)	Intra-neighbourhood correlation
Empty model		0.171 (0.053)	5.0%
Age and sex adjusted models			
Age			
Old	Reference		
Young	0.90 (0.87 to 0.94)		
Sex		0.175 (0.054)	5.2%
Men	Reference		
Women	1.55 (1.31 to 1.84)		
Country of origin			
Sweden	Reference	0.098 (0.040)	2.9%
Not Sweden	2.35 (1.95 to 2.84)		
Educational level			
High	Reference		
Medium	1.28 (0.99 to 1.67)		
Low	2.20 (1.83 to 2.75)	0.153 (0.050)	4.4%
Other	1.34 (0.91 to 1.88)		
Social participation			
High	Reference	0.114 (0.044)	3.3%
Low	3.59 (2.95 to 4.35)		
Mobility	1.01 (0.99 to 1.03)	0.171 (0.053)	4.9%

Table 3 Individual level odds ratios (OR) and 95% confidence intervals (95% CI) of leisure time physical inactivity, and neighbourhood effect on individual leisure time physical inactivity in 3377 people from 74 neighbourhoods in the city of Malmö, in function of different individual characteristics. The 1994 public health survey in Malmö

		Neighbourhood effect	
All variables in the model	OR (95% CI)	Neighbourhood level variance (standard error)	Intra-neighbourhood correlation
Age			
Old	Reference		
Young	0.98 (0.94 to 1.03)		
Sex			
Men	Reference		
Women	1.64 (1.37 to 1.95)		
Country of origin			
Sweden	Reference		
Not Sweden	2.06 (1.69 to 2.50)		
Educational level		0.070 (0.036)	2.1%
High	Reference		
Medium	1.24 (0.96 to 1.61)		
Low	2.08 (1.69 to 2.56)		
Other	1.30 (0.88 to 1.80)		
Social participation			
High	Reference		
Low	3.13 (2.56 to 3.82)		
Mobility	1.00 (0.99 to 1.01)		

variance in physical inactivity was not further reduced, 0.070 (0.036) (table 3).

Cross level effect modification

The covariances between the individual associations between physical inactivity and the other individual variables in each neighbourhood (that is, slopes), and physical inactivity at the neighbourhood level (that is, intercepts) were 0.000 (0.000), with the exception of the slopes of individual physical inactivity and social participation, and the intercepts of physical inactivity at the neighbourhood level: covariance –0.060 (0.066).

DISCUSSION

This study shows that individual factors such as country of origin and educational level are strong determinants of the proportion of persons with low leisure time physical activity in the neighbourhoods. In the crude model, there were small but significant neighbourhood differences in physical inactivity. After adjustment for a variety of individual factors (age, sex, country of origin, educational level) the neighbourhood differences in physical inactivity disappeared. The social participation variable, measured at the individual level, was significantly associated with physical inactivity, and strongly affected the neighbourhood differences in physical inactivity. The contextual migration variable was not significantly associated with individual physical inactivity, and did not affect the neighbourhood differences in physical inactivity. The results of this study thus suggest that leisure time physical inactivity is mainly affected by individual factors, and that the small neighbourhood differences in Malmö are explained by individual factors.

The proportions of different educational level categories and country of origin groups are comparable to those in the official registers covering the whole population.[22] The 71% participation rate is also acceptable. The selection of ecological units ought not to be an important source of selection bias, as the exclusion of the 25 smallest administrative areas (neighbourhoods) only marginally increased the proportion with leisure time physical inactivity among the individual participants of the study from 22.4% to 22.8%. The exclusion of the 484 participants of the smallest ecological units resulted in an increase in the proportion of participants born in other countries than Sweden from 26.7% to 30.3%, and a decrease in the proportion of participants with high education from 25.5% to 24.5%.[9]

The people covered within each of the categories of the four category leisure time physical activity question may in reality have considerably varied physical activity levels. However, when compared with other more detailed and more valid methods assessing leisure time physical activity, this four category item has been shown to have sufficiently high validity concerning the estimation of the leisure time physical inactivity status alternative.[26 27]

The reliability and validity of the social participation variable used in this paper was assessed in a previous paper that found an acceptable validity and reproducibility.[20]

Migration is regarded by Putnam as an important factor that affects social capital in such a way that increased in-migration and out-migration in a geographical area weakens the social ties within the social context of that area, thus also weakening social capital.[18] Sampson *et al* have also argued that a high population turnover has negative consequences for the social control of delinquency and for social capital.[28] The contextual migration variable might thus plausibly be regarded as a rather strong indirect measure of the preconditions for social capital within the geographical areas. However, these circumstances may of course be different in different cities.

Age, sex, country of origin, and education might be confounders of the associations between social capital and leisure time physical inactivity. Adjusting for these possible confounders affected the estimates as illustrated in tables 2 and 3.

The questionnaire was sent to the respondents without any translations or any translation help. Sweden provides courses in Swedish for immigrants and some of the introductory courses are even mandatory. As the persons who were chosen to be respondents were randomly chosen from the population register of Malmö, they must also have lived in Sweden for at least a year.

The inclusion of all the individual variables, particularly country of origin, education, and social participation, in the

Key points

- Neighbourhood factors accounted for a significant fraction of the crude total variance in physical inactivity.
- Individual factors, especially country of origin, education and social participation, significantly reduced the neighbourhood variance in physical inactivity.
- This study suggests that in the neighbourhoods leisure time physical inactivity is mainly affected by compositional (individual) factors.

model strongly affected the variance between the neighbourhoods in the proportions of low leisure time physical activity reported by the inhabitants. The contextual migration variable did not have this effect. However, there is a theoretical risk of over-adjusting for inter-level confounding, in that some of the mentioned individual variables could in fact be determined by area level contextual factors. They could therefore be on the pathway between area level social capital and individual physical inactivity. In fact, individual social participation in Malmö, as defined in this paper, seems to be influenced to some extent by the neighbourhood environment independently of a large number of individual factors.[29] However, this possibility does not seem plausible when it comes to the contextual migration variable, because this variable had no independent association with the levels of leisure time physical activity within the areas. Also, only a limited number of individual variables were included in the analyses, which excludes the possibility of over-adjustment because of too many individual factors.

Conventional methods of analysis are inadequate as means to distinguish to what extent the differences between geographical areas depend on variations in individual characteristics in contrast with contextual characteristics related to these areas.[30–35] Individual and ecological methods dealing with only one level of analysis do not account for the fact that the individuals appear in clusters—that is, that the individuals of a particular geographical area have a number of factors in common that may be of importance in the analysis. This leads to different problems of interpretation of the results of the analyses. The interpretation of the results of conventional individual level studies is often that they correctly reflect individual causal connections, without taking the possibility that the discovered connections could be attributable to area effects (for example, the effects of variations in social capital between geographical areas) into account. This possible misinterpretation has been named "the atomistic fallacy".[35] On the other hand, the results of conventional ecological analyses are often interpreted as being related to area characteristics, without any discussion concerning the possibility that the "ecological" results only reflect individual level associations because of compositional differences between the areas. This kind of fallacy has been named "the sociologist fallacy".[36] The "sociologist fallacy" obviously differs from the well known "ecological fallacy", where an observed association at the area level of analysis is interpreted as being the result of the same association at the individual (compositional) level.[37 38]

The results of this study suggest that the neighbourhood differences in leisure time physical inactivity status are mainly determined by individual factors such as country of origin, educational level and social participation. These findings have also previously been demonstrated in individual level analyses.[1–3 9] The notion that contextual area characteristics might be of importance for the neighbourhood differences in leisure time physical activity status[11 12] was not confirmed. These findings may of course reflect specific traits of southern Sweden or particularly the city of Malmö, because the area differences in physical activity also might reflect only the individual composition of the population at the individual level of analysis. It is also possible that other contextual factors than social capital, for example, walking environment, other physical traits of the environment, and access to fitness establishments and facilities, may affect the inclination to be physically active.[11 12] However, such contextual factors have not been investigated in this study. This research has obvious implications for public health policy. Findings that differences in physical activity between neighbourhoods are associated only with individual factors suggest that policies to increase physical activity levels should be specifically directed towards these groups. Findings that neighbourhood differences in physical activity levels are associated with contextual factors suggest policy measures directed towards, for example, the walking environment or police patrolling.

In conclusion, this study does not confirm the notion that leisure time physical activity status might partly be determined by contextual characteristics of the neighbourhoods.

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