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Neighborhood deprivation and risk of cervical cancer morbidity and mortality: a multilevel analysis from Sweden

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Abstract

Objectives. To analyze whether there is an association between neighborhood deprivation and cervical cancer morbidity and mortality, beyond individual level characteristics.

Design. The entire Swedish population aged 25 to 74, a total of 1.9 million women, were followed from January 1, 1990, until hospital admission due to cervical cancer during the study period, or the end of the study on December 31, 2008. Multilevel logistic regression was used in the analysis with individual level characteristics (age, marital status, family income, education, immigration status, urban/rural status, mobility, comorbidities, parities, and number of partners) at the first level and level of neighborhood deprivation at the second level. Neighborhood deprivation was measured at small area market statistics level by the use of an index.

Results. There was a strong association between level of neighbourhood deprivation and cervical cancer morbidity and mortality. In the full model, which took account of the individual level characteristics, the risks of cervical cancer morbidity and mortality were 1.25 and 1.36, respectively, in the most deprived neighborhoods. The between neighborhood variance was over twice the standard error, indicating significant differences in cervical cancer morbidity and mortality between neighborhoods.

Conclusions. This study is the largest to date of the influences of neighborhood deprivation on cervical cancer morbidity and mortality. The results suggest that neighborhood characteristics affect cervical cancer morbidity and mortality independently of individual level sociodemographic characteristics. Both individual and neighborhood level approaches are important in health care policies.

Key words: Neighborhood deprivation, cervical cancer, risk factors, Sweden.

Introduction

Cervical cancer is considered to be one of the major public health challenges. Many environmental risks factors are known and they include human papillomavirus (HPV) infection, obesity and reproductive factors. The incidence of cervical cancer is significantly lower among women from developed countries, because of the availability of cervical screening. For example, Sweden has a universal tax-financed health care system that covers all individuals with a residence permit. In Sweden, the incidence of cervical cancer has been reduced by 50% since the introduction of screening in the late 1960s [1]. To further reduce the burden of this cancer, vaccination against HPV infection has recently been introduced in Sweden and other western countries. However, socioeconomic disparities, and physical, and social characteristics may influence health-related behaviors, screening behaviors and health conditions in Sweden [2, 3] and other countries [1, 4-8].

Despite national cervical screening programmes and success in reducing cervical cancer rates, socioeconomic disparities in cervical cancer morbidity and mortality persist [8-13]. To identify risk factors and high-risk groups in different societies is essential for any prevention program for cervical cancer; still a significant public health priority in several countries [14]. According to previous research, individual socioeconomic status is inversely related to the morbidity and mortality in cervical cancer [8-13]

During the first decade of this millennium an increasing number of studies have described the separate influences of individual- and neighborhood-level SES on health [15-19]. However, only a few studies have examined the effects of neighborhood-level SES on cervical cancer risk [20, 21]. To the best of our knowledge, no study to date has simultaneously analyzed the

effect of neighborhood-level SES on cervical cancer morbidity and mortality, after adjusting for individual-level characteristics.

The first aim of this study is to investigate whether there is an association between neighborhood deprivation and cervical cancer morbidity and mortality. The second aim is to investigate whether this possible difference remains after accounting for individual-level sociodemographic characteristics, i.e. age, marital status, family income, education, immigration status, urban/rural status, mobility, comorbidities (hospitalization of chronic obstructive pulmonary disease, alcoholism and alcohol related liver disease, obesity, coronary heart disease, type 2 diabetes, hypertension, heart failure, stroke and other cancers), parities, and number of partners.

Materials and methods

The dataset used in this study is based on data from nationwide population-based datasources. The dataset incorporates information on the entire national population over a period of 40 years. It includes cervical cancer data for the entire population. Additionally, the dataset incorporates population-wide documentation regarding concomitant factors such as geographical region and socioeconomic status. We used the main diagnoses for cervical cancer recorded in the register. Additional linkages were carried out to national census data to obtain individual socioeconomic status, occupation, geographical region of residence. The National Registry of Causes of Death was used to identify date of death and mortality of cervical cancer and other causes of death. The Population Registry was used to identify date of emigration. All linkages were performed by the use of an individual national identification number that is assigned to each person in Sweden for his or her lifetime. This number was replaced by a serial number for each person in order to provide anonymity.

The follow-up period started on January 1, 1990 and proceeded until hospitalization for cervical cancer, death, emigration or the end of the study period on December 31, 2008.

Outcome variable

The outcome variable was morbidity and mortality from cervical cancer. We used the Swedish Cancer Registry to identify primary diagnoses of cervical cancer in the study population during the study period. All cases of cancer in Sweden must be registered in the Swedish Cancer Registry. The completeness of cancer registration is currently considered to be close to 100%. Only primary neoplasms of the cervix classified according to the 7th revision of the International Classification of Diseases (ICD-7) were studied (the Swedish Cancer Registry has transferred all the cancer ICD codes into ICD-7 code 171). The mortality due to cervical cancer was identified in the Cause of Death Registry during the same period. The 9th and 10th revisions of the WHO's International Classification of Diseases (ICD-9=180 and ICD-10=C53) were used to define mortality due to cervical cancer.

Individual variables

Individual variables included age at the start of the study, marital status, family income, educational attainment, immigration status, geographical region, mobility, and hospitalization for comorbidities of the subjects.

Age. Age ranged from 25 to 74 years and was divided into 10-year categories.

Marital status. Individuals were classified as married/cohabitating or single.

Family income by quartile. Information on family income in 2000 came from the Total Population Register, which was provided to us by Statistics Sweden. We used this

information to determine the distribution of family incomes in Sweden, and then used the distribution to calculate empirical quartiles.

Educational attainment. Educational attainment was classified as completion of compulsory school or less (≤ 9 years), practical high school or some theoretical high school (10–11 years), or theoretical high school and/or college (≥ 12 years).

Immigration status: (1) born in Sweden and (2) born outside Sweden.

Urban/rural status: large cities (Stockholm, Gothenburg, Malmö), middle-sized towns, and small towns/rural areas.

Mobility: length of time lived in neighborhood, categorized as lived in neighborhood < 5 years or ≥ 5 years.

Comorbidities were identified in the Hospital Registry: previous hospitalization for chronic obstructive pulmonary disease *(*COPD) was included because it was suspected to be one important prognostic factor for cervical cancer as a surrogate of smoking (ICD-9=490-496; ICD-10= J40-J47), alcoholism and alcohol related liver disease (ICD-9=291, 303, 571; ICD-10=F10 and K70), obesity (ICD-9=490-496; ICD-10= E65-E68), coronary heart disease (ICD-9=410-414; ICD-10=I20-I25), type 2 diabetes (ICD-9=250 and age at diagnosis over 30 years; ICD-10=E11-E14), hypertension (ICD-9=401-405; ICD-10=I10-I19), heart failure (ICD-9=428; ICD-10=I50), stroke (ICD-9=430-438; ICD-10=I60-I69), and other cancers (Swedish Cancer Registry ICD-7=140-209, except for cervical cancer 171).

Parities: Women were included in this study if they had at least one child.

Partners: Partners were identified according to children who the partners had pleaded fatherhood for immediately after birth.

Neighborhood Deprivation Index:

The home addresses of all Swedish adults have been geocoded to small geographic units that have boundaries defined by homogeneous types of buildings. These neighborhood areas,

called small area market statistics, or SAMS, have an average of 1000–2000 people and were used as proxies for neighborhoods, as has been done in previous research [18, 22]. Adults whose addresses were not able to be geocoded to a SAMS were excluded (*n*=35935 individuals, 1.8% of the sample). The final sample consisted of 8291 SAMS.

A summary measure was used to characterize neighborhood-level deprivation. We identified deprivation indicators used by past studies to characterize neighbourhood environments and then used a principal components analysis to select deprivation indicators in the Swedish national database. The following four variables were selected for those aged 25-64: low educational status (<10 years of formal education); low income (income from all sources, including that from interest and dividends), which was defined as less than 50% of the individual median income) [18, 23]; unemployment (not employed, excluding full-time students, those completing compulsory military service, and early retirees), which was measured at a certain point in time for all inhabitants in each neighborhood; and social welfare assistance. Each of the four variables loaded on the first principal component with similar loadings (+.47 to +.53) and explained 52% of the variation between these variables.

A z score was calculated for each SAMS neighbourhood. The z scores, weighted by the coefficients for the eigenvectors, were then summed to create the index.[24] The index was categorized into three groups: below one standard deviation (SD) from the mean (low deprivation), above one SD from the mean (high deprivation), and within one SD of the mean (moderate deprivation). Higher scores reflect more deprived neighborhoods.

Statistical Analysis

Age-standardized morbidity and mortality were calculated by direct age standardization using 10-year age groups specific to women, with the entire Swedish population of women in 1990

as the standard population. Multilevel (hierarchical) logistic regression models with incidence proportions (the proportion of women who became cases among those who entered the study time interval) were used as the outcome variables. The analyses were performed using MLwiN, version 2.02. First, a null model was calculated to determine the variance among neighborhoods. A neighborhood model was also calculated that included only neighborhood-level deprivation to determine the crude risk of cervical cancer morbidity and mortality by level of neighborhood deprivation. We then created a second model, which included neighbourhood-level deprivation and age, and a third model, which also included the other individual-level sociodemographic variables (added simultaneously). A fourth model, i.e., the full model, was calculated that included neighborhood-level deprivation and all individual-level variables, which were added simultaneously to the model. These full models tested whether neighborhood-level deprivation was significantly associated with cervical cancer morbidity and mortality after adjusting for the individual-level characteristics, and whether there were differential effects of neighborhood-level deprivation on cervical cancer morbidity and mortality across sociodemographic characteristics [25].

Random effects: The between-neighborhood variance was estimated both with and without a random intercept. It was regarded as significant if it was larger than 1.96 times the standard error, which is in accord with the precedent set in previous studies [18, 26, 27].

Ethical considerations

This study was approved by the Ethics Committee of Lund University, Sweden.

Results

Table 1 shows population sizes and neighbourhood characteristics in the year 1990 by neighbourhood-level deprivation. The total number of neighbourhoods was 8291. Of the total

population, 25%, 61%, and 14% lived in low, moderate, and high deprivation neighborhoods, respectively. During the follow-up period from January 1, 1990 through December 31, 2008, there were 4321 (0.2%) women who were diagnosed with cervical cancer, of whom 818 (18.9%) died due to cervical cancer during the study period. Age-adjusted morbidity of cervical cancer increased from 21.0 per 10000 person years in neighborhoods with low deprivation to 22.5 per 10000 in neighborhoods with moderate deprivation and 28.2 per 10000 in neighborhoods with high deprivation. The age-adjusted mortality was 3.4, 4.4, and 5.6 per 10000 person years, respectively. A similar pattern of higher morbidity and mortality with each increasing level of neighborhood-level deprivation was observed across all eleven individual-level sociodemographic categories and comorbidities. All categories showed a gradient effect across level of neighborhood deprivation.

The odds ratio (OR) of cervical cancer morbidity for women living in a high versus low deprivation neighborhood was 1.34 (1.21-1.48) in the crude neighborhood-level model (Table 2). Neighbourhood-level deprivation remained significantly associated with hospitalisation for cervical cancer after adjustment for age (model 2) and age and the other individual-level sociodemographic variables (model 3). Neighborhood-level deprivation remained also significantly associated with cervical cancer morbidity after adjusting for all individual-level sociodemographic variables and comorbidities (OR = 1.25; 95% CI, 1.13–1.38) (model 4). The highest odds of cervical cancer morbidity were shown for individuals who were never married, widowed, or divorced; had low family income (middle-low and low family income); the lowest educational attainments; mobility; more parities, and more partners. The odds of cervical cancer were highest in women with comorbidities of alcoholism and alcohol-related liver disease (OR=1.45), hypertension (OR=1.23), and chronic lower respiratory diseases (OR=1.18). Immigrant women, women living in small towns or rural areas and women

affected with coronary heart disease showed decreased odds of cervical cancer morbidity.

The odds ratio (OR) of mortality in women living in a high versus low deprivation neighborhood was 1.63 (1.29-2.06) in the crude neighborhood-level model (Table 3). Neighborhood-level deprivation remained significantly associated with mortality after adjusting for the individual-level sociodemographic variables (no case of mortality was found in immigrants) and comorbidities (OR = 1.36; 95% CI, 1.07–1.73) (model 4). The highest odds of mortality were found for individuals who were never married, widowed, or divorced, had low level family income (middle-low and low family income); had more children; and more partners. The odds of cervical cancer mortality were highest in women with comorbidities of alcoholism and alcohol-related liver disease (OR=1.76), and other cancers (OR=1.44). Women living in small towns or rural areas had decreased odds of cervical cancer mortality.

The test for cross-level interactions between the individual-level sociodemographic variables and neighborhood-level deprivation on risk of cervical cancer morbidity and mortality showed no meaningful cross-level interactions or effect modification.

The between-neighborhood variance (i.e., the random intercept) was over 1.96 times the standard error in all models, indicating that there were significant differences in cervical cancer morbidity and mortality between neighborhoods after accounting for the neighborhood-level variable and the individual-level variables. The neighborhood-level variable explained 14% and 7% for morbidity and mortality, respectively, of the between-neighborhood variance in the null model (Table 2 and Table 3). After inclusion of the individual-level variables, the explained variance increased to 60% and 38%, respectively.

Discussion

The main findings of this study are that the odds of cervical cancer morbidity and mortality are higher among women living in deprived neighborhoods than among women living in affluent neighborhoods. This difference remained significant after adjustment for the individual-level sociodemographic variables and comorbidities. The present study represents a novel contribution as previous neighbourhood study of cervical cancer morbidity and mortality are scarce [20].

The causal pathways between neighborhood socioeconomic deprivation and poor health outcomes are not fully understood. However, several possible mechanisms could lie behind our findings. One possible mediator could be psychological stress [28, 29] due to littered and unsafe environments, vandalism, isolation/alienation and violent crime [30] in deprived neighborhoods. For example, it has been suggested that crime lies in the pathway linking the neighborhood social environment and health [17, 31]; indeed, a consistent association between neighborhood social deprivation and crime has been found in previous studies [31]. Socially deprived neighborhoods in the U.S. are often affected by both criminal violence and residential instability [17]. It is possible that women are particularly vulnerable to stressors such as sexual violence [32]. Consistent with this hypothesis are the results of a 2011 U.S. study, which found that violence was associated with women's cervical cancer morbidity [33].

Additionally, socio-cultural norms regarding diet, smoking and physical activity, could vary between neighborhoods and affect the health of the residents and the risk for cervical cancer. It is possible that the lack of safe environments reduces the possibility to exercise, which

aggravates an unhealthy life style**.** Living in a deprived neighborhood can cause isolation from health-promoting milieus (e.g. safe places to exercise, decent housing) and services. For example, a French study showed that risk factors, such as low socioeconomic status (education and household income), unemployment, and living in middle-, or lower-class neighborhoods were associated with increased risks of lack of cervical screening [5]. Similar results were found in another neighborhood study on cervical cancer mortality in a New York population [20]; the mortality was 32% higher among women living in high poverty neighborhoods than among women living in high-income neighborhoods.

In Sweden, universal medical care is provided to all permanent residents, and primary healthcare clinics and hospitals are equally distributed and located centrally in all types of neighborhoods [34]. However, the actual number of health professionals working in primary healthcare clinics can vary considerably by neighborhood type. This is due to difficulties in recruiting and retaining healthcare personnel in high-deprivation neighborhoods. The misdistribution of medical personnel across neighborhoods has also been documented in England, another country with universal health care [35].

Our study has some limitations. For example, in studies of neighborhood effects on health, selective residential mobility can cause compositional neighborhood differences. Selective residential mobility is the tendency of individuals to move to neighborhoods whose characteristics match their individual characteristics (for example, the tendency of individuals with low socioeconomic status to move to low-socioeconomic status neighborhoods). However, we adjusted for family income, which improved our possibilities to differentiate between compositional and contextual effects on cervical cancer morbidity and mortality.

There are also a number of strengths in this study. The large cohort included practically all patients with cervical cancer (25 years and older) in Sweden during the study period, which increases the generalizability of our results. Another strength is the use of personal identification numbers that made it possible to follow the individuals in the different registers, for example in the Migrant Register, which permitted calculation of exact risk time for each individual. Second, the Swedish Total Population Register is highly complete, with very few missing data. For example, data for income were 99.4% complete. Finally, the use of multilevel modeling helped us to separate neighborhood-level and individual-level effects and allowed us to consider both fixed and random effects in the analyses.

CONCLUSIONS

Neighborhood deprivation has an independent contribution on the risk of cervical cancer morbidity and mortality. The individual-level and neighborhood-level variables may cumulatively load against individuals so that the most at-risk individuals would be those who have both individual- and neighborhood-level risk factors. These findings raise important clinical and public health concerns, and indicate that both individual- and neighborhood-level approaches are important in health care policies.

Conflict of Interest Statement

There are no conflicts of interest.

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Table 1. Distribution of population, number of cervical cancer morbidity and mortality events, and age-standardized morbidity (per 10000 personyears) and mortality (per 10000 personyears) by neighborhood-level deprivation

	Population	Distribution (%)	Morbidity	Deaths due to cervical cancer	Morbidity rate by neighborhood deprivation			Mortality rate by neighborhood deprivation		
					Low	Moderate	High	Low	Moderate	High
Total population (%)	1887118				476594 (25.3%)	1152176 (61.0%)	258438 (13.7%)			
Cervical cancer events			4321	818	21.0	22.5	28.2	3.4	4.4	5.6
Age (years)										
25-34	348270	18.5	918	71	26.4	24.8	32.3	1.1	1.8	4.2
35-44	501360	26.6	1210	147	22.4	23.9	29.1	2.3	2.9	4.6
45-54	437935	23.2	879	158	17.3	20.0	27.1	3.0	3.6	5.0
55-64	327091	17.3	706	221	19.3	21.7	24.8	5.2	7.0	8.3
65-74	272462	14.4	608	221	19.8	22.1	26.5	8.7	8.2	7.0
Marital status										
Married/cohabiting	1122805	59.5	1999	292	18.1	17.4	18.4	2.6	2.8	3.1
Never married, Widowed, or divorced	764313	40.5	2322	526	26.9	30.1	38.6	4.8	6.6	8.1
Family income (quartiles)										
Low income	472903	25.1	1103	237	27.0	23.3	27.2	5.6	5.0	6.7
Middle–low income	471897	25.0	1240	261	21.8	25.1	35.4	3.2	5.2	6.5
Middle–high income	471462	25.0	1074	183	21.5	23.2	30.4	3.6	4.4	5.7
High income	470856	25.0	904	137	18.8	20.1	18.0	3.0	3.3	3.5
Educational attainment										
Compulsory school or less (≤ 9 years)	446001	23.6	1125	307	27.1	27.1	31.8	5.8	4.7	8.9
Practical high school or some theoretical high school (10–11 years)	594696	31.5	1363	202	19.8	17.8	26.8	3.0	2.8	4.3
Theoretical high school and/or college (≥ 12 years)	846421	44.9	1833	309	17.4	18.8	21.0	1.8	3.2	3.8
Immigrant status										
Sweden	1709964	90.6	3997	818	21.4	23.0	29.8	3.7	4.8	6.7
Other countries	177154	9.4	324	0	16.3	17.0	20.7	-		
Urban/rural status										
Large cities	590102	31.3	1511	293	21.8	27.2	34.2	3.4	5.9	7.7
Middle-sized towns	686702	36.4	1619	310	20.7	22.8	32.2	3.8	4.5	6.1
Small towns/rural areas	610314	32.3	1191	215	18.3	19.3	21.6	2.6	3.4	4.3
Move										
Not moved	1445314	76.6	3044	609	19.8	20.9	25.8	3.2	4.1	5.3
Moved	441804	23.4	1277	209	25.1	28.4	33.4	4.4	5.5	6.6
Number of children										
One	423332	22.4	934	176	19.5	21.6	26.8	3.5	4.7	4.3
Two	856597	45.4	1838	296	20.7	21.2	24.4	3.1	3.5	5.5
Three	404016	21.4	947	196	22.3	23.2	28.0	3.9	5.0	5.3
Four or more	203173	10.8	602	150	23.9	28.6	39.4	3.9	7.0	7.2
Number of partners										
One	1790573	94.9	3909	748	20.1	21.6	26.4	3.3	4.3	5.0
Two	78197	4.1	320	51	38.7	38.8	51.4	6.4	5.4	12.5
Three or more	18348	1.0	92	19	54.0	40.2	71.5	7.0	10.3	21.4
Hospitalized for chronic lower respiratory diseases										

No	1822835	96.6	4129	773	20.8	22.2	27.7	3.3	4.4	5.6
Yes	64283	3.4	192	45	22.2	26.0	45.5	5.2	5.0	6.2
Hospitalized for alcoholism and alcohol related liver disease										
No	1865428	98.9	4225	799	20.8	22.2	28.0	3.3	4.4	5.6
Yes	21690	1.1	96	19	39.8	42.0	39.0	10.8	7.8	7.5
Hospitalized for obesity										
No	1861546	98.6	4246	806	21.0	22.5	27.8	3.4	4.4	5.5
Yes	25572	1.4	75	12	17.9	26.0	54.9	2.6	3.3	11.4
Hospitalized for coronary heart disease										
No	1739757	92.2	4015	753	21.2	22.5	28.5	3.5	4.7	5.9
Yes	147361	7.8	306	65	12.5	22.8	35.3	4.0	2.2	3.4
Hospitalized for type 2 diabetes										
No	1826269	96.8	4155	773	20.8	22.3	28.1	3.4	4.4	5.6
Yes	60849	3.2	166	45	31.1	33.8	32.9	4.4	6.6	5.8
Hospitalized for hypertension										
No	1703693	90.3	3843	703	20.5	22.2	27.1	3.3	4.5	5.4
Yes	183425	9.7	478	115	21.1	27.7	42.5	4.2	4.2	5.8
Hospitalized for heart failure										
No	1810375	95.9	4136	774	21.0	22.4	27.9	3.5	4.5	5.8
Yes	76743	4.1	185	44	5.7	26.7	48.2	0.8	4.3	4.6
Hospitalized for stroke										
No	1770055	93.8	4070	750	20.8	22.7	28.2	3.5	4.5	5.6
Yes	117063	6.2	251	68	19.6	22.9	26.5	1.5	6.1	4.6
Hospitalized for other cancers										
No	1688118	89.5	3845	674	21.1	22.1	28.0	3.2	4.1	5.7
Yes	199000	10.5	476	144	22.2	27.3	29.6	5.3	6.7	4.9

Table 2. Odds ratios (OR) and 95% confidence intervals (CI) for cervical cancer morbidity; Results of the multi-level logistic regression models

	Model 1			Model 2			Model 3			Model 4		
	OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI	
Neighborhood deprivation (ref. Low)												
Moderate	**1.07**	**1.00**	**1.16**	**1.08**	**1.00**	**1.17**	1.07	0.99	1.16	1.07	0.98	1.15
High	**1.34**	**1.21**	**1.48**	**1.34**	**1.22**	**1.49**	**1.26**	**1.13**	**1.40**	**1.25**	**1.13**	**1.38**
Age (yrs)				1.00	0.99	1.00	**0.99**	**0.99**	**0.99**	**0.99**	**0.99**	**0.99**
Marital status (ref. Married/co-habiting)												
Never Married,widowed, divorced							**1.60**	**1.50**	**1.70**	**1.59**	**1.50**	**1.70**
Family income (ref. Highest quartile)												
Middle-high income							**1.14**	**1.04**	**1.25**	**1.14**	**1.04**	**1.24**
Middle-low income							**1.24**	**1.14**	**1.36**	**1.23**	**1.13**	**1.35**
Low income							**1.11**	**1.02**	**1.22**	**1.11**	**1.01**	**1.22**
Education attainment (ref.≥ 12 yrs)												
Compulsory school or less (≤9 years)							**1.15**	**1.06**	**1.25**	**1.16**	**1.06**	**1.26**
Practical high school or some theoretical high school (10–11 years)							0.98	0.92	1.06	0.98	0.91	1.05
Country of origin to other countries (ref. Sweden)							**0.69**	**0.61**	**0.77**	**0.69**	**0.61**	**0.77**
Urban/rural status (ref. Large cities)												
Middle-sized towns							**0.89**	**0.82**	**0.96**	**0.90**	**0.83**	**0.97**
Small towns/rural areas							**0.72**	**0.66**	**0.78**	**0.73**	**0.67**	**0.79**
Mobility (ref. Not moved)							**1.15**	**1.08**	**1.23**	**1.15**	**1.07**	**1.23**
Parity (ref. one child)												
2							1.06	0.98	1.15	1.07	0.98	1.15
3							**1.14**	**1.04**	**1.25**	**1.14**	**1.04**	**1.25**
4							**1.35**	**1.21**	**1.50**	**1.34**	**1.20**	**1.50**
Number of partners (ref. One partner)												
Two							**1.55**	**1.38**	**1.74**	**1.53**	**1.36**	**1.72**
Three or more							**1.75**	**1.41**	**2.17**	**1.73**	**1.39**	**2.14**
Hospitalized for chronic lower respiratory diseases (ref. Non)										**1.18**	**1.00**	**1.39**
Hospitalized for alcoholism and alcohol related liver disease (ref. Non)										**1.45**	**1.18**	**1.78**
Hospitalized for obesity (ref. Non)										1.01	0.78	1.31
Hospitalized for coronary heart disease (ref. Non)										**0.84**	**0.74**	**0.96**
Hospitalized for type 2 diabetes (ref. Non)										1.17	1.00	1.36
Hospitalized for hypertension (ref. Non)										**1.23**	**1.11**	**1.36**
Hospitalized for heart failure (ref. Non)										1.02	0.86	1.19
Hospitalized for stroke (ref. Non)										0.88	0.77	1.00
Hospitalized for other cancers (ref. Non)										1.08	0.98	1.19
Variance (S.E.)	*0.083 (0.025)*			*0.082 (0.025)*			*0.041 (0.023)*			*0.039(0.023)*		
Explained variance (%)	*14*			*15*			*58*			*60*		

Model 1, crude model; model 2, age adjusted model; model 3, adjusted for age, marital status, family income, educational attainment, country of origin, region of residence, mobility, parity, and number of partners; model 4, full model

Table 3. Odds ratios (OR) and 95% confidence intervals (CI) for mortality in women with cervical cancer; Results of the multi-level logistic regression models

	Model 1			Model 2			Model 3			Model 4		
	OR	95% CI		OR	95% CI					OR	95% CI	
Neighborhood deprivation (ref. Low)												
Moderate	**1.28**	**1.07**	**1.54**	1.19	0.99	1.43	1.15	0.95	1.39	1.15	0.95	1.39
High	**1.63**	**1.29**	**2.06**	**1.56**	**1.24**	**1.97**	**1.36**	**1.07**	**1.73**	**1.36**	**1.07**	**1.73**
Age (yrs)				**1.04**	**1.03**	**1.04**	**1.03**	**1.02**	**1.04**	**1.03**	**1.02**	**1.04**
Marital status (ref. Married/co-habiting)												
Never Married,widowed, divorced							**2.09**	**1.80**	**2.43**	**2.10**	**1.80**	**2.44**
Family income (ref. Highest quartile)												
Middle-high income							1.24	0.99	1.55	1.24	0.99	1.56
Middle-low income							**1.38**	**1.11**	**1.71**	**1.40**	**1.13**	**1.74**
Low income							**1.45**	**1.16**	**1.81**	**1.48**	**1.19**	**1.85**
Education attainment (ref.≥ 12 yrs)												
Compulsory school or less (≤9 years)							0.98	0.81	1.18	1.02	0.85	1.23
Practical high school or some theoretical high school (10–11 years)							0.99	0.82	1.18	0.99	0.82	1.18
Country of origin to other countries (ref. Sweden)							-					
Urban/rural status (ref. Large cities)												
Middle-sized towns							0.86	0.73	1.02	0.87	0.74	1.03
Small towns/rural areas							**0.62**	**0.52**	**0.76**	**0.64**	**0.53**	**0.77**
Mobility (ref. Not moved)							1.10	0.94	1.30	1.10	0.94	1.30
Parity (ref. one child)												
2							0.94	0.78	1.14	0.94	0.78	1.14
3							1.20	0.98	1.48	1.21	0.98	1.49
4							**1.36**	**1.09**	**1.72**	**1.38**	**1.10**	**1.74**
Number of partners (ref. One partner)												
Two							**1.38**	**1.03**	**1.85**	**1.36**	**1.02**	**1.83**
Three or more							**1.83**	**1.14**	**2.94**	**1.80**	**1.12**	**2.89**
Hospitalized for chronic lower respiratory diseases (ref. Non)										1.21	0.86	1.70
Hospitalized for alcoholism and alcohol related liver disease (ref. Non)										**1.76**	**1.11**	**2.81**
Hospitalized for obesity (ref. Non)										0.75	0.40	1.41
Hospitalized for coronary heart disease (ref. Non)										0.74	0.53	1.02
Hospitalized for type 2 diabetes (ref. Non)										1.25	0.92	1.71
Hospitalized for hypertension (ref. Non)										1.10	0.89	1.35
Hospitalized for heart failure (ref. Non)										0.74	0.53	1.02
Hospitalized for stroke (ref. Non)										0.79	0.61	1.03
Hospitalized for other cancers (ref. Non)										**1.44**	**1.20**	**1.73**
Variance (S.E.)	*0.499 (0.133)*			*0.446 (0.132)*			*0.334 (0.125)*			*0.330 (0.125)*		
Explained variance (%)	*7*			*17*			*38*			*38*		

Model 1, crude model; model 2, age adjusted model; model 3, adjusted for age, marital status, family income, educational attainment, country of origin, region of residence, mobility, parity, and number of partners; model 4, full model