Geographic Context and Population's Health Status: from the CUA Effect to Neighbourhood Effects

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A previous Irdes study indicated a poorer health status among residents of critical urban areas* (CUA*). In line with this finding, this new study shows the impact of neighbourhood characteristics on inhabitants' health status. Indeed, independently of individual characteristics, contextual variables can also affect health status.
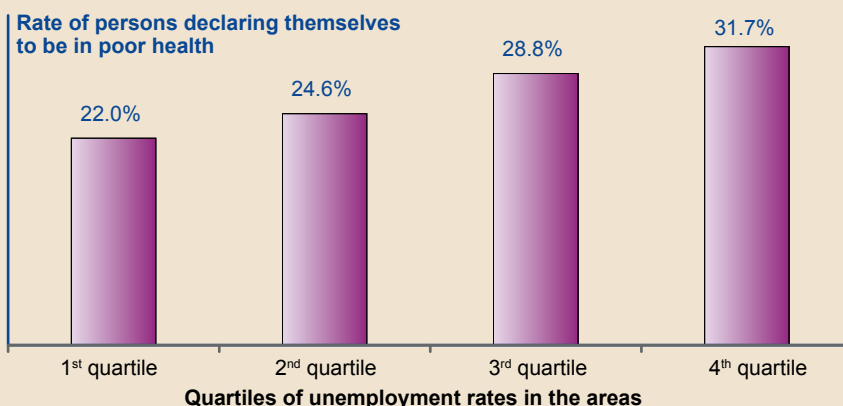
The results suggest that living in a neighbourhood exposed to economic and social problems increases the probability of declaring a poor health status. The same observation has been made for inhabitants of neighbourhoods with a low residential mobility. Lastly, inhabitants of neighbourhoods with a predominantly young population and with recently built report better health than those living in old neighbourhoods inhabited by older households.

Defined at the administrative level, the CUA criteria is a good zoning method for observing health status evolution in the most disadvantaged areas. However, CUAs do not permit a holistic understanding of all the geographic contextual factors that affect the population's health.

These results confirm the importance of implementing localized policies in order to reduce health inequalities.

On February 4th 1995, the French Government passed an act defining CUA as neighbourhoods where people with economic, social, and housing problems live. The aim of this law is to target specific populations experiencing residential isolation and socio-economic deprivation in order to carry out reviving urban policies in disadvantages areas. Geographical segregation, linked to housing development history and individual choices, can affect health status owing to, for example, a massive concentration of poverty, poorer housing quality and environmental risks. Our first study indicated a poorer health status for CUA residents (ONZUS, 2006; Allonier, Debrand, Lucas-Gabrielli and Pierre, 2007). We now seek to highlight the specific role of neighbourhoods' socioeconomic characteristics on their residents' health status.

Disparities of self-reported health according to place of residence

By and large, socioeconomic inequalities of self-reported health have been accounted for in most neighbourhoods – CUA or elsewhere. For instance, wherever respondents live: women systematically report worse health status than men (36% vs 28% for CUA residents and 29% vs

Proportion of persons declaring themselves to be in poor health as a function of the unemployment rate in the neighbourhood

Rate of persons declaring themselves to be in poor health

- 1st quartile: 22.0%
- 2nd quartile: 24.6%
- 3rd quartile: 28.8%
- 4th quartile: 31.7%

Quartiles of unemployment rates in the areas

Interpretation: among the inhabitants of a neighbourhood included in the 4th quartile (grouping 25% of the neighbourhoods where the unemployment rates are highest), 31.7% self-report poor health.

Source: 2002-03 National Health survey* (INSEE*). Exploitation: IRDES.

22% for non-CUA residents), and older people declare to be less healthy (respectively 24% vs 17% for 30-44 years old and 56% vs 45% for 60-79 years old). Nevertheless, CUA's inhabitants' self-perceived health is more often undermined than health of people living outside such deprived areas. In other words, women (resp. older people) living in CUA declare to be in much worse health than women (resp. older people) living outside (7 percentage point difference for women and 6 percentage point difference for older people).

In order to compare residents' health status according to their living area, we grouped the neighbourhoods of our sample by quartiles[1] of socioeconomic indicator (unemployment rate, proportion of university graduates, proportion of large families, etc.).

Neighbourhood characteristics are linked to their inhabitants' health status: in neighbourhoods with very high unemployment rates, the proportion of residents reporting poor health is higher than in neighbourhoods with the lowest unemployment rates (22% vs 32% respectively) (*Cf.* chart p. 1). Poor health is also reported more frequently

1 For example, the first-quartile group of neighbourhoods for the unemployment rate series comprises the quarter of our neighbourhood sample with the lowest unemployment rates. The last quartile groups the quarter of neighbourhoods with the highest unemployment rates

in neighbourhoods with low populations of university graduates: 21% of people living in the first-quartile group of neighbourhoods report poor health versus 33% of those living in the fourth-quartile group of neighbourhoods. Perceived health is also correlated to the proportion of large and single parent families, low rent housing, etc. (*Cf.* table below).

Geographic disparities of health status are linked to variations in the demographic and social structure of the population from one neighbourhood to another (composition effect). However, it is probable that these differences are also attributable to environmental characteristics (context effect). In the following part, in order to study the impact of context data independently of composition effects, we rely on an "all other things being equal" econometric analysis.

A multidimensional approach of context effects

Context effects are analyzed trough a wide range of aggregated indicators from the general population census and summarised in three "synthetic factors" resulting from a principal components analysis (*Cf.* box p. 5). The first factor reflects the neighbourhoods' economic and social condition. It notably distinguishes neighbourhoods according to professional

activity, proportion of non-graduates, proportion of single parent families and proportion of low-rent housing. The second synthetic factor expresses "residential mobility". It is highly correlated with the proportion of persons having moved in after 1990 or who have been living in the same region since 1990. It is also dependent on context variables

	Proportion of persons reporting poor health according to six socioeconomic indicators								
	Socioeconomic characteristics of neighbourhoods								
	Unemployed	University graduates	Large families	Single parent families	Non French natives	Persons over 60 years old	Persons living in the same dwelling as in 1990	Low rent housing	Housing built after 1982
	%	%	%	%	%	%	%	%	%
Quartiles									
1st quartile	22.0	33.1	25.4	23.7	26.3	24.7	23.8	25.1	29.0
2nd quartile	24.6	26.9	25.2	25.9	25.5	25.5	26.4	24.5	27.1
3rd quartile	28.8	26.1	26.1	28.0	27.5	26.3	27.0	27.0	27.7
4th quartile	31.7	20.7	30.1	29.2	27.5	30.5	29.8	30.1	23.3

Field: persons aged 18 and over having participated in the 2002-03 National Health survey*. The sample is composed of 16,505 people including 2,013 living in a CUA.
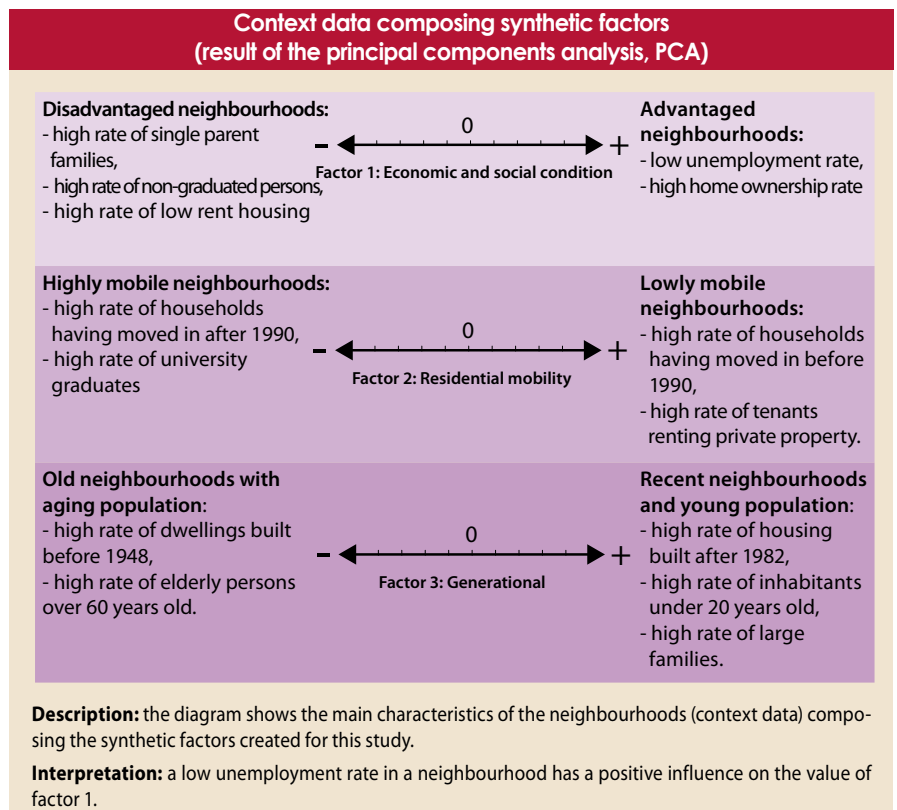
Interpretation: the first line of column "single parent family" indicates that 23.7% of the respondents living in neighbourhoods with the lowest rate of single parent families (1st quartile) report poor health.

Source: 2002-03 National Health survey* (INSEE*). Exploitation: IRDES.

that reflect type of housing. And, the third one, called "generational", depicts neighbourhoods in terms of population as well as habitat. It distinguishes neighbourhoods whether they are predominantly composed of an elderly population living in older housing or a young population living in relatively recent areas (*Cf.* box above).

We carried out a four-step study in order to set apart the individual determinants of context effects on health status reports. First, we estimated, all other things being equal, only the individual characteristics effects on health status (*Cf.* table p. 4, column A). Then, we include the indicator variable "living in a CUA", enabling us to identify a 'CUA effect' (*Cf.* table p. 4, column B). Reutilising the first estimation, we then include the three synthetic context factors, allowing us to identify the context effects (*Cf.* table p. 4, column C). Lastly, to understand the interactions between the CUA effect and the context effects identified previously, we simultaneously include the "living in a CUA" variable and the three synthetic factors (*Cf.* table p. 4, column D).

The first model shows that the least well-off people, the least educated, as wells

Context data composing synthetic factors (result of the principal components analysis, PCA)

Disadvantaged neighbourhoods:
- high rate of single parent families,
- high rate of non-graduated persons,
- high rate of low rent housing

Advantaged neighbourhoods:
- low unemployment rate,
- high home ownership rate

0
− ⟷ +
Factor 1: Economic and social condition

Highly mobile neighbourhoods:
- high rate of households having moved in after 1990,
- high rate of university graduates

Lowly mobile neighbourhoods:
- high rate of households having moved in before 1990,
- high rate of tenants renting private property.

0
− ⟷ +
Factor 2: Residential mobility

Old neighbourhoods with aging population:
- high rate of dwellings built before 1948,
- high rate of elderly persons over 60 years old.

Recent neighbourhoods and young population:
- high rate of housing built after 1982,
- high rate of inhabitants under 20 years old,
- high rate of large families.

0
− ⟷ +
Factor 3: Generational

Description: the diagram shows the main characteristics of the neighbourhoods (context data) composing the synthetic factors created for this study.

Interpretation: a low unemployment rate in a neighbourhood has a positive influence on the value of factor 1.

as workers and the elderly report poorer health than the others (*Cf.* table p. 4, column A). On the contrary, in-dwelling duration and conurbation size are not correlated with perceived health status.

If living in a CUA is added to these individual socioeconomic characteristics (*Cf.* table p. 4, column B), then, independently of individual characteristics, the probability that CUA residents report poor health is higher by 2.2 points than that of non-CUA residents. The "CUA effect" can be interpreted as a negative context effect linked to disadvantaged neighbourhoods. The values of the coefficients linked to individual determinants vary little with the addition of the CUA indicator, the information included in "living in a CUA" variable is quite different from that existing in individual variables.

If the three synthetic context factors (*Cf.* table opposite, column C) are taken into account instead of the "CUA effect" then, independently of the individual characteristics, the fact of living in an advantaged neighbourhood has a negative impact on the probability of reporting poor health. The negative coefficient assigned to the first synthetic factor shows that, independently of individual socioeconomic characteristics, the more individuals live in a neighbourhood with low economic and social levels, the higher is the probability that they report poor health. Living in a neighbourhood with combined economic and

social difficulties is therefore associated with the further negative effect of poor health. In order to this context effect to individual effects (*Cf.* Method box p. 5), we calculate the probability difference of reporting poor health between residents from a very advantaged and a very disadvantaged neighbourhood. This difference of 4.6 points is slightly higher than the difference of perceived health between men and women (3.8 percentage points), workers and intermediate professions (3.8 percentage points) and between craftspersons-shopkeepers and the intermediate professions (3.3 percentage points) and lower than the differences in perceived health between non-graduates and the most graduated (6.5 percentage points), between the most modest and the wealthiest (7.4 percentage points) and between the active and the inactive (10.6 percentage points).

Regarding the synthetic "residential mobility" factor, its positive coefficient shows that the more individuals live in "lowly mobile" neighbourhoods, the more they tend to report poor health. Contrary to the others synthetic context factors that tend to provide a current inventory of urban areas, the third factor represents the population flows that shape the town of tomorrow (Debrand, Pierre, Allonier and Lucas-Gabrielli, 2008). The probability difference of reporting poor health between residents from a highly mobile neighbourhood and a lowly mobile neighbourhood is + 3.6 percentage points. It is lower than the difference measured for the first synthetic factor. Thus it is also lower than the impacts of most of the individual effects, but remains quite close to the gender effect.

The third synthetic factor, called "generational", distinguishes recently built neighbourhoods inhabited by young households from old neighbourhoods inhabited by older households. All other things being equal, individuals who live in recent and "young" neighbourhoods are in better health than those who live in old and "elderly" ones. This probability difference of self reported poor health status, nearly 3 percentage point, is lower

Model of the probability of reporting poor health according to individual characteristics and context factors

	Without contextual factors		Witht contextual factors	
	Without CUA	With CUA	Without CUA	With CUA
	A	**B**	**C**	**D**
INDIVIDUAL VARIABLES				
Age (Reference: 18 to 29)				
30 to 44	11.74**	11.83**	11.74**	11.74**
45 to 59	25.66**	25.81**	25.86**	25.86**
60 to 79	29.38**	29.64**	29.84**	29.84**
80 and over	43.89**	44.22**	44.45**	44.44**
Gender (Reference: men)				
Women	3.75**	3.74**	3.77**	3.77**
Level of education (Reference: higher)				
Non graduate	6.92**	6.81**	6.61**	6.61**
A-level	-3.17**	-3.10**	-3.03**	-3.03**
A-level +2 years university	-6.62**	-6.51**	-6.33**	-6.33**
Monthly household income (Reference: from €15,500 to €23,999)				
Less than €14,499	3.95**	3.86**	3.73**	3.73**
From €24,000 to €35,999	-2.50**	-2.43**	-2.17**	-2.17**
More than €36,000	-7.77**	-7.71**	-7.30**	-7.29**
Profession (Reference: intermediate professions)				
Farmers	0.82	1.03	1.77	1.77
Craftspersons/shopkeepers	-3.39**	-3.31**	-3.27**	-3.27**
Managers	-4.15**	-4.16**	-4.04**	-4.04**
White collar workers	0.48	0.46	0.34	0.34
Manual workers	4.06**	3.99**	3.58**	3.58**
Unknown	-6.17**	-6.18**	-6.18**	-6.18**
Main occupation (Reference: active)				
Unemployed	8.82**	8.79**	8.66**	8.66**
Inactive	10.87**	10.85**	10.69**	10.69**
Nationality (Reference: French native)				
French by acquisition	4.81**	4.67**	4.49**	4.49**
Foreigners from the EEC 15	4.10*	4.12*	4.21**	4.21**
Foreigners from outside the EEC 15	1.73	1.29	1.04	1.05
Size of conurbation (Reference: Paris)				
Population less than 49,999	-0.49	-0.61	-2.25	-2.25
Population between 50,000 and 199,999	-1.39	-1.47	-2.64**	-2.63**
Population over 200,000	-0.48	-0.48	-1.57*	-1.57*
Duration of dwelling (Reference: less than 13 years)				
More than 13 years	-0.65	-0.66	-0.86	-0.86
CUA variable (Reference: outside CUA)				
CUA		2.22*		-0.05
SYNTHETIC CONTEXT FACTORS				
Economic and social position factor (factor 1)			-0.46**	-0.46**
Residential mobility factor (factor 2)			0.37**	0.37**
Generational factor (factor 3)			-0.55**	-0.55**

Interpretation: in the model including the CUA variable and synthetic context factors (column D), the probability that women report poor health is, all other things being equal, higher by 3.77 points than that of men.

Source: 2002-03 National Health survey (INSEE*). Exploitation: IRDES.

Results of analyses testing the quadratic effects of synthetic factors

	Without contextual factors		Witht contextual factors	
	Without CUA	With CUA	Without CUA	With CUA
CUA VARIABLE				
CUA		-0.05*		0.78
SYNTHETIC CONTEXT FACTORS				
Economic and social condition (factor 1)				
Factor 1	-0.46**	-0.46**	-0.54**	-0.50**
Factor 1 x Factor 1			-0.05	-0.06
Residential mobility (factor 2)				
Factor 2	0.37**	0.37**	0.44**	0.44**
Factor 2 x Factor 2			-0.02	-0.02
Generational factor (factor 3)				
Factor 3	-0.55**	-0.55**	-0.58**	-0.59**
Facteur 3 x Facteur 3			0.22**	0.22**

Interpretation: coefficient -0.50 of column D indicates that living in an advantaged neighbourhood reduces the probability of reporting poor health. This effect is linear. To compare it to the effects of individual variables, see Method box p. 5.

Significativity threshold of P-value: ** = $p < 5\%$; * = $5\% \leq p < 10\%$.

Source: 2002-03 National Health survey* (INSEE*). Exploitation: IRDES.

METHOD

Processing context data, construction of synthetic indicators

The aggregated data were subjected to a principal components analysis (PCA) in order to work with all the information available. Thus the data are synthesised and grouped in synthetic orthogonal indicators of context which are used "all other things being equal": their orthogonality allow us to introduce them simultaneously in a multivariate analysis by bypassing problems of colinearity.

All other things being equal

Probit econometric models were used to understand the context factors that have an impact on individual health status reports independently of individual characteristics. The analysis focuses on the probability of reporting poor health according to the respondent's type of neighbourhood and compares these effects to those of individual characteristics. In order to omit taking into account the most extreme situations while including as best as possible behaviours relating to the population studied, the econometric analyses were performed on persons whose "scores" in the synthetic factors are included in percentiles p1 and p99, *i.e.* 15,552 individuals. To check the hypothesis of linearity, the synthetic factors and their quadratic effects were included simultaneously in our different models (*Cf.* second table p. 4). In our analyses, we introduce two types of explanatory variables: the individuals characteristics represented by variables (X1, X2, ..., Xk) and the contextual factors represented, on one hand, by the synthetic linear factors (Z1, Z2, Z3) and, on the other hand, by synthetic quadratic factors (Z1², Z2², Z3²).

$$\text{Health status} = \underbrace{a_1 X_1 + \ldots + a_k X_k}_{individual} + \underbrace{b_1 Z_1 + b_2 Z_2 + b_3 Z_3}_{linear\ contexts} + \underbrace{c_1 Z_1^{\,2} + c_2 Z_2^{\,2} + c_3 Z_3^{\,2}}_{quadratic\ contexts}$$

Determinants

Calculation of marginal effects associated with neighbourhoods relating to the probability of declaring oneself in poor health

The first column of the table below explain the method to the found the probability difference of reporting poor health between individuals living in a disadvantaged neighbourhood and in an advantaged one. The estimated linear coefficient of -0.46 indicates that a positive variation of one unit on factor 1 reduces the probability of self-reporting poor health by a percentage point of 0.46. Multiplying this coefficient by the number of units separating the most disadvantaged neighbourhoods (P95) from the most advantaged ones (P5), (variation P95-P5, i.e. 9.9 units), allows us to compare the effect of the economic and social condition (synthetic factor 1) with the impact of individual characteristics (9.9 x -0.46 = -4.56).

		Synthetic factor		
		1	**2**	**3**
		Economic and social situation	Residential mobility	Generational mixity
Value of synthetic factors				
95%	A	4.3	4.43	2.92
Median		0.46	0.41	-0.06
5%	B	-5.6	-5.22	-2.48
Variation P95-P5	A-B	9.9	9.66	5.4
Estimated linear coefficient	C	-0.46	0.37	-0.55
Marginal effect on the probability of self-reporting poor health (in absolute value)	(A-B)*C	**-4.56**	**3.57**	**2.97**

Source: 2002-03 National Health survey* (INSEE*). Exploitation: IRDES.

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than the marginal effects of the first two synthetic factors.

The importance of generational mix

Up to now we have considered that the effects of context were linear, that is to say that the largest differences in health status should be sought between the most extreme configurations: neighbourhoods with a very favourable context versus those with a very unfavourable one. However, this hypothesis could be over-simplistic. In order to study the health status of persons living in intermediate situations, the effects of context have been introduced in quadratic form in an alternative model. For the first two synthetic factors (socioeconomic condition and residential mobility) we were unable to highlight an effect specific to intermediate situations. On the contrary, we observed that the linear form is unsatisfactory when taking

into account the synthetic generational factor (*Cf.* chart p. 6 and table p. 4).

This non-linear effect can be interpreted as an effect of generational mix. To understand it, we return to the determinants of the third synthetic factor. The extreme values of this factor represent, on the one hand, neighbourhoods with a high proportion of recent dwellings, young people and large families and, on the other hand, neighbourhoods with very old dwellings and a high proportion of households over 60 years old. Persons living in neighbourhoods with a high proportion of elderly persons and old dwellings report, all other things being equal, a less good health than those living in neighbourhoods with many large families, young persons under 20 years old and dwellings built after 1982. In fact, the maximal differences in health status are not found between the extreme values. Households living in neighbourhoods with an intermediate position on the third synthetic factor have the best health status. We assume that this factor

reflects a certain mix in the population (according to age) and buildings (according to year of construction). The total effect of the synthetic "generational mix" factor therefore has an L shape (*Cf.* chart opposite).

Geographic effects are more precise than CUA classification

After having observed that the probability of self-reporting poor health is increased if the respondent lives in a CUA, as well as by the social and residential contexts of neighbourhoods, we seek to understand the position of the "CUA effect" in relation to context effects by introducing each synthetic factor one by one in a synthetic model[2].

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2 These models designed to understand the interactions of synthetic factors with the CUA effect are presented in Debrand, Pierre, Allonier and Lucas, 2008.

We observe that the first synthetic factor – which takes into account the economic and social condition – is the best factor to explain the "CUA effect". Indeed, the identification of CUAs results in part from taking into account the socioeconomic characteristics of neighbourhoods. However, it does not incorporate other facets of context that influence health status: information involving in the two other factors "residential mobility" and "generational" explains only partially (or not) the CUA effect. However, they are correlated with perceived health.

The effects of synthetic factors are higher than the "CUA effect" alone. This administrative criterion does not allow taking into account the considerable heterogeneity between the neighbourhoods of conurbations.

Impact of the generational factor on the probability of self-reporting poor health

Probability of self-reporting poor health

The lowest probability of reporting poor health

Neighbourhoods with "generational mix"

Old neighbourhoods and old population

Recent neighbourhoods and young population

Position of neighbourhoods regarding the synthetic generational factor

Description: the chart shows the impact of the generational factor (abscissas) on the probability of reporting poor health (ordinates). The types of neighbourhoods (in brown) depend on their socio-demographic characteristics (*Cf.* diagram p. 3). The notion of "generational mix" refers to neighbourhoods in which the probability is lowest.

Interpretation: the people with the lowest probability of reporting poor health live in neighbourhoods with "generational mix".

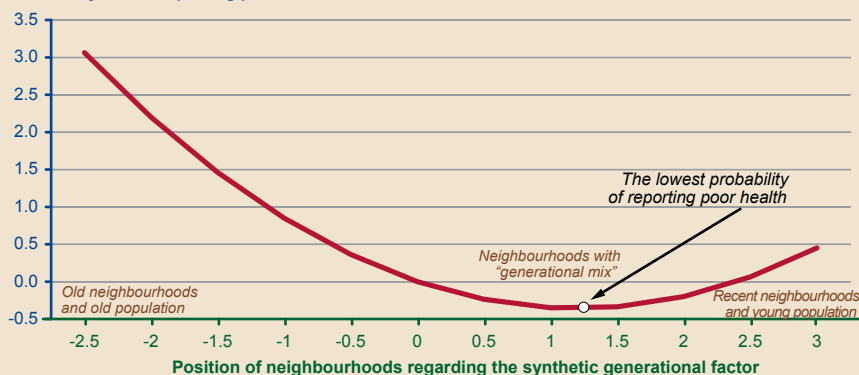Source: 2002-03 National Health survey* (INSEE*). Exploitation: IRDES.

We draw two main conclusions. Firstly, in addition to individual determinants, three types of context effect have been highlighted: the first refers to economic and social conditions, the second to "residential mobility" and the third can be qualified as "generational". Each has a specific link with health status: living in an economically disadvantaged neighbourhood with low "mobility" and little generational mix is linked to a poorer health status. What is more, the impact of synthetic factors on health status is very close to that of certain individual characteristics.

The synthetic factor of the neighbourhoods' economic and social condition is the best factor to reflect the CUA effect on health. The CUA criterion is therefore a good indicator to observe health status. However, the two other synthetic factors, not taking into account in the CUA classification, highlight other dimensions that influence health status. The CUA criterion is insufficient for taking into account the global heterogeneity of neighbourhoods. It is therefore necessary to adopt a multidimensional approach in order to take better account of the complexity of context effects on individual health status.

It appears important to implement geographically targeted policies and to provide more resources to all socially disadvantaged neighbourhoods in order to reduce health inequalities.

Glossary

- **Critical urban area (CUA):** Zone urbaine sensible (Zus)
- **Interministerial Delegation for Town (and urban social development):** Délégation interministérielle de la ville (Div)
- **Iris:** French acronym for 'Aggregated blocks for statistical information' (Ilots regroupés pour l'information statistique)
- **National Health survey:** Enquête décennale santé
- **National Institute of Statistics and Economic Studies:** Institut national des statistiques et des études économiques (Insee)
- **National Observatory of Critical Urban Areas:** Observatoire national des zones urbaines sensibles (Onzus)
- **Principal Components Analysis (PCA):** Analyse en composantes principales (Acp)

Further information

- Allonier C., Debrand T., Lucas-Gabrielli V. et Pierre A. (2007), *Des indicateurs de santé moins favorables pour les habitants des Zones urbaines sensibles*, *Questions d'économie de la santé* n° 117, Irdes, 4 p.
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- Diez Roux A. (2007). Neighbourhoods and health: where are we and where do we go from here? *Revue d Epidémiologie et de Santé Publique*, 55(1), 13-21.
- Onzus (2006), *Rapport 2006*, 152 p.