

Compared application of local and national deprivation indices to study cancer incidence in Italian regions

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AIMS

The goal of this study was to compare the different results when analysing cancer incidence by sites using socio-economic Local Deprivation Indices (LDI) or the National Deprivation Index (NDI).

We will stress their different ability in identifying the incidence characteristics at different socio-economic status (SES).

Background and state of the art

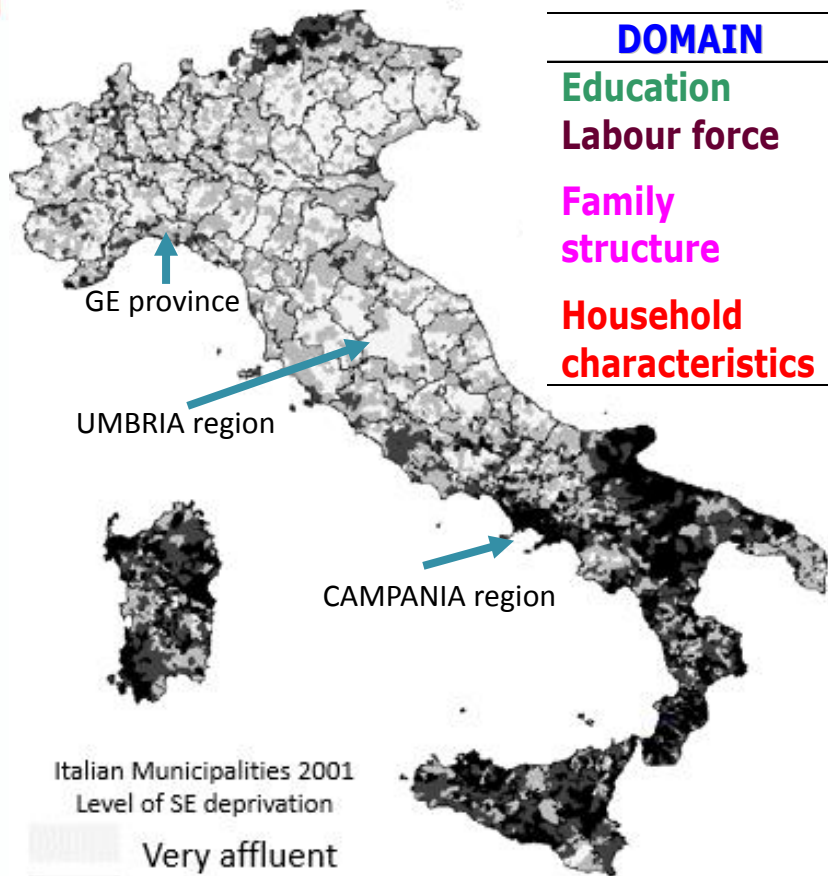
The variables used for computing the LDIs and NDI came from the National Italian Census 2001. The NDI was computed for all Italian population, but in this project were re-parameterised for the areas of Genoa, Umbria and Campania.

The LDIs were computed specifically for three regional areas.

Until now we built, validated and used only the indices for Liguria (LRDI) and Umbria (UDI), while the LDI for Campania (CDI) is ongoing.

2001 National Deprivation Index characteristics

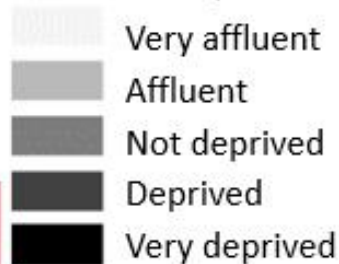
DEPRIVATION INDEX
Italian Municipalities 2001



INDEX COMPOSITION

DOMAIN	NDI 2001
Education	- % pop. with at least primary level education
Labour force	- % pop. unemployed or searching for first employment
Family structure	- % families with one parents and dependent sons living together
Household characteristics	- % rented households - No. of people by 100 mtrs ²

Italian Municipalities 2001
Level of SE deprivation



Caranci N., De Maria M., Spadea T., Costa G.
Verso un indice di deprivazione aggregato che possa essere usato a livello nazionale: composizione dell'indice 2001 e sua validazione.
 AIE Meeting: *Metodi e Strumenti per Misurare le Disparità*, Roma 15-16 maggio 2008

Building of Liguria and Umbria Deprivation Indexes -1

Demographic and socio-economic variables (DSE) for Liguria and Umbria regions were derived from census data at municipality and sub-municipality level (for Liguria we subdivided Genoa and Savona; for Umbria the cities of Perugia, Terni and Foligno).

A 1st selection of the DSE was performed by computing the Pearson's Correlation Coefficient with the SMRs of Overall Mortality; only the variables significantly correlated ($p < 0.05$) were chosen for the 2nd step.

A 2nd selection was performed by collinearity tolerance check ($p < 0.01$). The remaining variables were entered in a Principal Component factor Analysis (conditions: eigenvalues > 1 , varimax orthogonal rotation), which synthesized the factors describing the main characteristics of the two populations.

The two Regional Deprivation Index (RDI) were computed by linear combination of factors, standardising the index on a % scale.

Building of Liguria and Umbria Deprivation Indexes -2

The municipalities and sub-municipalities were classified on the basis of distribution by quintiles of the RDIs.

In order to give a more balanced distribution of the population inside the groups, also the population of each area was considered as a criterion of classification to obtain the groups on the basis of maximum similarity of the RDI values and of the best normalized population level

So, we used the cluster discriminant analysis based on the algorithm of Agnelli, Cadeiras, Tabak, Turner and Vander-Eijden*, which allows to aggregate cases maintaining one or more clustering variables with a quite normal distribution through the generated clusters.

The reached normalization level was tested at the $p < 0.05$ level.

Finally, the local index for Genoa province (GDI) was obtained re-parameterising the Liguria RDI on the Genoa province population.

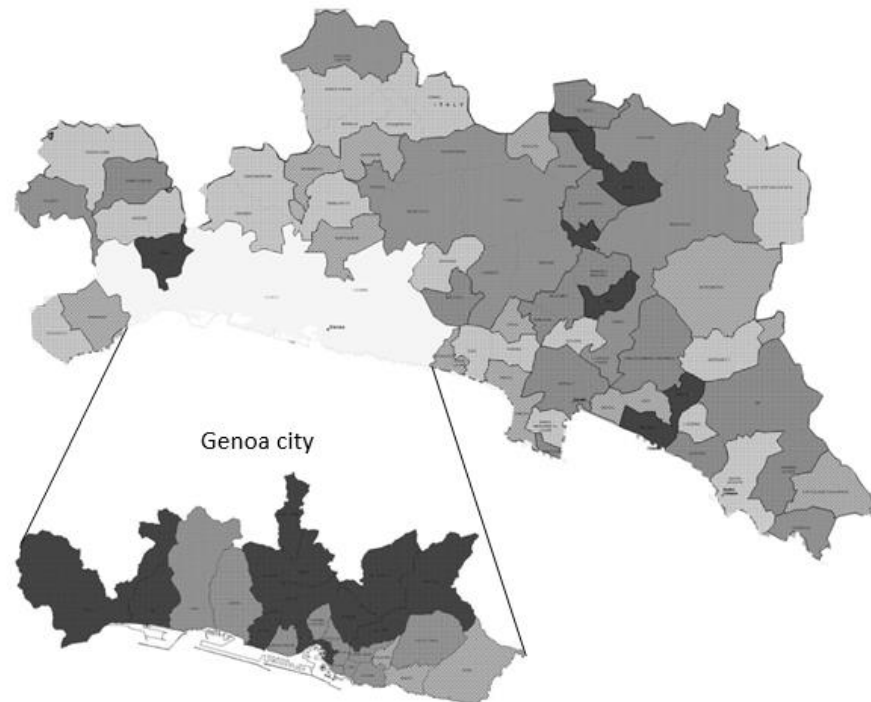
* Agnelli JP, Cadeiras M, Tabak EG et al. Clustering and classification through normalizing flows in feature space. Multiscale Model Simul, 2010; 8(5): 1784-1802.

Variables composing the factors of the GDI and UDI

DOMAIN	2001 Genoa (GDI)	2001 Umbria (UDI)
Education	- % of high school and university degree diploma	- % of high school and university degree diploma
Labour force	- % entrepreneurs and professionals	- youth employment rate - employment rate
Family structure	- % two people families - % married people	- average age of 3-persons families - % of people born in the same municipality of residence - % of singles - N° of persons in the family
Household	- % houses with very small kitchen	- % of owned houses - % of houses with independent heating system

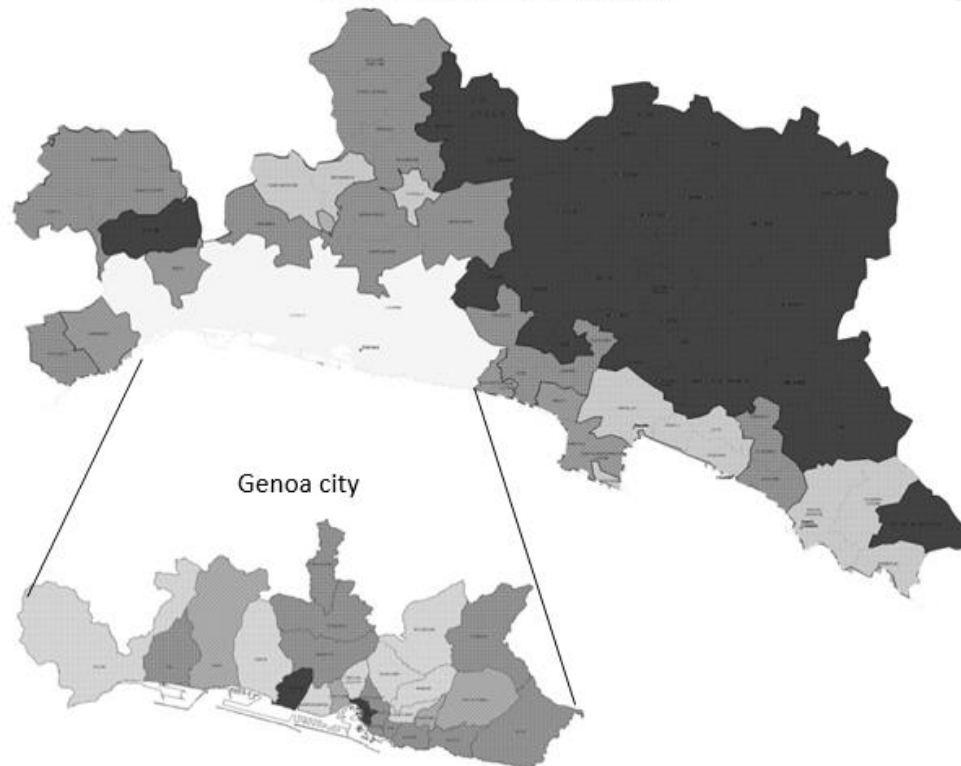
Genoa province maps: NDI-G vs. GDI distribution

NDI geographical distribution



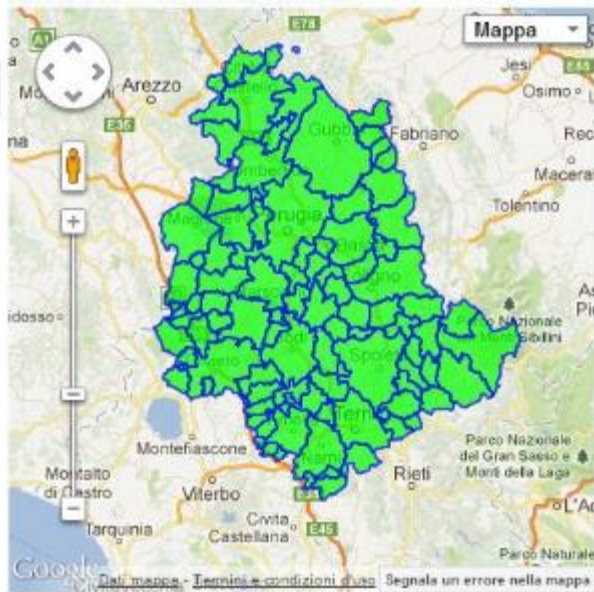
Very deprived Deprived Not deprived Rich Very rich

GDI geographical distribution

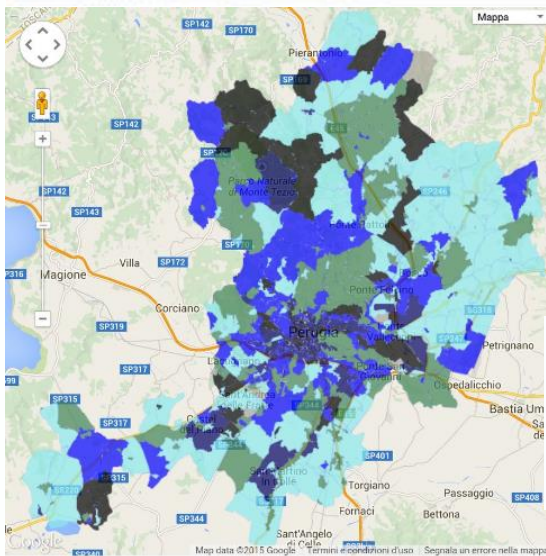


Very deprived Deprived Not deprived Rich Very deprived

Umbria maps (geo-referring Google based): UDI distribution by census tracts



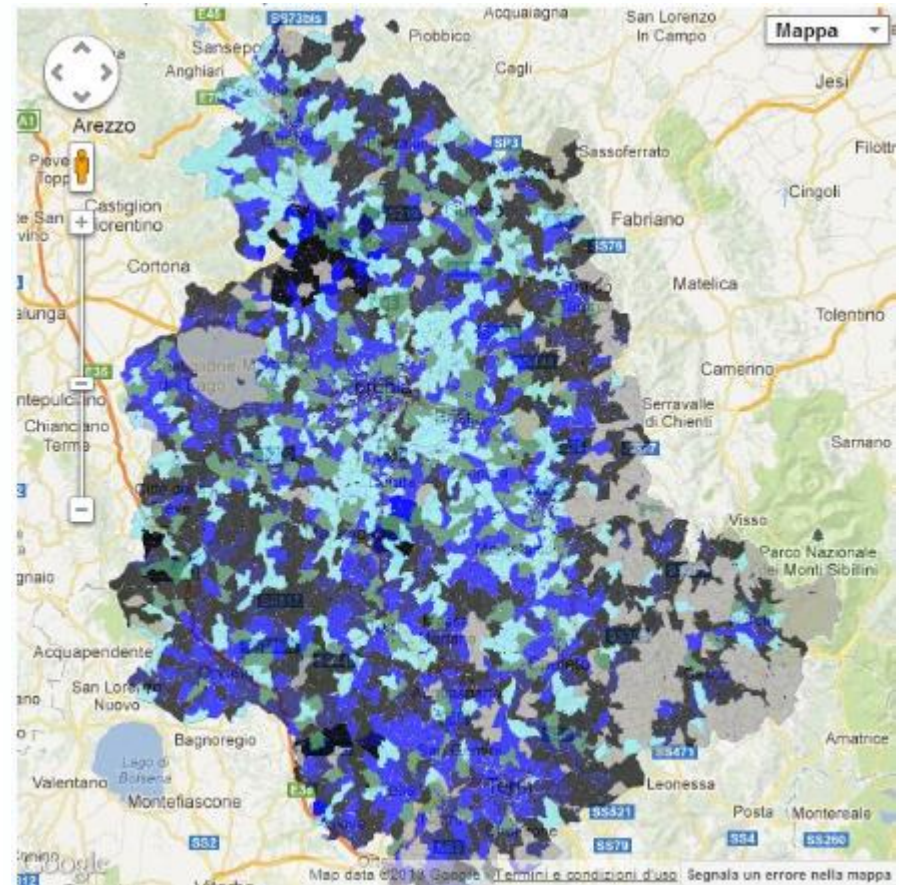
UMBRIA'S MUNICIPALITIES



PERUGIA
CENSUS
TRACT BY
UDI

- Very rich
- Rich
- Not deprived
- Deprived
- Very deprived
- Not classified

UMBRIA CENSUS TRACT BY UDI



- Very rich
- Rich
- Not deprived
- Deprived
- Very deprived
- Not classified

Results - 1

We have found more statistically significant associations between cancer incidence distribution by site and gender and trend of deprivation by local index, compared to the ones found by the NDI.

These associations were generally homogeneous with the results found in the international literature.

Genoa province: NDI-G vs. GDI

NDI-G	SEX	Trend	Cancer Sites																									
			All cancers	Oropharynx	Oesophagus	Stomach	Colon	Rectum	Liver	Pancreas	Larynx	Lung	Mesothelioma	Melanoma	Skin ca.	Prostate	Testis	Penis	Bladder	Kidney	Brain	HD	NHL	Myeloma	Leukaemia			
NDI-G	MALES	Positive trends	0-64	All cancers						Liver			Lung	Mesothelioma							Testis							
			65+	All cancers										Lung	Mesothelioma													
		No linear trend	0-64											Larynx									Bladder					
			65+		Oesophagus				Rectum					Larynx										Bladder	Brain		Leukaemia	
		Negative trends	0-64																									
			65+																									
	No trend	0-64		Oropharynx	Oesophagus	Stomach	Colon	Rectum		Pancreas				Mesothelioma				Skin ca.	Prostate	Testis	Penis	Bladder	Kidney	Brain	HD	NHL	Myeloma	Leukaemia
		65+		Oropharynx		Stomach	Colon			Liver	Pancreas			Mesothelioma	Melanoma	Skin ca.	Prostate	Testis	Penis	Bladder	Kidney			HD	NHL	Myeloma		
	FEMALES	Positive trends	0-64																									
			65+																					Brain				
		No linear trend	0-64					Colon	Rectum																			
			65+					Colon																				
Negative trends		0-64																										
		65+																										
No trend	0-64	All cancers	Oropharynx	Oesophagus	Stomach			Liver	Pancreas	Larynx	Lung	Mesothelioma	Melanoma	Skin ca.	Breast	Endometrium	Ovary	Bladder	Kidney	Brain	HD	NHL	Myeloma	Leukaemia				
	65+	All cancers	Oropharynx	Oesophagus	Stomach		Rectum	Liver	Pancreas	Larynx	Lung	Mesothelioma	Melanoma	Skin ca.	Breast	Endometrium	Ovary	Bladder	Kidney			HD	NHL	Myeloma	Leukaemia			
GDI	MALES	Positive trends	0-64		Oropharynx	Oesophagus				Liver			Lung	Mesothelioma										HD	NHL			
			65+			Oesophagus	Stomach				Rectum				Lung													
		No linear trend	0-64																								Leukaemia	
			65+		Oropharynx							Liver				Larynx								Kidney	Brain	NHL	Leukaemia	
		Negative trends	0-64																									
			65+																									
	No trend	0-64	All cancers			Stomach	Colon	Rectum		Pancreas												Penis	Bladder	Kidney	Brain		Myeloma	
		65+	All cancers							Pancreas													Penis	Bladder			HD	Myeloma
	FEMALES	Positive trends	0-64																									
			65+																									
		No linear trend	0-64																									
			65+																								Leukaemia	
Negative trends		0-64																										
		65+																										
No trend	0-64	All cancers	Oropharynx	Oesophagus	Stomach	Colon		Liver	Pancreas	Larynx	Lung	Mesothelioma													NHL	Myeloma	Leukaemia	
	65+	All cancers		Oesophagus	Stomach		Rectum	Liver	Pancreas	Larynx	Lung	Mesothelioma	Melanoma									Ovary	Bladder	Kidney		HD	NHL	Leukaemia

Significance:

Site All ages only

Site 0-64 yrs & all ages

Site 65+ yrs & all ages

Site All ages, 0-64 & 65+ yrs

Umbria region: NDI-U vs. UDI

NDI-U	Gender	Trend	Cancer Sites																														
			All cancers	Oropharynx	Oesophagus	Stomach	Colon-Retto	Colon	Retto	Liver	Pancreas	Lung	Mesothelioma	Melanoma	Skin	Uterus	Endometrium	Cervix	Ovary	Bladder	Kidney	Brain	Thyroid	HD	NHL	Myeloma	Leukaemia						
NDI-U	MALES	Positive trends	0-64			Stomach	Colon-Retto								Prostate																		
		65+													Prostate																		
		No linear trend	0-64		Oesophagus		Colon-Retto	Colon				Lung			Prostate		Testis			Bladder	Kidney							Leukaemia					
		65+		Oesophagus		Colon-Retto	Retto							Prostate						Bladder		Brain											
		Negative trends	0-64																														
		65+																															
	No trend	0-64	All cancers	Oropharynx	Oesophagus		Colon-Retto		Retto	Liver	Pancreas		Mesothelioma	Melanoma	Skin							Bladder		Brain	Thyroid	HD	NHL	Myeloma					
	65+	All cancers	Oropharynx	Oesophagus	Stomach		Colon			Liver	Pancreas	Lung	Mesothelioma	Melanoma	Skin							Testis		Bladder		Kidney		Thyroid	HD	NHL	Myeloma	Leukaemia	
	FEMALES	Positive trends	0-64	All cancers																													
		65+	All cancers								Retto	Pancreas																	Brain				
		No linear trend	0-64		Oropharynx											Skin													Brain	NHL			
		65+		Oropharynx						Liver							Breast																
Negative trends		0-64																															
65+																																	
No trend	0-64		Oropharynx	Oesophagus	Stomach	Colon-Retto	Colon	Retto	Liver	Pancreas		Mesothelioma	Melanoma					Uterus	Endometrium	Cervix			Bladder	Kidney		Thyroid	HD	NHL	Myeloma	Leukaemia			
65+		Oropharynx	Oesophagus	Stomach	Colon-Retto	Colon						Mesothelioma	Melanoma	Skin					Endometrium	Cervix	Ovary	Bladder	Kidney	Brain	Thyroid	HD	NHL	Myeloma	Leukaemia				
UDI	MALES	Positive trends	0-64		Oesophagus																												
		65+																															
		No linear trend	0-64				Colon-Retto																										
		65+		Oesophagus		Colon-Retto																											
		Negative trends	0-64		Oropharynx		Stomach		Colon																								
		65+		Oropharynx		Stomach		Colon																									
	No trend	0-64	All cancers					Colon	Retto	Liver	Pancreas		Mesothelioma																				
	65+	All cancers					Colon	Retto	Liver	Pancreas		Mesothelioma	Melanoma	Skin																			
	FEMALES	Positive trends	0-64	All cancers	Oropharynx																												
		65+																															
		No linear trend	0-64					Colon-Retto																									
		65+		Oropharynx			Colon-Retto		Retto																								
Negative trends		0-64																															
65+						Stomach																											
No trend	0-64		Oropharynx	Oesophagus	Stomach	Colon-Retto	Colon	Retto		Pancreas		Mesothelioma							Uterus	Endometrium	Cervix			Bladder	Kidney	Brain	Thyroid			Myeloma	Leukaemia		
65+	All cancers	Oropharynx	Oesophagus			Colon				Pancreas		Mesothelioma	Melanoma	Skin					Uterus	Endometrium	Cervix	Ovary	Bladder	Kidney	Brain		HD		Myeloma				

Significance:

Site

All ages only

Site

0-64 yrs & all ages

Site

65+ yrs & all ages

Site

All ages, 0-64 & 65+ yrs

Site

Conclusions

We propose the use of the two types of index for different public health purposes.

LDIs are able to provide specific information for an improvement of the health and social support policies and actions, identifying specific health needs in targeted groups of population.

NDI can give a more general description of the relationships between deprivation and health status, allowing a comparison among different regions and providing a validation benchmark for the LDIs.



Thank you for your attention

Population and SE indexes by deprivation groups discriminated by the NDIs and the LDIs in Genoa province and Umbria region

Deprivation groups			Very deprived	Deprived	Not deprived	Rich	Very rich	ALL
Umbria region	UDI	N°	162196	176275	188458	163401	135466	825796
		%	19,6	21,3	22,8	19,8	16,4	100,0
	NDI-U	N°	93236	183952	231950	219347	97311	825796
		%	11,3	22,3	28,1	26,6	11,8	100,0
Genoa province	GDI	N°	69635	176099	362956	129438	139822	877950
		%	8,1	20,0	41,3	14,7	16,0	100,0
	NDI-GE	N°	290006	233302	94956	124441	135245	877950
		%	33,0	26,6	10,8	14,2	15,4	100,0

Deprivation	Aging		Active population turn-over		Structural dependence		Unemployment	
	GDI	NDI	GDI	NDI	GDI	NDI	GDI	NDI
Genoa province								
Very deprived	532,8	313,6	327,6	223,7	79,0	59,1	10,8	10,4
Deprived	279,1	477,3	234,1	231,6	63,7	65,6	10,7	10,1
Not deprived	253,3	265,8	211,4	220,2	55,8	58,5	10,6	10,2
Rich	243,2	263,5	229,7	257,5	56,1	58,3	11,0	9,4
Very rich	251,6	376,8	211,0	278,8	57,4	67,4	7,8	9,4
F test:	p<0.05 L	n.s.	p<0.05 L	n.s.	p<0.05 L	n.s.	p<0.05 NL	n.s.
Umbria region								
Very deprived	332.2	265.9	177.4	100.1	68.0	78.7	10.7	16.5
Deprived	217.3	255.6	149.7	135.3	59.8	69.9	10.4	11.7
Not deprived	209.6	246.4	139.5	147.0	58.8	64.8	9.3	9.6
Rich	182.4	236.0	132.9	142.2	54.8	60.0	9.0	8.4
Very rich	168.6	211.2	127.9	119.2	53.5	57.0	7.6	6.8
F test:	p<0.05 L	p<0.05 L	p<0.05 L	p<0.05 NL	p<0.05 L	p<0.05 L	p<0.05 L	p<0.05 L

Genoa province: NDI-G vs. GDI

Overall cancers by age and gender: SIR and cases by deprivation groups

GENOA PROVINCE OVERALL CANCERS		MEN						WOMEN						
		Very deprived	Deprived	Not deprived	Rich	Very rich	GE	Very deprived	Deprived	Not deprived	Rich	Very rich	GE	
NDI-G	All ages	SIR	104,5	100,9	97,8	96,1	94,5		100,0	100,9	99,2	99,5	99,5	
		OBS	6093	4876	1939	2530	2754	18192	4897	4202	1580	2188	2533	15400
	0-64 yrs	SIR	102,1	101,8	97,2	99,1	95,0		99,2	100,6	99,0	99,0	102,2	
		OBS	1786	1399	551	741	755	5232	1777	1443	559	773	860	5412
	65+ yrs	SIR	105,5	100,5	98,0	94,9	94,4		100,5	101,0	99,4	99,8	98,1	
		OBS	4307	3477	1388	1789	1999	12960	3120	2759	1021	1415	1673	9988
GDI	All ages	SIR	100,5	100,2	101,3	102,3	94,2*		94,0*	100,1	100,9	99,1	101,1	
		OBS	1494	3508	7611	2785	2794	18192	1078	2914	6446	2266	2696	15400
	0-64 yrs	SIR	109,3	99,5	99,2	103,1	94,6		98,5	100,4	99	100,2	102,4	
		OBS	479	1057	2128	801	767	5232	392	1069	2223	817	911	5412
	65+ yrs	SIR	96,7	100,5	102,1	101,9	94,0*		91,7*	99,9	101,9	98,5	100,5	
		OBS	1015	2451	5483	1984	2027	12960	686	1845	4223	1449	1785	9988



Linear positive trend



Linear negative trend



No trend

* = p<0.05

Genoa province incidence: 1999 - 2003

Umbria region: NDI-U vs. UDI

Overall cancers by age and gender: SIR and cases by deprivation groups

UMBRIA REGION			MEN					WOMEN						
OVERALL CANCERS			Very deprived	Deprived	Not deprived	Rich	Very rich	UMBRIA	Very deprived	Deprived	Not deprived	Rich	Very rich	UMBRIA
NDI-U	All ages	SIR	97,4	97,1*	97,7*	101,6	94,5*	98,2*	102,4	100,3	98,2	97,4*	95,4*	98,6*
		OBS	3431	6822	8421	8293	3694	30661	3000	5562	6904	6444	2919	24829
	0-64 yrs	SIR	95,8	97,4	98,1	104,0	96,8	99,1	103,8	100,9	100,5	95,4*	96,6	99,1
		OBS	930	1892	2387	2456	954	8619	1149	2123	2767	2492	1037	9568
	65+ yrs	SIR	98,1	97,0*	97,5	100,7	93,8*	97,8*	101,5	100,0	96,8*	98,8	94,7*	98,3*
		OBS	2501	4931	6035	5837	2740	22044	1851	3439	4138	3953	1883	15264
UDI	All ages	SIR	93,3*	98,3	99,9	100,2	99,5	98,2*	99,4	101,0	96,3	100,1	95,7*	98,6*
		OBS	6061	6760	6992	5900	4948	30661	5365	5577	5406	4749	3732	24829
	0-64 yrs	SIR	96,0	95,8	101,8	102,7	99,5	99,1	103,5	98,3	97,2	101,2	94,9*	99,1
		OBS	1682	1764	1959	1752	1462	8619	2062	1980	2091	1912	1523	9568
	65+ yrs	SIR	92,3*	99,2	99,2	99,1	99,5	97,8*	96,9	102,6	95,8	99,4	96,2	98,3*
		OBS	4379	4996	5033	4149	3487	22044	3303	3598	3315	2838	2210	15264

Linear positive trend
 Linear negative trend
 No trend
 * = p<0.05

Umbria region incidence: 2001 - 2010

Results -2

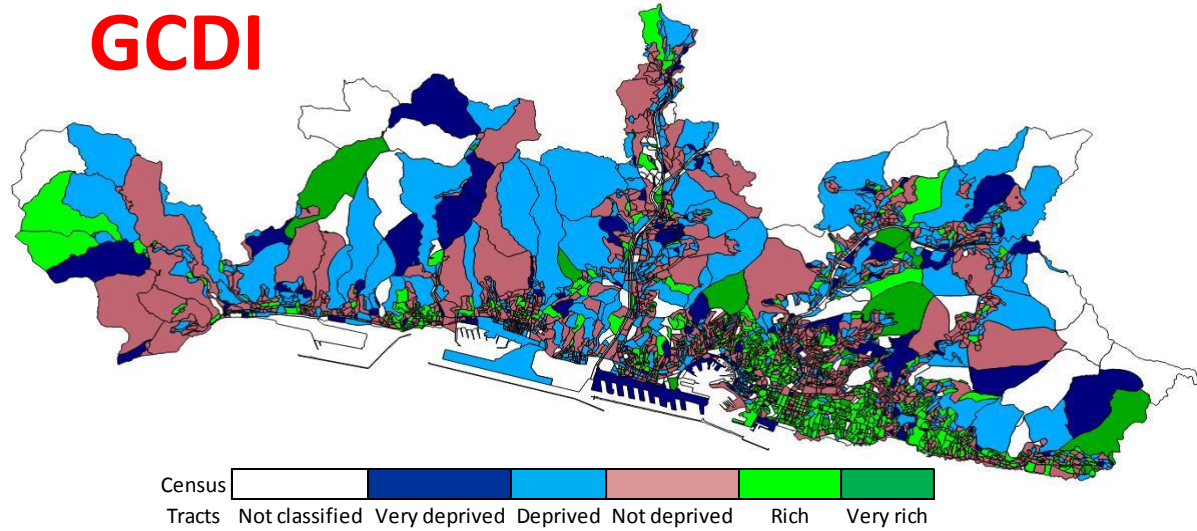
The NDIs and LDIs produced similar results where the populations were more urbanised, stressing the main feature of the NDI as descriptor of the Italian population as a whole, the elevated urbanisation (67% of Italian people were urbanised in 2001).

E.g. this happens when the NDI and the LDI were build at Census Tract (CT) level specifically for Genoa City, after the geo-referring of the 2008-2011 mortality by cause of resident at CT level.

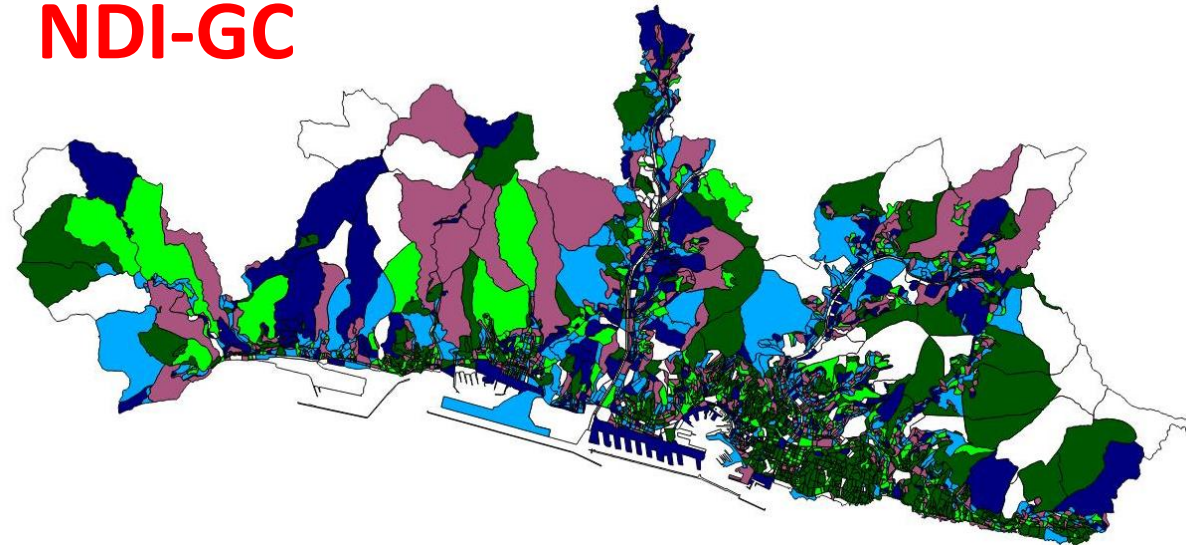
Genoa city by census tracts

Classification of
census tracts by
deprivation
using the GCDI
and the NDI-GC

GCDI



NDI-GC



Genoa city cancer mortality: NDI-GC vs. GCDI

NDI-GC	MALES																			
	Positive trends	No linear trend	All cancers	Oropharynx	Stomach	Liver	Lung	Bladder	Haematological	Leukaemia	Oesophagus	Pancreas	Melanoma	Prostate	Kidney	Brain	NHL	Myeloma		
NDI-GC	Positive trends																			
	No linear trend																			
	Negative trends																			
	No trend																			
GCDI	Positive trends																			
	No linear trend																			
	Negative trends																			
	No trend																			
NDI-GC	Positive trends																			
	No linear trend																			
	Negative trends																			
	No trend																			
GCDI	Positive trends																			
	No linear trend																			
	Negative trends																			
	No trend																			