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Combined analysis of health flow data assessment and local surveillance in industrial areas

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ABSTRACT

Objectives: The approach was based on analysis of hospitalization data and contextual analysis of active health surveillance data, including questionnaires, blood chemistry analysis, spirometry and activation of a biobank.

Methods: Hospitalization risk was calculated for respiratory, cardiovascular and oncological diseases. The health surveillance sample was analyzed by calculating cardiovascular risk, spirometry data and risk perception (questionnaire-based). All data (environmental and clinical) were georeferenced and analyzed using GIS software.

Results: Hospitalization data showed an increase in hospital admissions for respiratory and cardiovascular diseases. However, this may be due to inappropriate admissions to the local facility, which lacks all medical departments but includes cardiology and pulmonology units. The hospitalization data showed a hospital-centered distribution.

Discussion: The study also highlights the importance of considering socio-economic factors in environmental health research. Lower socio-economic status may exacerbate the health effects of pollution, making vulnerable populations more susceptible to adverse outcomes.

Keywords: pollution, study population, data flow, active health surveillance, industrial area

INTRODUCTION

Environmental epidemiology studies aim to assess the effects of environmental factors on human health, including both the physical environment (physical, chemical, and biological agents) and the social environment. Since the 1950s, epidemiology has made a major contribution to understanding the relationship between disease development and environmental factors. In routine practice, all types of observational and experimental epidemiological studies are used in environmental epidemiology, including quasi-experimental and community-level experimental designs. The validity of an epidemiological study depends on the production of accurate estimates of relevant measures, be they frequency measures (e.g., prevalence, rates, risks), association measures (e.g., relative risks, odds ratios) or effect measures (e.g., attributable risks, proportions) [1, 2].

The main challenges in these studies are the estimation of exposure measures (both the study factor and other contributing factors), the selection of subjects, and the measurement of effects and associations. This research aims to define an integrated approach to exposure risk assessment through health data analysis and active health surveillance in populations. The aim is to assess the health status of the study population from both an epidemiological and a clinical/laboratory perspective, integrating population data on environmental risk perception and socio-health factors [3].

METHODS

The aim of the study was to carry out an epidemiological survey to assess the health status of the population living in areas of high anthropogenic pressure (municipalities in the Val d'Agri region and neighboring areas close to the extraction sites) in relation to exposure to the main sources of air pollution. This was achieved by analyzing hospitalization data and considering the nosologically causes related to the pollutants identified in the scientific literature [3-6].

The effects of environmental exposures, adjusted for socioeconomic factors [7], were investigated using a residential cohort approach [8-10]. Among observational studies, this approach is best suited to assess the association between exposure to industrial pollutants and their health effects (morbidity) in an exposed resident population.

The study cohort consisted of all 47,572 residents (as of 2010) in the study municipalities with geo-referenced residential addresses. As suggested by the European Environment Agency [11], individual exposure estimates were based on pollutant dispersion models provided by the local regional authority and the Faculty of Engineering of the University of Basilicata [12, 13]. These models consider atmospheric dispersion mechanisms, including meteorology and terrain orography [14].

Hospital utilization from 2001 to 2019 was assessed in relation to pollution exposure and cohort mortality/morbidity using risk ratios [15]. Factors such as age, sex, socio-economic status and exposure to other pollution sources in the area were considered as potential confounders in the analysis.

Geographic risk mapping of morbidity rates was performed using QGIS software (version 3.16.7) with GRASS 7.8.5. The standardized hospitalization risk (SHR) was calculated according to the methodology proposed in [16], with reference to the municipalities of Val D'Agri.

The period analyzed is from 2002 to 2019. Data for 2020 were not analyzed because of the SARS-CoV-2 pandemic, which could have distorted hospitalization trends, especially for respiratory diseases.

The following data sources were used to calculate the standardized risk of hospitalization in the resident population of the municipalities considered:

1. Hospital discharge data (SDO) from the Basilicata region from 2002 to 2019 related to hospitalizations for respiratory, cardiovascular, and oncological diseases
2. ISTAT (National Institute of Statistics) data on the resident population by municipality from 2002 to 2019
3. ISTAT data on hospitalizations of the Italian population for respiratory, oncological, and cardiovascular diseases from 2002 to 2019, grouped into three categories
4. Demographic data from ISTAT for the Italian population from 2002 to 2019
5. Environmental data from the Regional Environmental Protection Agency of Basilicata

The standardized risk of hospitalization [16] was calculated and determined by estimating the hospitalization rate in the Italian national population for each year:

$$SHR = \frac{Rxy}{Rpxy}, \tag{1}$$

where *SHR* is the standardized hospitalization risk for each municipality and reference year (*x* refers to the year, *y* to the municipality), *Rxy* is the received-recorded hospitalization for each municipality and reference year, and *Rpxy* is the expected hospitalization for each municipality and reference year.

The period analyzed is 2002 to 2019. Data for 2020, although available and accessible, were not analyzed due to the emergence of the SARS-CoV-2 epidemic, which would have made them unreliable, in particular with regard to the use of hospital care for respiratory diseases and the associated variation in the use of care following isolation/confinement measures. The analysis of hospitalization data was carried out on a municipal basis, as the environmental profile assessment did not reveal excessive exposure to individual pollutants or unfavorable air quality index conditions [7]. The social profile of the municipalities studied was assessed on the basis of available ISTAT data, focusing on socio-economic indicators. The data included income levels, education levels and employment rates. These factors were considered in order to understand the context in which the population lives and to account for potential confounding factors that could influence the health outcomes studied.

Statistical analysis was performed using multivariate models to assess the association between exposure to pollutants and health outcomes, using specific software (R-Studio). The models were adjusted for potential confounders, including age, sex, socioeconomic status and other environmental exposures.

Active surveillance on population groups: the study approach of populations potentially exposed to anthropogenic pressure based on active population surveillance has taken place, as highlighted in the literature [17, 18], with the aim of measuring health indicator; a population sample of approximately 700 individuals between the ages of 30 and 70 years was identified; the sample was drawn from the general population and extracted by randomization using criteria of representativeness by age group and location (through use of subsets of municipalities, i.e., through "census sections"). The health surveillance study was approved by the Regional Joint Ethics Committee and the approved informed consent template was administered to participants.

Hematochemical investigations: A panel of blood tests was performed to assess organ functionality, including complete blood count, lipid profile, creatinine, glucose, liver function markers, electrolytes, and inflammatory markers. Some samples were cryopreserved for future biomolecular research.

Cardiovascular risk score calculation: The individual cardiovascular risk score [19, 20] estimated the probability of a major cardiovascular event (myocardial infarction or stroke) within 10 years, based on eight risk factors: sex, age, diabetes, smoking, systolic blood pressure, total cholesterol, HDL cholesterol, and antihypertensive treatment.

Cardiovascular risk score calculation:

(1) invalid if the risk factors have been measured following the standardized methodology

(2) used on women and men aged between 35 and 69 who have not had previous cardiovascular events

(3) cannot be used in pregnant women

(4) exclusion criteria: cannot extremely values of risk factors: systolic blood pressure higher than 200 mmHg or lower than 90 mmHg, total cholesterolemia higher than 320 mg/dl or lower than 130 mg/dl, HDL cholesterolemia lower than 20 mg/dl or higher than 100 mg/dl.

For the purpose of assessing cardiovascular risk, the values of clinical blood sugar and cholesterol tests can be used if performed no more than three months ago.

The frequency of score reassessment is suggested in relation to the risk percentage:

1. Value > 20: High risk (follow-up every six months for people at high cardiovascular risk)
2. Value between 3 and 20: Intermediate risk (follow-up each year for people at risk to be kept under control through the adoption of a healthy lifestyle)
3. Value < 3: Low risk (follow-up every 5 years for people at low cardiovascular risk)

RESULTS

The primary outcome measures were hospital admissions for respiratory, cardiovascular and oncological diseases. Exposure measures were derived from pollutant dispersion models, and health data were obtained from hospital discharge records.

Table 1. HR data for the periods 2002-2010 and 2010-2019 and the level of significance for respiratory diseases

Municipality	Time period					
	2002-2010			2011-2019		
	HR	p	Sign.	HR	p	Sign.
Armento	1.865	0.236	NS	2.849	0.182	NS
Calvello	2.610	7E-05	S	3.874	0.098	NS
Corleto Perticara	2.361	0.054	NS	3.845	4E-12	S
Gallicchio	2.078	0.020	S	2.684	0.122	NS
Grumento Nova	2.375	0.220	NS	2.918	0.082	NS
Guardia Perticara	2.502	0.117	NS	1.983	0.304	NS
Marsico Nuovo	4.701	6E-29	S	4.502	1E-116	S
Marsicovetere	3.402	9E-12	S	3.608	4E-26	S
Missanello	2.233	0.227	NS	3.038	0.089	NS
Moliterno	3.101	2E-05	S	3.302	8E-76	S
Montemurro	2.351	0.107	NS	3.563	0.001	S
Paterno	4.147	4E-20	S	4.560	2E-55	S
Roccanova	2.788	0.001	S	3.493	0.111	NS
San Chirico Raparo	1.510	0.343	NS	2.451	0.095	NS
San Martino d'Agri	1.905	0.074	NS	2.317	0.292	NS
Sant'Arcangelo	2.311	0.077	NS	3.601	7E-15	S
Sarconi	1.096	0.256	NS	1.526	0.322	NS
Spinoso	0.869	0.198	NS	1.861	0.104	NS
Tramutola	3.819	0.003	S	3.818	0.009	S
Viggiano	3.902	5E-39	S	4.102	0.001	S

Note. S: Significant & NS: Not significant

Table 2. HR data for the periods 2002-2010 and 2010-2019 and the level of significance for cardiovascular diseases

Municipality	Time period					
	2002-2010			2011-2019		
	HR	p	Sign.	HR	p	Sign.
Armento	2.545	0.017	S	2.104	0.072	NS
Calvello	2.199	0.001	S	1.983	0.041	S
Corleto Perticara	2.829	3E-07	S	2.558	8E-13	S
Gallicchio	1.570	0.044	S	1.810	0.210	NS
Grumento Nova	2.020	0.004	S	2.555	0.021	S
Guardia Perticara	1.612	0.094	NS	1.274	0.375	NS
Marsico Nuovo	2.991	2E-05	S	4.285	7E-36	S
Marsicovetere	2.570	0.065	NS	3.659	3E-24	S
Missanello	0.866	0.484	NS	1.620	0.148	NS
Moliterno	2.085	0.001	S	3.218	9E-27	S
Montemurro	2.331	0.084	NS	2.116	0.030	S
Paterno	3.600	0.024	S	4.138	2E-11	S
Roccanova	2.045	0.006	S	2.258	0.007	S
San Chirico Raparo	1.384	0.207	NS	1.908	0.037	S
San Martino d'Agri	1.637	0.169	NS	1.719	0.296	NS
Sant'Arcangelo	2.452	0.039	S	3.177	2E-76	S
Sarconi	1.370	0.192	NS	1.351	0.071	NS
Spinoso	1.114	0.296	NS	1.236	0.239	NS
Tramutola	2.373	7E-07	S	3.055	8E-18	S
Viggiano	2.946	6E-21	S	2.996	0.001	S

Note. S: Significant & NS: Not significant

The standardized risks of hospitalization for respiratory diseases (**Table 1**) were significantly higher in Viggiano and Grumento Nova.

A similar pattern was observed for cardiovascular diseases (**Table 2**), while for oncological pathologies (**Table 3**) the data highlight risk measures in line with national averages; statistical significance was calculated with p-value < 0.05.

The annual average concentrations of pollutants were compared with the national legal limits (D.Lgs 155/2010). Concentrations of PM10, PM2.5, NO_2, and SO_2 occasionally exceeded the legal limits, especially in industrial areas [7]. The graphical representation of the risk index calculation showed that, for oncological diseases, the average values in all municipalities were in line with or below the national reference values (**Figure 1**, **Figure 2**, and **Figure 3**) red line–HR value equal to 1, i.e., the number of observed hospitalizations equal to the number of expected hospitalizations.

Table 3. HR data for the periods 2002-2010 and 2010-2019 and the level of significance for oncological diseases

Municipality	Time period					
	2002-2010			2011-2019		
	HR	p	Sign.	HR	p	Sign.
Armento	0.540	0.160	NS	0.511	0.160	NS
Calvello	0.576	0.128	NS	0.887	0.402	NS
Corleto Perticara	0.831	0.264	NS	0.836	0.189	NS
Gallicchio	0.594	0.199	NS	0.388	0.052	NS
Grumento Nova	0.627	0.112	NS	0.574	0.153	NS
Guardia Perticara	0.631	0.210	NS	0.533	0.252	NS
Marsico Nuovo	0.920	0.242	NS	0.913	0.242	NS
Marsicovetere	0.641	0.149	NS	0.768	0.216	NS
Missanello	0.999	0.359	NS	0.686	0.210	NS
Moliterno	1.119	0.155	NS	0.853	0.190	NS
Montemurro	0.566	0.010	S	0.550	0.182	NS
Paterno	0.705	0.186	NS	0.836	0.308	NS
Roccanova	0.586	0.147	NS	0.620	0.203	NS
San Chirico Raparo	0.770	0.345	NS	0.850	0.138	NS
San Martino d'Agri	0.829	0.228	NS	0.710	0.173	NS
Sant'Arcangelo	0.476	0.060	NS	0.742	0.064	NS
Sarconi	0.403	0.042	S	0.623	0.087	NS
Spinoso	0.375	0.010	S	0.587	0.121	NS
Tramutola	0.777	0.191	NS	0.622	0.074	NS
Viggiano	0.630	0.028	S	0.615	0.058	NS

Note. S: Significant & NS: Not significant

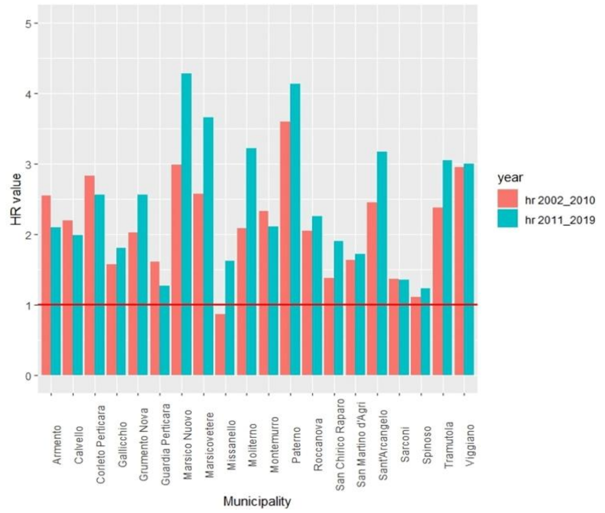

Figure 1. Estimate of HR/cardiovascular diseases periods 2002/2010 and 2011/2019 (Source: Authors' own elaboration)

For respiratory and/or cardiovascular diseases, the indices were generally above the expected values compared to national data. The interpretative analysis based on the appropriateness of hospitalization and the type of territorial hospital facilities was then detailed.

The spatial analysis of the HR estimates (**Figure 4**, **Figure 5**, and **Figure 6**) for respiratory diseases showed (as shown in [**Figure 4**]) an average value (greater than 2–red color) in all the studied populations, except for those living in the municipalities of Sant'Arcangelo, Sarconi and Spinoso (where the HR values were between 1.2 and 2–orange color).

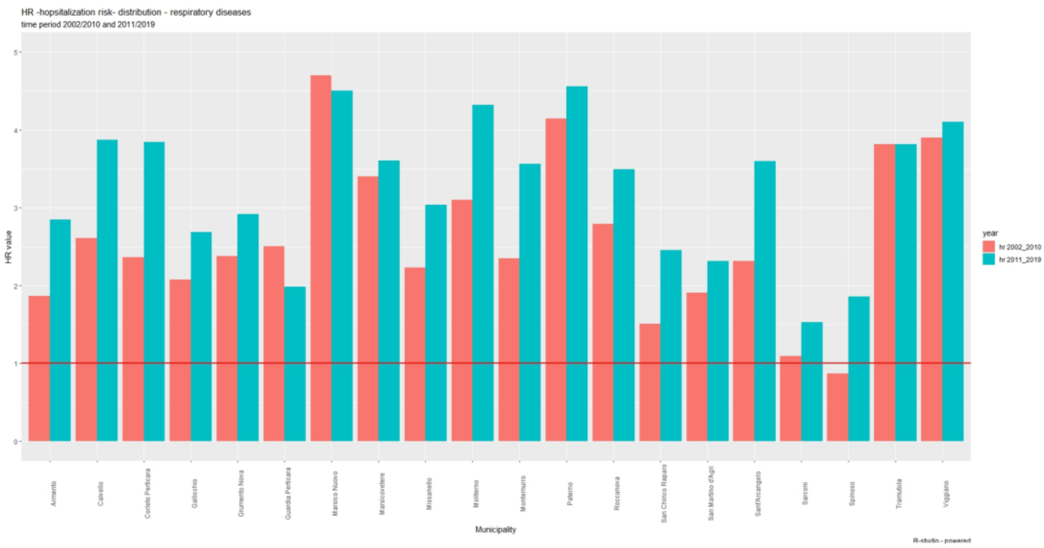

Figure 2. Estimate of HR/respiratory diseases periods 2002/2010 and 2011/2019 (Source: Authors' own elaboration)

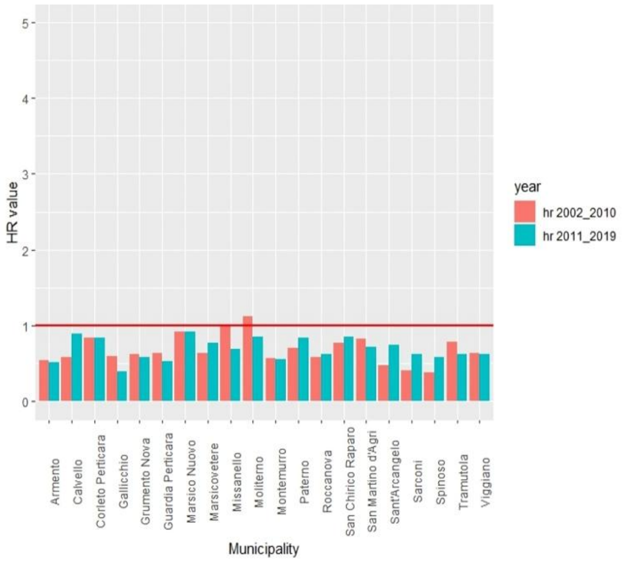

Figure 3. Estimate of HR/oncological diseases periods 2002/2010 and 2011/2019 (Source: Authors' own elaboration)

- Green color: SHR < 1, indicating a lower risk of hospitalization compared to the national benchmark;
- Orange/red color: SHR > 1, indicating a higher risk of hospitalization compared to the national benchmark.
- White color: municipalities where HR is not significantly different from 1 (equal risk of hospitalization compared to the national benchmark).

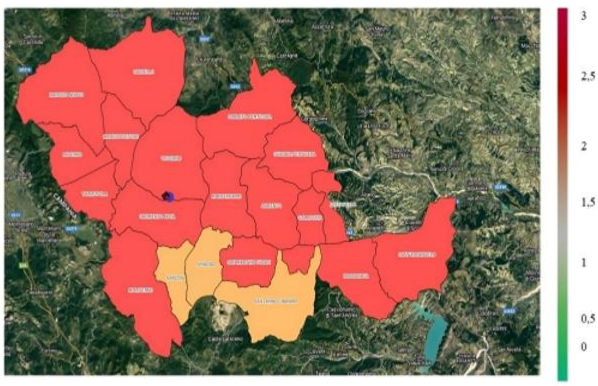

Figure 4. Distribution map of HR (respiratory disease) (Source: Authors' own elaboration)

- Green color: SHR < 1, indicating a lower risk of hospitalization compared to the national benchmark;
- Orange/red color: SHR > 1, indicating a higher risk of hospitalization compared to the national benchmark.
- White color: municipalities where HR is not significantly different from 1 (equal risk of hospitalization compared to the national benchmark).

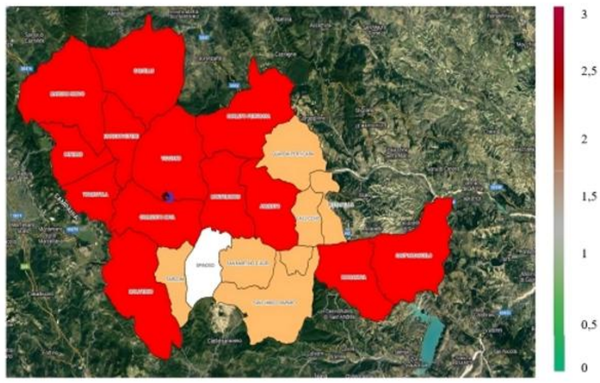

Figure 5. Distribution map of HR (cardiovascular disease) (Source: Authors' own elaboration)

- Green color: SHR < 1, indicating a lower risk of hospitalization compared to the national benchmark;
- Orange/red color: SHR > 1, indicating a higher risk of hospitalization compared to the national benchmark.
- White color: municipalities where HR is not significantly different from 1 (equal risk of hospitalization compared to the national benchmark).

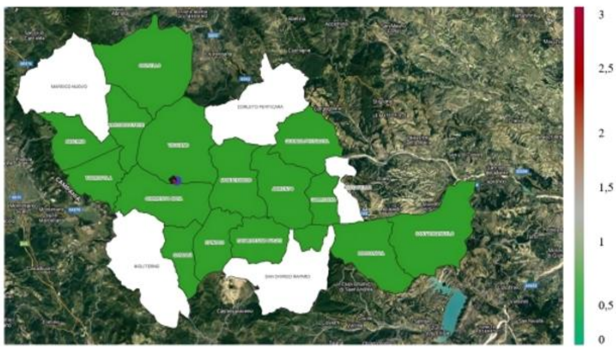

Figure 6. Distribution map of HR (oncological disease) (Source: Authors' own elaboration)

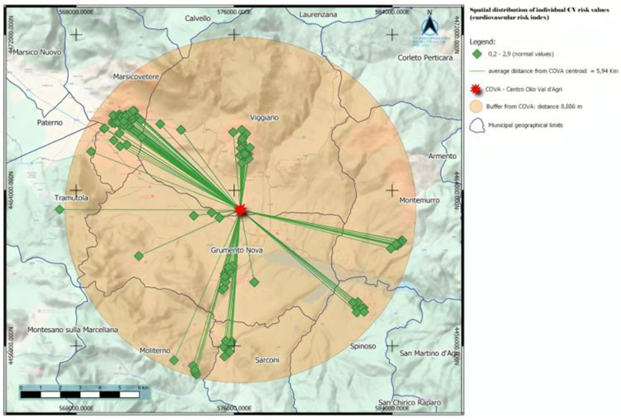

Figure 7. Spatial distribution of individual cardiovascular risk index–normal values (Source: Authors' own elaboration)

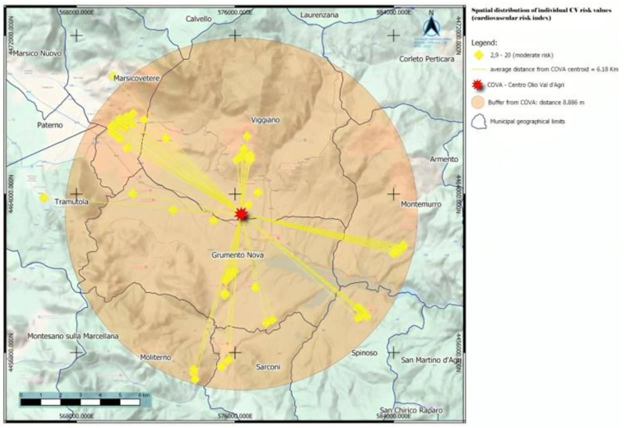

Figure 8. Spatial distribution of individual cardiovascular risk index–moderate risk values (Source: Authors' own elaboration)

It should be noted that the estimated risk of hospitalization is lower in precisely those municipalities, such as Sarconi and Spinoso, where, according to the main pollutant dispersion models, there is the highest risk of fallout/accumulation in terms of air matrix (dominant wind direction south/southeast).

The data analysis showed, in relation to the cohort of subjects enrolled, average values of blood chemistry parameters and cardiovascular risk–CV risk–(calculated according to the criteria established at the national level of the "heart project") that substantially overlapped with the reference values, both on a regional and national basis. The next level of analysis was to evaluate the data calculated for each individual in the cohort of subjects enrolled in the study according to the geo-referencing criteria. The criterion used was the place of residence provided by the municipal authorities during the initial phase of the project and confirmed during the recruitment phase by means of a specific questionnaire; the spatial analysis did not reveal any concentrations of people with a medium/high risk type, confirming an even distribution throughout the territory (distribution partly influenced by low population density in rural areas and concentration in the few urban areas) (**Figure 7**, **Figure 8**, and **Figure 9**).

Appendix A shows the distribution of mean values, standard deviations and confidence interval (CI) of hematochemical tests (parameters calculating cardiovascular risk) for male female samples.

DISCUSSION

This study highlights the importance of considering socio-economic factors in environmental health research. Lower socio-economic status can exacerbate pollution-related health effects and increase vulnerability to adverse outcomes.

The integrated risk assessment approach provides a comprehensive understanding of the health effects of environmental exposures. By combining environmental data with health surveillance and socio-economic analysis, the study provides valuable insights for policy makers and public health officials. Future research should focus on long-term health monitoring and the implementation of effective pollution control measures. The data highlighted the possibility that analysis of current health care flows may be affected by data bias due to inappropriate hospitalizations/coding.

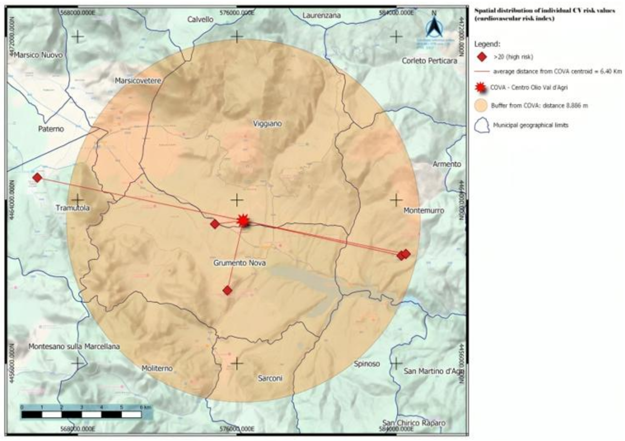

Figure 9. Spatial distribution of individual cardiovascular risk index–high risk values (Source: Authors' own elaboration)

CONCLUSIONS

Data analysis and interpretation highlighted potential limitations of the study, which are summarized below:

1. The epidemiological study did not account for individual risk factors such as occupational exposure and smoking, which could influence the observed health outcomes.
2. Socio-economic deprivation indices, known to be predictive of lifestyle habits, were considered, but individual behavioral data were not collected.
3. Coding errors in hospital discharge records could not be systematically verified.

These limitations suggest the need for continued epidemiological surveillance, in-depth investigations, and the development of tools to ensure the health protection of populations in this region and beyond.

Future Developments

Based on the results and discussion arisen in the present work, further development will be addressed to implement systematic auditing of hospital discharge coding, with greater emphasis on admission appropriateness and expand digital data collection methods (online questionnaires, mobile platforms) to improve participation and compliance, in order to better enhance the "appropriateness of hospitalization".

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AI statement: The authors stated that no generative AI or AI-based tools were used in any part of the study, including data analysis, writing, or editing.

Declaration of interest: No conflict of interest is declared by the authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

REFERENCES

1. Comba P, Bianchi F, Iavarone I, Piratsu R. Impatto sulla salute dei siti inquinati: Metodi e strumenti per la ricerca e le valutazioni [Health impacts of polluted sites: Methods and tools for research and ISTISAN; 2000. Available at: https://www.iss.it/documents/20126/45616/07-50.1204799444.pdf/27301283-e0b1-e741-25396f7eb1349852?t=1581098476498 (Accessed: 18 March 2025).
2. Ivaldi C, Carnà P, Romeo D. Studio di coorte storica sullo stato di salute dei residenti nel Comune di Saluggia sede di un sito nucleare [Historical cohort study on the health status of residents in the Municipality of Saluggia, home to a nuclear site]. ARPA Piemonte; 2020. Available at: https://www.regione.piemonte.it/web/sites/default/files/media/documenti/2020-10/2015-Rapporto%20stato%20di%20salute%20comuni%20nucleari.pdf (Accessed: 18 March 2025).
3. Burns A, Shin JM, Unice KM, et al. Combined analysis of job and task benzene air exposures among workers at four US refinery operations. Toxicol Ind Health. 2017;33(3):193-210. https://doi.org/10.1177/0748233715619072 PMid:26862134 PMCid:PMC5477978
4. Hayes RB, Lim C, Zhang Y, et al. PM2.5 air pollution and cause-specific cardiovascular disease mortality. Int J Epidemiol. 2020;49(1):25-35. https://doi.org/10.1093/ije/dyz114 PMid:31289812 PMCid:PMC7124502
5. Powers M, Saberi P, Pepino R, Strupp E, Bugos E, Cannuscio C. Popular epidemiology and "fracking": citizens' concerns regarding the economic, environmental, health and social impacts of unconventional natural gas drilling operations. J Community Health. 2015;40(3):534-41. https://doi.org/10.1007/s10900-014-9968-x PMid:25392053
6. Edokpolo B, Yu QJ, Connell D. Health risk assessment for exposure to benzene in petroleum refinery environments. Int J Environ Res Public Health. 2015;12(1):595-610. https://doi.org/10.3390/ijerph120100595 PMid:25588154 PMCid:PMC4306881
7. Negrone M, Greco M, Serio C, et al. Integrated approach for the assessment of real risk of population exposure in industrial areas. Eur J Med Health Res. 2024;2(5):58-66. https://doi.org/10.59324/ejmhr.2024.2(5).06
8. Minichilli F, Bianchi F, Ancona C, et al. [Residential cohort study on mortality and hospitalization in Viggiano and Grumento Nova municipalities in the framework of HIA in Val d'Agri (Basilicata Region, Southern Italy)]. Epidemiol Prev. 2018;42(1):20-33.
9. Fano V, Michelozzi P, Ancona C, Capon A, Forastiere F, Perucci CA. Indagine epidemiologica presso la popolazione residente a Falconara Marittima e comuni limitrofi [Epidemiological survey among the population living in Falconara Marittima and surrounding municipalities]. Occup Environ Med. 2004;61:757-63. https://doi.org/10.1136/oem.2003.010728 PMid:15317916 PMCid:PMC1763676
10. Biggeri A, Lagazio C, Catelan D, Pirastu R, Casson F, Terracini B. [Report on health status of residents in areas with industrial, mining or military sites in Sardinia, Italy]. Epidemiol Prev. 2006;30(1 Suppl 1):5-95.
11. European Environment Agency. Air quality in Europe. EEA; 2020. Available at: https://www.eea.europa.eu/en/analysis/publications/air-quality-in-europe-2020-report (Accessed: 18 March 2025).
12. Cerosimo A, Derio C, Masiello G. TROPOMI NO_2 tropospheric column data: Regridding to 1 km grid-resolution and assessment of their consistency with in situ surface observations. Remote Sens. 2020;12(14):2212. https://doi.org/10.3390/rs12142212
13. Serio C, Masiello G, Cerosimo A. NO_2 pollution over selected cities in the Po Valley in 2018-2021 and its possible effects on boosting COVID-19 deaths. Heliyon. 2022;8(8):e09978. https://doi.org/10.1016/j.heliyon.2022.e09978 PMid:35873538 PMCid:PMC9297682
14. Priti K, Prashant K. A critical evaluation of air quality index models. Environ Monit Assess. 2022;194(4):324.
15. Accordo di Collaborazione ISS–Regione Basilicata Contributo dell'Ufficio di Statistica dell'ISS. La descrizione del profilo di salute delle popolazioni della Val d'Agri attraverso lo studio dei dati sanitari correnti [Describing the health profile of the Val d'Agri population through the study of current health data]. Available at: https://www.scienzainrete.it/files/rapporto_iss_regione_basilicata_0.pdf 04-02-2025 (Accessed: 18 March 2025).
16. Duggento A, Toschi N, Pietroiusti A, et al. A novel approach for geographical risk mapping of morbidity and mortality rates: The case of Val D'Agri, Italy. Sci Rep. 2019;9:10348. https://doi.org/10.1038/s41598-019-46479-z PMid:31316084 PMCid:PMC6637145
17. Eyayo F. Evaluation of occupational health hazards among oil industry workers: A case study of refinery workers. IOSR J Environ Sci Toxicol Food Technol. 2014;8(12):22-53. https://doi.org/10.9790/2402-081212253
18. Miller M, Newby DE. Air pollution and cardiovascular disease: Car sick. Cardiovasc Res. 2020;116:279-94. https://doi.org/10.1093/cvr/cvz228 PMid:31583404
19. ISS. Methodology for measuring risk factors. ISS; 2025. Available at: https://www.cuore.iss.it/valutazione/METOD-PRESS (Accessed: 18 March 2025).
20. Donfrancesco C, Di Lonardo A, Lo Noce C, et al. Trends of blood pressure, raised blood pressure, hypertension and its control among Italian adults: CUORE Project cross-sectional health examination surveys 1998/2008/2018. BMJ Open. 2022;12(11):e064270. https://doi.org/10.1136/bmjopen-2022-064270 PMid:36375969 PMCid:PMC9664280

APPENDIX A

Table A1. Distribution of Ms, SDs, and CI of hematochemical tests (parameters calculating cardiovascular risk)–Female sample

	Data val d'Agri			Data Basilicata Region heart project			Data Italy heart project		
	M	**SD**	**95% CI**	**M**	**SD**	**95% CI**	**M**	**SD**	**95% CI**
PA systolic (mmhg)	120.94	16.93	118.87-21.4	127.1	17.7	123.5-130.7	127.8	19.5	127.2-128.4
PA diastolic (mmhg)	75.98	13.46	74.34-77.62	74.5	9.3	72.6-76.4	79.1	9.7	78.8-79.4
Total cholesterolemia (mg/dl)	191.34	36.55	186.89-190.4	226.1	44.0	217.2-235.1	218.3	43.6	216.9-219.7
HDL cholesterolemia (mg/dl)	62.39	14.05	60.68-61.78	59.5	14.2	56.6-62.4	62.2	14.9	61.7-6 2.7
Triglyceridemia mg/dl	98.64	47.45	92.85-94.89	121.0	61.4	108.5-133.5	106.7	55.4	105.0-108.4
LDL cholesterolemia (mg/dl)	125.32	34.54	121.11-123.99	142.4	37.2	134.9-150	134.9	37.6	133.7-136.1
Blood glucose (mg/dl)	92.75	24.44	90.03-90.14	103.1	23.7	98.2-108.1	94.7	23.1	93.9-95.4
Height (cm)	159.98	6.08	159.24-159.92	153.8	6.9	152.4-155.2	157.7	6.8	157.5-158
Weight (kg)	68.38	1.3	66.76-67.35	69.0	13.7	66.2-71.8	67.4	13.4	67.0-67.8
Waist circumference (cm)	94.8	14.05	93.09-94.43	29.2	5.7	28.1-30.4	27.2	5.6	27-27.3
Smoking	10.35	6.73	8.64-10.14	88.1	13.1	85.5-90.8	87.0	13.4	86.6-87.5
BMI	25.84	3.72	25.36-25.75	10.5	4.5	8.5-12.4	11.6	7.1	11.1-12.1
Cardiovascular risk	3.94	4.19	3.39-3.42				2.5	3.3	2.4-2.6

Table A2. Distribution of Ms, SDs, and CI of hematochemical tests (parameters calculating cardiovascular risk)–Male sample

	Data val d'Agri			Data Basilicata Region heart project			Data Italy heart project		
	M	**SD**	**95% CI**	**M**	**SD**	**95% CI**	**M**	**SD**	**95% CI**
PA systolic (mmhg)	123.76	16.46	121.74-124.54	134.8	16.7	131.5- 138.1	133.2	17.3	132.7-133.7
PA diastolic (mmhg)	78.94	14.84	77.12-77.25	81.2	10.0	79.3-83.2	84.2	10.1	83.9-84.5
Total cholesterolemia (mg/dl)	190.4	36.67	185.9-19.78	222.2	42.5	213.9-230.4	210.7	43.3	209.3-212 1
HDL cholesterolemia (mg/dl)	51.9	12.62	50.36-51.28	49.0	12.2	46.6-51.4	50.9	12.6	50.5-51.3
Triglyceridemia mg/dl	130.97	90.94	119.82-120.6	155.3	89.1	138.0-149.9	136.6	84.9	134.0-139.3
LDL cholesterolemia (mg/dl)	129.71	32.85	125.68-129.97	142.5	37.8	135.0-149.9	132.9	37.5	131.7-134.1
Blood glucose (mg/dl)	100.63	22.11	98.07-98.07	107.8	22.8	103.2-112.4	102.2	24.3	101.5-171.5
Height (cm)	172.67	6.97	171.82-172.58	167.1	6.6	165.8-168.4	171.3	7.5	171.1-181.8
Weight (kg)	83.27	14.48	81.49-82.68	81.9	14.3	79.1-84.7	81.4	13.5	81.0-81.8
Waist circumference (cm)	101.63	11.28	100.25-101.69	29.3	4.5	28.4-30.2	27.7	4.2	27.6-27.9
Smoking	15.76	7.71	14-15.89	97.7	11.9	95.3-100	96.8	11.5	96.4-97.1
BMI	27.45	3.56	26.97-27.43	14.5	5.4	12.2-16.8	16.3	9.1	15.7-16.9
Cardiovascular risk	3.87	5.22	3.17-3.13				7.5	7.8	7.2-7.8