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Exploration study on mortality trends in the territory surrounding an incineration plant of urban solid waste in the municipality of Vercelli (Piedmont, Italy) 1988-2009

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Key word: Incinerator, cancer, environmental risk, Vercelli
Parole chiave: Inceneritore, cancro, rischio ambientale, Vercelli

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Abstract

Background: *The places, where the incinerators are located, often present problems of heterogeneous people having different environmental factors. It becomes important to evaluate the possible etiologic role of various environmental risk factors and try to quantify as they affect in the excess epidemiological*
Methods: *This study considers the ISTAT index mortality due to all causes occurred from 1988 to 2009 referred to ten municipalities at south of Vercelli (Piedmont, North Western Italy) placed nearby the active incinerator from 1977 (10 latent years). The risks were calculated considering this area at risk versus the municipalities placed at North of Vercelli and versus the Vercelli.*
Results: *Some significant statically excesses emerged in the South area such as neoplasia of nervous system, liver and total of tumours.*
Conclusions: *The study presents some drawbacks, but it is a work creditable of widening by specific research ad hoc such as cohort and/or control where it is possible to verify various environmental, occupational and occasional factors.*

Introduction

The areas interested by the presence of incinerators are often heterogeneous and complex realities, characterized by the presence of other industrial activities, agricultural and commercial activities as well as residential settlements (1-6).

The contamination factors derive from a wide variety of activities and have multiple consequences on the environment and the population living and working in these areas (7-12).

Besides, the consequences on health are mediated by social and economic factors (13), which add complexity and make it

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difficult to understand and describe how health and quality of life are affected.

Environmental pressure factors, which are usually associated to the presence of incinerators, can be summarised in the management and transport of waste products and in the presence of other industrial, agricultural and commercial activities, and residential settlements (7-9,14-16). All these factors can entail, in a very variable way, strong environmental pressures and important risk factors, such as, for example, the emission of Dioxin (17-21) with multiple exposures (22). The concerns about the effects on health of the polluters in the environment surrounding incinerators is growing. Many epidemiological studies, which have been performed to assess the impact on health of waste incineration plants, gave heterogeneous results (23).

Therefore, this complex scenario entails a delicate communication problem and underlines the need to apply effective interventions. (24-27)

The aim of this paper consists in investigating the presence of potential health risk factors for the population residing in the city of Vercelli, a North-western Italian city. Very close to the city, an incineration plant for urban solid waste has been operating since 1977. In the near-by area, there are also other plants with strong environmental impact, producing chemical substances, which have been operational since the early 80s.

This study is based on ISTAT municipal mortality for cancer and general pathologies in the period 1988-2009, involving 10 municipalities neighbouring the plant compared with 8 municipalities to the North of the chief town (Zone A); these territories are compared with each other and with Vercelli, the chief town (Zone C). The study makes the hypothesis of a local impact of the emissions (3, 28-34) potentially dangerous, net of long-term trends related to improvements in the nosography definition and the diagnostic survey techniques.

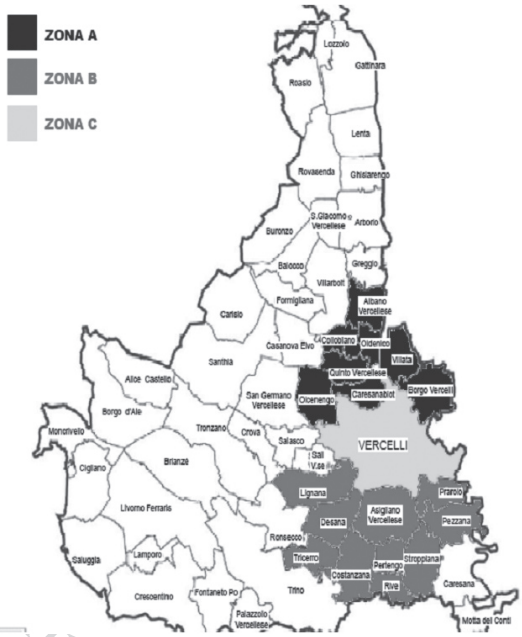

Figure 1 - Study area

As many studies () show a correlation between the distance from the emission source and the frequency of pathologies, we further divided Zone B and compared the number of cases in the municipalities that lie within 9 km from the incineration plant with the farthest ones (Figure 1).

Materials and methods

The populations living in the municipalities included in this research have been obtained from the Evolutionary Demographic Database of Piedmont (35) grouped as follows:

Zone B, which includes 10 municipalities for a total of 8682 inhabitants (4184 men and 4498 women); it stretches for a maximum distance of 15 km from the industrial area.

Zone A, which includes 8 municipalities for an average population of 7018 inhabitants (3474 men and 3544 women); it stretches

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for a maximum distance of 21 km from the reference zone.

Zone C, which is the metropolitan area of the main city, Vercelli that has a population 46979 inhabitant (22,248 men and 24,731 women) with an extension of about 80 km^2.

Data on mortality were obtained from the Regional Database on Mortality (36) and, for oncological pathologies for year 2001-2009 by the RENCAM of the Local Health Authority of Vercelli. To exclude prevalent cases, since the incinerator plant was activated in the 1977, the following latencies were taken into account (7-9, 14-16, 37): (i) ten years for tumours (from 1988 to 2009); (ii) 5 years for leukaemia (from 1983 to 2009); fifteen years for non-oncological pathologies (from 1992 to 2003). Considering the high number of tests performed and the risk of committing a type I error, correction is provided in accordance with the method of Holm for multiple testing.

The analysis was obtained by computing relative risks of mortality, comparing the number of deaths for the different pathologies in Zone B (potentially exposed zone) with those observed in Zones A and C (not exposed), related to the number of inhabitants. P-values were adjusted for multiple comparison using the Holm method.

Results

Figure 2 (see attachments) shows how the most important environmental and/or industrial forcing factors (referred to 1991) are mainly situated inside the Zone A and, obviously, in the main town (Zone C). The plains in Vercelli lowland are a mainly agricultural area of Piedmont, and in particular, the agricultural areas being studied (Zone A and Zone B) are characterised by rice cultivation, which suggests a homogeneous use of pesticides and a similar presence of active agricultural population. Lastly, figure 3 (attached) shoes the industrial activities neighbouring the administrative borders of the Province of Vercelli: no particular problems caused by industry plants of other cities can be found in the 3 areas being studied. Finally, we also took into account the presence of nursing homes in the municipalities included in the analysis; they are evenly distributed among the 3 areas, with similar number of beds.

Another data to be taken into account, although surrogate, obtained from ARPA (38) Piedmont, is that during the solar year, winds blow mainly from North to South-South-east/west for 2/3 of the year (6, 18, 39), which suggests a possible higher exposure to factory fumes for the municipalities in Zone B and in Vercelli's neighbourhoods that are closer to the industrial area.

In table 1-2, we reported the epidemiological data for oncological and general pathologies, with the related risks of mortality with the relevant level of statistical significance.

Discussion

As far as lung neoplasia are concerned, we found a prevalence of significant excesses for countryside zones (B and A), both in the total of sexes and for men towards the main city, Vercelli. The same consideration applies to brain neoplasia, even if in this case, the higher number of significant excesses recorded for the total observed cases is encountered in women; nevertheless, we must consider that, for this pathology, also non statistically relevant RMs show values that highlight a higher risk for rural zones, compared with the metropolitan area.

As regards leukaemia, significant excesses are only observed in women in countryside zones, whereas analysing the total data for this neoplasia a higher risk for the inhabitants of Vercelli seems present, maybe induced by

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Table 1 - Risks of mortality, total and by sex, divided for for oncological diseases. Letters A, B and C refer to the different zones.

Neoplasm	Sex	OBS south belt	OBS north belt	OBS Vercelli	South vs north	P-value	VC vs south	P-value	VC vs north	P-value
Lung	M+F	178	105	848	1,33	0,052	0,82	0,048	1,08	0,47
	M	153	68	686	1,80	0,0003*	0,78	0,007	1,41	0,0003*
	F	25	37	162	0,52	0,02	1,09	0,75	0,57	0,006*
Nervous system	M+F	26	12	101	**1,70**	**0,34**	**0,67**	**0,24**	1,13	0,80
	M	12	7	53	1,37	0,99	0,77	0,99	1,06	0,99
	F	14	5	48	**2,15**	**0,40**	**0,58**	**0,30**	1,24	0,80
Colon-rectum	M+F	91	72	533	0,99	0,99	1,00	0,99	0,99	0,99
	M	54	43	283	1,00	0,99	0,99	0,99	0,92	0,99
	F	37	29	250	0,98	0,99	1,14	0,99	1,12	0,99
Leukaemia	M+F	37	21	141	1,38	0,58	0,65	0,06	0,90	0,74
1983-2009	M	14	11	72	1,02	0,99	0,90	0,99	0,91	0,99
	F	23	10	69	1,76	0,36	0,51	0,0003*	0,89	0,87
Lymphonodes	M+F	24	8	127	2,35	0,12	0,91	0,74	2,13	0,12
	M	11	2	62	**4,40**	**0,12**	0,98	0,91	4,32	0,12
	F	13	6	65	1,66	0,99	0,84	0,99	1,40	0,99
All tumours	M+F	791	508	3136	1,22	0,0009*	0,68	0,0003*	0,83	0,0004*
	M	473	301	2119	1,26	0,006*	0,78	0,0003*	0,98	0,79
	F	318	207	1017	**1,18**	**0,08**	0,54	0,0003*	0,64	0,0003*
Liver/V.B.	M+F	70	27	244	2,03	0,004*	0,60	0,0006*	1,21	0,39
	M	38	17	130	**1,79**	**0,12**	0,60	0,02	1,07	0,90
	F	32	10	114	2,45	0,03	0,60	0,03	1,48	0,29
Myeloma	M+F	11	10	60	0,86	0,99	0,94	0,99	0,81	0,99
	M	8	7	29	0,91	0,93	0,63	0,84	0,58	0,84
	F	3	3	31	0,77	0,99	1,75	0,99	1,34	0,99
Stomach	M+F	27	33	214	0,64	0,33	1,36	0,33	0,87	0,52
	M	19	22	122	0,69	0,90	1,12	0,90	0,77	0,90
	F	8	11	92	0,56	0,58	**1,94**	**0,27**	1,09	0,92

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Neoplasm	Sex	OBS south belt	OBS north belt	OBS Vercelli	South vs north	P-value	VC vs south	P-value	VC vs north	P-value
Bladder	Total by sex	28	14	127	1,57	066	0,78	0,66	1,22	0,66
	M	21	12	89	1,40	0,88	0,74	0,78	1,03	0,96
	F	7	2	38	**2,68**	**0,90**	0,92	0,98	2,46	0,90
Kidney	M+F	17	12	78	1,11	0,99	0,79	0,99	0,87	0,99
	M	11	6	52	1,47	0,99	0,82	0,99	1,21	0,99
	F	6	6	26	0,77	0.99	0,73	0,99	0,56	0,93
00-44aa(tumour)	M+F	20	15	94	1,10	0,99	0,76	0,93	0,83	0,99
00-44(all causes)	M+F	46	31	243	1,22	0,99	0,85	0,99	1,04	0,99
Breast	--	57	48	265	0,91	0,70	0,79	0,22	0,71	0,12
Uterus	--	15	8	91	1,44	0,99	1,02	0,99	1,47	0,99
Ovary	--	17	13	62	1,00	0,85	**0,62**	**0,10**	**0,62**	**0,15**
Larynx	M+F	16	6	55	2,09	0,34	**0,59**	**0,24**	1,23	0,77
	M	15	6	49	2,00	0,42	**0,57**	**0,21**	1,14	0,92
	F	1	Nn	6	---	---	1,01	0,59	---	---
Pleura	M+F	8	7	39	0,89	0,99	0,84	0,99	0,75	0,99
	M	3	7	20	0,34	0,38	1,16	0,95	**0,40**	**0,18**
	F	5	Nn	19	---	---	0,64	0,54	---	---

Table 2 - Risks of mortality, total and by sex, divided for chronic diseases. Letters A, B and C refer to the different zones.

Non tumoural patologies										
Patology	Sex	OBS south belt	OBS north belt	OBS Vercelli	Sud vs Nord	P-value	VC vs Sud	P-value	VC vs Nord	P-value
Malformations	Total by sex	5	4	36	0,98	0,99	1,23	0,99	1,21	0,99
	M	Nn	3	17	---	---	---	---	0,79	0,97
	F	5	1	19	3,83	0,99	0,64	0,99	2,42	0,99
Respiratory system	Total by sex	99	89	559	0,87	0,99	0,97	0,99	0,94	0,99
	M	61	52	290	0,94	0,81	0,83	0,40	0,78	0,33
	F	38	37	269	0,79	0,99	1,20	0,99	0,94	0,99
Metabolic illness	Total by sex	42	28	207	1,17	0,99	0,84	0,99	0,99	0,99
	M	12	9	85	1,07	0,99	1,23	0,99	1,32	0,99
	F	30	19	122	1,21	0,99	0,69	0,24	0,83	0,99
All causes	Total by sex	1606	1197	7526	1,05	0,24	0,80	0,0003*	0,84	0,0003*
	M	771	512	3653	1,21	0,0056*	0,83	0,0003*	0,99	0,93
	F	835	685	3873	0,93	0,24	0,78	0,0003*	0,73	0,0003*
Diabetes	M+F	35	22	160	1,25	0,99	0,78	0,66	0,98	0,99
	M	9	6	62	1,20	0,99	1,20	0,99	1,44	0,99
	F	26	16	98	1,25	0,94	0,64	0,15	0,79	0,94
Cardio-vascular illness	Total by sex	732	557	3377	1,03	0,64	0,79	0,0003*	0,81	0,0003*
	M	309	196	1462	1,96	0,02	0,82	0,009*	1,04	0,64
	F	423	361	1915	0,90	0,16	0,76	0,0003*	0,69	0,0003*
Ischaemic illness	Total by sex	169	141	1159	0,94	0,62	1,18	0,15	1,10	0,58
	M	89	64	574	1,11	0,66	1,12	0,66	1,25	0,30
	F	80	77	585	0,80	0,36	1,24	0,24	0,98	0,94
Cronical respiratory illness	Total by sex	37	30	238	0,97	0,99	1,10	0,99	1,06	0,99
	M	25	22	137	0,91	0,99	0,95	0,99	0,87	0,99
	F	12	8	101	1,15	0,93	1,42	0,69	1,63	0,69
Genito-urinary illness	Total by sex	23	17	120	1,06	0,99	0,89	0,99	0,95	0,99
	M	12	5	65	1,92	0,78	0,94	0,98	1,81	0,78
	F	11	12	55	0,70	0,99	0,84	0,99	0,59	0,42

P-value: (Fisher Test)

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Table 3 - Analysis of semiurban vs rural belts and vs Vercelli- oncological diseases

Neoplasia	Sex	OBS semiur-ban belt	OBS rural belt	OBS Vercelli	>10 km vs <10 km	P-value	>10 km vs VC	P-value	<10 Km vs VC	P-value:
Lung	Total by sex	85	93	848	0,98	0,94	1,21	0,20	1,24	0,18
	M	70	83	686	0,92	0,66	1,22	0,26	1,33	0,03
	F	15	10	162	1,58	0,99	1,13	0,99	0,71	0,99
Nervous	Total by sex	10	16	101	0,67	0,84	1,20	0,84	1,79	0,12
	M	6	6	53	1,09	0,99	1,35	0,99	1,24	0,99
	F	4	10	48	0,42	0,42	1,02	0,81	2,81	0,03
Colon-rectum	Total by sex	55	36	533	1,64	0,06	1,25	0,26	0,76	0,26
	M	22	32	283	0,75	0,87	0,93	0,87	1,24	0,87
	F	17	20	250	0,90	0,99	0,83	0,99	0,93	0,99
Lynphoma	Total by sex	13	11	127	1,27	0,99	1,24	0,99	0,98	0,99
	M	9	2	62	4,90	0,15	1,74	0,36	0,35	0,36
	F	4	9	65	0,47	0,78	0,75	0,78	1,60	0,78
Liver+bile duct	Total by sex	34	36	244	1,01	0,94	1,68	0,015*	1,66	0,015*
	M	18	20	130	0,98	0,91	1,66	0,12	1,69	0,12
	F	16	16	114	1,05	0,97	1,71	0,18	1,62	0,18
Leukaemia	Total by sex	17	20	127	0,97	0,24	1,55	0,24	1,60	0,18
	M	5	9	72	0,64	0,99	0,79	0,99	1,24	0,99
	F	12	11	69	1,24	0,76	2,03	0,09	1,65	0,34
Estomach	Total by sex	12	15	214	0,86	0,88	0,68	0,69	0,79	0,88
	M	8	11	122	0,79	0,99	0,78	0,99	0,99	0,99
	F	4	4	92	1,05	0,78	0,53	0,69	0,50	0,69
Bladder	Total by sex	9	19	127	0,51	0,24	0,86	0,77	1,69	0,12
	M	8	13	89	0,67	0,99	1,07	0,99	1,60	0,45
	F	1	6	38	0,18	0,42	0,32	0,52	1,83	0,52
Kidney	Total by sex	9	8	78	1,21	0,99	1,39	0,99	1,16	0,99
	M	6	5	52	1,31	0,99	1,38	0,99	1,06	0,99
	F	3	3	26	1,05	0,99	1,41	0,99	1,33	0,99
All tumours	Total by sex	355	436	3136	0,87	0,07	1,37	0,0003*	1,57	0,0003*
	M	210	263	2119	0,87	0,16	1,18	0,04	1,36	0,0003*
	F	145	173	1017	0,88	0,31	1,74	0,0003*	1,97	0,0003*

Residents = semi-urban belt = 3968 inhabitants (1899 male-2069 female); Rural belt = 4251 inhabitants (2069 male – 2182 female)

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Table 4 - Analysis of semiurban vs rural belts and vs Vercelli- chronic diseases

Non tumoural patologies										
Neoplasia	Sex	OBS semi-urban belt	OBS rural belt	OBS Vercelli	>10 km vs <10 km	P-value	>10 km vs VC	P-value	<10 km vs VC	P-value
	M	---	---	---	---	---	---	---	---	---
	F	4	1	19	**4,22**	**0,68**	**2,57**	**0.48**	0,61	0.94
Respiratory sistem illness	Total by sex	55	44	559	1,34	0.54	1,19	0.54	0,89	0.54
	M	32	29	290	1,20	0.99	1,32	0.48	1,10	0.99
	F	23	15	269	1,62	0.38	1,04	0,93	**0,65**	**0.36**
Cronical pulmonary illness	Total by sex	15	22	238	0,73	0.99	0,76	0.99	1,04	0.99
	M	12	13	137	1,01	0.99	1,05	0,99	1,04	0,99
	F	3	9	101	0,35	0.34	**0,36**	**0.30**	1,03	0,92
Genito-urinary illness	Total by sex	12	11	120	1,17	0.99	1,21	0.99	1,03	0.99
	M	5	7	65	0,78	0.99	0,92	0.99	1,18	0.99
	F	6	5	55	1,27	0,99	1,33	0.99	1,05	0.99
Ischemia illness	Total by sex	81	88	1159	0,99	0.99	0,84	0.48	0,86	0.48
	M	43	46	574	1,02	0.99	0,90	0.99	0,88	0.99
	F	38	42	585	0,95	0.92	0,79	0.57	0,83	0.57
Cardio-vascular illness	Total by sex	359	373	3377	1,03	0.72	1,28	0.0003	1,25	0.0003
	M	146	163	1462	0,98	0.88	**1,19**	**0.10**	1,22	0.06
	F	227	196	1915	**1,22**	**0.06**	1,45	0.0003	1,18	0.06
Diabetes	Total by sex	13	22	160	0,63	0.50	0,98	0.93	**1,55**	**0.21**
	M	4	5	62	0,87	0.99	0,77	0.99	0,88	0.99
	F	18	8	98	**2,37**	**0.10**	2,24	0.006	0,94	0,98
All causes	Total by sex	760	846	7526	0,96	0,50	1,22	0.0003	1,27	0.0003
	M	368	403	3653	0,99	0,97	1,20	0.004	1,21	0.0027
	F	392	443	3873	0,93	0,38	1,23	0.0006	1,32	0.0003

Legend:
With asterisk= significant to 99%
yellow = significant to al 95%
in bold= to comment interesting because epidemiologically
--- = no case observed

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the higher vehicle pollution that characterises a city compared with the countryside. As regards NH lymphomas, that many researches (5, 9, 17, 40-43) indicate as acknowledged pathology, (together with sarcomas and soft tissues, which we did not take into account for their very small numbers), associated to the closeness to incinerator plants, we obtained the highest risk values, both in the total of sexes and for men, while we still have to clarify any excess in women.

Taking into account all neoplasia, we find that Zone B, considered as the most exposed zone, shows statistically significant excesses that are almost homogeneously diffused for both sexes, while the population living in the city show a higher risk compared with the municipalities lying North of the main town; a similar trend is shown by hepatic neoplasia Colorectal cancers, myelomas and stomach cancers show scarce statistically significant excesses and rather contradictory data, even if the good number of intestine cancers makes us almost certain that no relevant differences exist among the three areas studied in this research. Globally, also the neoplasia of the urinary tract (kidney and bladder) in its whole, although not characterised by significant RMs, show a trend where the population living in the countryside have a higher risk of falling ill and die; the opposite happens when the frequency of these pathologies is compared between the main city and municipalities North of it. In the analysis of juvenile cancers (age: 00-44) (14, 37, 44) as regards neoplasia, a trend is observed to a higher risk among the inhabitants of the two countryside zones, especially for men; this result seems the opposite in women; when all the death causes are taken into account, a higher risk only emerges for the women living in Zone B or in Vercelli. Strictly feminine cancers (uterus or breast) show opposing trends: breast neoplasia seem to show a higher risk for women living in the countryside, probably because of the higher average age and the lower cultural inclination to perform screening exams and/or visits; uterine cancers, on the contrary, show a mainly opposite trend, which is difficult to interpret at the time being. Larynx cancers show the same trend as the other neoplasia, with excess in the two sexes induced by the higher frequency of cases for males, especially in Zone B, while the city of Vercelli shows excesses when compared with Zone A only.

Observing the data on malformations (6-10) any hypotheses can be made, since results seems to be contradictory; nevertheless we think that the rather high RM values (especially analysing the two sexes separately) should be investigated further.

Moving to non oncological pathologies (8, 33, 37, 45,4 6) we highlight an opposing trend for cardiovascular events, in fact when taking into account all the illnesses of the circulatory apparatus, the higher RM number with a significant excess is registered for the total of the two sexes and for men and women in rural Zones A and B; this trend is the opposite when considering ischemic pathologies only. In our opinion, such clear difference may be due in part to a bad classification by the certifying doctor at the death of a person, also induced by the strictly clinical-diagnostic difficulty of perfectly distinguishing a ischemic pathology from a cardiac on, and deciding which of them really caused the death.

As regards the pathologies of the respiratory apparatus, we notice that for all RM accidents, they are not excessively far from the average data and the distribution is rather homogeneous among the various areas; on the contrary, excesses are present in women for chronic respiratory illnesses only, especially for the women living in the main city. No particular considerations can be made as regards genital-urinary and metabolic pathologies, even if some high and statistically significant values may be the subject of further investigations.

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In analysing all death causes (excluding the previously mentioned cancers), we find in the total of sexes slightly higher but statistically significant RMs for the two rural areas; on the contrary, if we analyse the two sexes separately, males show borderline results, while females are characterised by a trend that shows a much more unfavourable situation for the women living in the countryside compared with those living in the main city. Another hypothesis to be taken into account because of the historical features of the analysed population, is that the presence of excesses in one of the two sexes only should not force the research to be limited to a professional risk factor, instead of an environmental one. As a matter of fact, it is certain the women living in rural zones, compared with women living in cities, usually perform agricultural and/or household activities that inevitably force them to spend more time in their living area (13).

Moving to the analysis of risks according to a higher closeness (47-49) to the risk source (Table 3-4) we notices associations, in the closer municipalities, for neoplasia of lungs, lymphomas, age 00-44 for all the causes, kidneys and all cancers; whereas for non oncological pathologies, we noticed an excess for illnesses of the respiratory and circulatory apparatus, ischemic pathologies, deformities and for all causes. The remaining pathologies show discordant data and in some cases we observed higher significant RMs for people living in farther areas; in the light of such non linear results, it is paramount to exactly study the fall of fumes and the length of stay of the deceased people in their living area, as well as their professional occupation.

Conclusions

Overall, for many oncological and non-oncological pathologies, we observed higher mortality risks for the people living in the two rural zones (A and B); the excesses are mainly observed in the area that we considered at higher risk (Zone B). Considering the other risk factors that we took into account in this pilot study, and knowing that the distribution of the agricultural activity, the hygienic-healthcare conditions and the education level (13) are almost homogeneous among the three areas, it is paramount to perform an inferential study (37) in order to check other variables that may influence the risk of illness. In particular, we refer to a space analysis study (47-49) on the city of Vercelli and its lowland that may at least quantify the surrogate of the residence (39), case by case, in parallel to the creation of a dispersion model of pollutants (10, 18, 39, 45, 48, 50-52) and their fall on the neighbouring territory. As a conclusion to such an intermediate phase, it would be important to perform a historical cohort study taking into account the variables not yet analysed, such as the professional exposure, the familiarity and the unnecessary factors. We think that only after these interventions we will be able to state that the differences emerged from this preliminary study are induced or not by environmental pressure factors and/or other aetiology and risk determinants.

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Riassunto

Studio esplorativo sull'andamento della mortalità nel territorio circostante un impianto di inceneri-mento di rifiuti solidi urbani nel comune di Vercelli (Piemonte, Italia) 1988-2009

Obiettivi: Le realtà dove presente inceneritori presentano spesso problemi di popolazioni eterogenee e con presenza di diversi pressanti ambientali. Diventa importante valutare il possibile ruolo eziologico dei diversi fattori di rischio ambientali e cercare di quantificare quanto essi incidano nell'eccesso epidemiologico

Metodi: Il presente studio si basa sulla mortalità ISTAT per tutte le cause nel periodo 1988-2009 riferito a 10 comuni a sud del capoluogo limitrofi all'inceneritore attivo dal 1977 (10 anni di latenza). I rischi sono stati

calcolati considerando quest'area a rischio vs i comuni a Nord di Vercelli e vs lo stesso capoluogo di provincia.

Risultati: Sono emersi eccessi statisticamente significativi a maggior carico per l'area sud come neoplasia s. nervoso, fegato e totale tumori.

Conclusioni: Lo studio pur presentando diversi limiti è meritevole di approfondimento tramite ricerche inferenziali ad hoc quali coorte e/o caso controllo dove si possano controllare diversi confondenti ambientali,occupazionali e voluttuari.

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