

Multiple Cause of Death: Preliminary Results of the Analysis of the Italian Mortality in Older Ages

Cause Multiple di Morte: Primi Risultati di un'Analisi della Mortalità degli Anziani in Italia

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Riassunto: Le statistiche di mortalità utilizzano in genere una sola causa di morte facendo riferimento al concetto di causa iniziale. Il sistema di codifica automatica delle cause di morte, introdotto in Italia dai decessi del 1995, rende disponibili tutte le informazioni relative alle malattie e condizioni morbose certificate dai medici al momento del decesso. In questo lavoro si illustrano i primi risultati dell'analisi delle cause multiple di morte in Italia nel 2001, con riferimento agli ultra settantenni.

Keywords: multiple causes of death, associated cause, mortality in older ages

1. Introduction

Mortality analysis is generally based on the notion of "underlying cause of death", defined as that disease or condition which initiated the morbid process leading directly to death. However, since 1995, data base death records in Italy have also included information on any other significant disease (and/or condition) that may have led to, or contributed to, death (i.e. associated causes). Being able to take into account the entire set of this health-related information greatly enhances the analysis of the health of a population, for two main reasons: first, analysis of the multiple causes of death provides a more comprehensive picture of diseases and conditions that are often present at the time of death, but which are rarely registered as the underlying cause of death (e.g. Alzheimer's, diabetes, pneumonia); second, such analysis furnishes evidence regarding multi-morbid associations among diseases and/or conditions. In low mortality countries over 75% of people die aged 70 and above, when their overall pathological state is often complex, and identifying a single underlying cause of death may not always be justifiable. Given this situation multiple causes of death statistics can provide a more comprehensive view of mortality patterns (Désesquelles et Meslé 2004, Steelnand et al. 1992, Goodman et al. 1982). This paper presents the preliminary results of an analysis of multiple causes of death in Italy of persons aged 70 and above during 2001.

2. Data

"Automated cause of death coding" was first introduced for deaths occurring in 1995 (Istat, 2004). It renders the overall pathological state at time of death available on that

subset of records which were submitted to this coding, and for which the recognition process was successful.

In 2001 the automated cause of death coding was applied to the individual record of every death which occurred during the year, with the exception of deaths in the first year of life, deaths due to violent causes and deaths in the Italian provinces of Trento and Bolzano – for a total of 519,965 units. The process yielded the following results: 413,167 records, equal to 79.5% of the total, were automatically coded while the remaining 20.5% were rejected and manually coded, for the underlying cause only.

The first stage of the study was devoted to validating the results obtained from automatic coding, verifying the representativeness of the population formed by all those certificates which were successfully coded automatically (only these contained the data required for investigating multiple causes), with respect to the total population of deaths. Because of the high numbers involved in the two populations, an in-depth comparative graphical analysis was first performed on their structural characteristics, according to gender, age, average number of recorded pathologies and underlying cause of death by ICD9 chapters. The graphical results show a strong similarity between the two populations whose profiles tend to overlap, while any differences present never exceed 0.4%.

Subsequently, these differences were evaluated by means of a Chi-square test applied to a random sample of 3% of the deaths, in order to verify the null hypothesis of independence of the two populations in respect of the variables examined. The results show that the two populations are not significantly different in respect of the variables: gender, age and ICD9 chapters, but do differ significantly in respect of the variable “number of recorded pathologies”. This latter result, however, was expected, since the performance of automated coding had proved to be poorer on records containing a greater number of pathologies.

Nonetheless, since analysis of records containing medical terms rejected by the automated system revealed that no specific diseases were rejected systematically, the differences between automatically and manually coded death records can be considered quantitative rather than qualitative. In fact, the differences found were in respect of the mean number of diseases or conditions reported (higher in the rejected records), and not of multi-morbid patterns.

3. Results

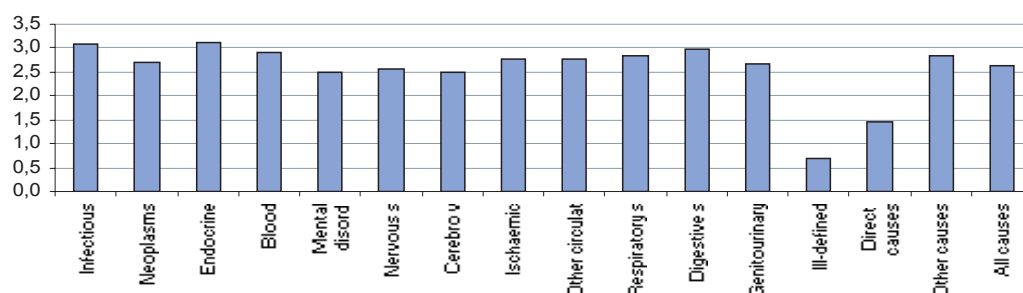
For the 325,229 deaths over 70 years of age studied, 860,048 medical terms were codified, representing 2.6 pathologies on average per death record (excluding the underlying cause). The number of associated diseases or conditions was usually 2 (37.7% of the death certificates) or 3 (26.2%). The average number of associated causes by underlying cause varied between 2.5 and 3.1, except for direct causes and ill-defined causes (1.4 and 0.7 associated causes, respectively) (Figure 1).

Table 1 illustrates the main results of the exploratory analysis carried out on the multiple causes of death data. The cluster analysis carried out on the first 10 factors¹ drawn from the MCA, led to the identification of 8 groups that presented distinct profiles regarding both causes of death (underlying and associated) and demographic

¹Identified on the basis of the criterion, proposed by Benzecri, to consider as non-insignificant factors all those whose self-value is above the average self-value $1/k$, where $k=23$ is the number of active variables.

characteristics. The first cluster is the largest one as it comprises 21.4% of all deaths. It presents a profile strongly characterised by neoplasms, both as associated causes and as underlying cause of death: 85.4% of all deaths attributed to neoplasms belong to this cluster. A high proportion of associated causes of blood and blood-forming organs diseases are also associated to this profile.

Figure 1: *Average number of associated causes and/or conditions by underlying cause.*



The second cluster (15.2% of the deaths) is even more selective, as it includes 99.2% of all deaths attributed to cerebrovascular diseases. In this group the association is evident among these causes and other cerebrovascular diseases, diseases of the nervous system and mental disorders. The third group (14.9%) regards the cluster of ischaemic heart diseases (95.7% of all deaths attributed to this cause belong to this cluster), which are indicated both as underlying and as associated cause, in addition to endocrine, other circulatory, respiratory and cerebrovascular diseases. The fourth cluster presents a profile characterised by a higher percentage of deaths attributable to other diseases of the circulatory system (97.6% of deaths due to these causes belong to this cluster). Associated causes include diseases belonging to the same group, in addition to diseases of the respiratory and genitourinary systems, as well as mental disorders.

The profile of the fifth cluster (7.6% of deaths) is clearly characterised by diseases of the respiratory system (99.8% of the deaths attributed to this cause are included in this group). In this case, the associated causes vary even if mental disorders, diseases of the respiratory system and ischaemic heart diseases clearly prevail.

The sixth group is the cluster (6.7%) of diseases of the digestive system (100% of the deaths attributed to this cause are classified in this group), which are associated with diseases belonging to the same chapter, to blood and blood-forming organs diseases, diseases of the genitourinary and endocrine systems.

The seventh group (13.1% of the deaths) is a cluster that includes, both as underlying and as associated cause, all the causes that indicate possible problems due either to the quality of the death certification or to poor information available to the certifier: it includes direct causes, diseases of the nervous system, mental disorders and symptoms, signs and ill-defined conditions as associated causes. The eighth and smallest cluster is characterised by a higher percentage of deaths attributed to endocrine diseases (99.9% of the deaths attributed to these causes). The situation regarding the associated causes is rather heterogeneous and the cluster also exhibits the association between endocrine diseases and ischaemic heart diseases, as was the case in the third cluster.

Table 1: Cluster's profiles of the death certificates and ratio between the proportion of certificates with a specific characteristic in the cluster and in the overall population².

Cluster1	Ratio	Cluster2	Ratio	Cluster3	Ratio	Cluster4	Ratio
U Neoplasms	4,00	U Cerebro vascul	6,51	U Ischaemic	6,44	U Other circulat	5,68
A Neoplasms	3,84	A Nervous syst	2,76	A Ischaemic	2,52	A Respiratory syst	1,46
A Blood	1,81	A Cerebro vascul	1,72	A Other circulat	1,56	A Other circulat	1,45
70-74 years	1,77	U Other causes	1,28	A Endocrine	1,38	A Genitourinary s	1,32
75-79 years	1,39	A Mental disord	1,27	A Respiratory syst	1,35	A Cerebro vascul	1,23
Male	1,25	A Direct causes	1,07	A Cerebro vascul	1,17	A Mental disord	1,20
		85-89 years	1,21			A Direct causes	1,05
		90-94 years	1,22			85-89 years	1,15
		95 + years	1,11			90-94 years	1,35
		Female	1,14			95 + years	1,56
						Female	1,13
Cluster5	Ratio	Cluster6	Ratio	Cluster7	Ratio	Cluster8	Ratio
U Respiratory syst	13,09	U Digestive syst	14,95	U Direct causes	7,58	U Endocrine	25,55
A Mental disord	1,89	A Digestive syst	8,47	U Nervous syst	7,49	A Ischaemic	2,98
A Respiratory syst	1,32	A Blood	2,91	U Mental disord	7,23	A Cerebro vascul	2,32
A Ischaemic	1,29	A Genitourinary s	1,52	A Ill-defined	2,87	A Endocrine	2,32
A Direct causes	1,17	A Endocrine	1,12	U Other causes	1,78	A Genitourinary s	1,86
A Nervous syst	1,10	U Neoplasms	1,06	A Mental disord	1,14	A Mental disord	1,54
85-89 years	1,77	A Direct causes	1,05	85-89 years	1,05	U Other causes	1,36
90-94 years	1,15	70-74 years	1,37	90-94 years	1,29	A Other circulat	1,31
95 + years	1,20	75-79 years	1,19	95 + years	1,65	A Nervous syst	1,18
Male	1,27			Female	1,12	70-74 years	1,06
						75-79 years	1,09
						80-84 years	1,10
						Female	1,20

Legend: Label / *ICD 9 chapter*: Infectious / *Infectious and parasitic disease*; Neoplasms / *Neoplasms*; Endocrine / *Endocrine, nutritional and metabolic diseases, immunol. disorders*; Blood / *Diseases of the blood (-forming organs)*; Mental disord / *Mental and behavioural disorders*; Nervous syst / *Diseases of the nervous system and the sense organs*; Respiratory syst / *Diseases of the respiratory system*; Digestive syst / *Diseases of the digestive system*; Genitourinary s / *Diseases of the genitourinary system*; Ill-defined / *Symptoms, signs, abnormal findings, ill-defined causes*; Direct causes / *4275=Cardiac arrest; 7855=Shock, without mention of trauma; 7991=Respiratory collapse; 7800=Coma and stupor*; Cerebro vascul / *Cerebrovascular diseases*; Ischaemic / *Ischaemic heart diseases*; Other circulat / *Other diseases of the circulatory system*; Other causes / *Other causes*. U= underlying cause of death, A= associated causes of death.

4. Conclusions

This analysis enabled deaths to be subdivided by according to underlying cause and its association with other diseases. Eight clusters were identified and, within these clusters, definite associations among diseases and/or conditions were found. Moreover, although the frequency of “signs, symptoms and ill-defined conditions” as underlying cause of death has significantly decreased, the problem of low quality of death certification reemerges when considering multiple causes of death, as cluster 7 demonstrates.

References

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² Only the characterises that differ from the average by more than 5%, are indicated.