Accuracy of cancer death certificates in Spain: a summary of available information

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(Validez de la certificación de la muerte por cáncer en España: resumen de la evidencia disponible)

Abstract

Objectives: Differences in mortality rates within Europe might be partly due to the quality of mortality statistics. The present article summarizes the available data on the quality of cancer death certification in Spain. A short description of the temporal distribution of the proportion of deaths due to ill-defined tumors in Spain –an indirect indicator of the quality of cancer death certification– is also provided.

Methods: Relevant studies were identified from electronic databases (MEDLINE, EMBASE, IME and IBECS) and from manual searches of the references contained in the articles retrieved. Quality data on death certificates for all tumors and for each specific cancer location were summarized, and all main cancer sites were classified according to their pooled accuracy indicators. Trends for the percentage of deaths due to ill-defined tumors and conditions were studied for the period from 1980 to 2002.

Results: In Spain, deaths from cancer as a whole and leading cancer sites (lung, colon-rectum, prostate, stomach, pancreas, female breast, uterus, brain, leukemia, lymphomas and myeloma) were well-certified. However, other frequent locations, such as the larynx, esophagus and liver were overcertified, while deaths from bladder, kidney and ovarian cancer were undercertified. The percentage of deaths due to ill-defined tumors and causes was regularly higher in females and decreased in both sexes during the study period. However, the recent introduction of the International Classification of Diseases (ICD)-10 has reversed this trend.

Conclusions: Spanish death certificates can be considered as accurate and useful to estimate the burden of cancer, though certification of some frequent sites should be improved. The possible effect of the introduction of the ICD-10 requires careful surveillance.

Key words: Death certificates. Mortality. Cancer. Quality control. Spain.

Resumen

Objetivos: Parte de las diferencias en tasas de mortalidad por cáncer entre países europeos podrían deberse a diferencias de calidad en las estadísticas de mortalidad. Nuestro objetivo es sintetizar la información cuantitativa que hay acerca de la calidad de los certificados de defunción de cáncer en España, y se añade una somera descripción de la evolución temporal de la proporción de defunciones por tumores mal definidos, indicador indirecto de calidad.

Métodos: Se identificaron los estudios relevantes mediante búsquedas en bases de datos electrónicas (MEDLINE, IME, EMBASE e IBECS), y posteriormente se añadieron referencias presentes en los artículos encontrados. Se extrajo la información acerca de calidad de certificación para cáncer en conjunto y para las principales localizaciones tumorales, y se clasificaron los tumores según sus indicadores de calidad. Se estudió también la tendencia del porcentaje de muertes mal definidas o tumores mal definidos entre 1980-2002.

Resultados: En España, el cáncer en conjunto y las principales localizaciones –pulmón, colon-recto, próstata, estómago, páncreas, mama, útero, cerebro, leucemia, linfomas y mieloma– están bien certificados. Sin embargo, otras localizaciones como laringe, hígado y esófago están sobrecertificadas, mientras que el cáncer de vejiga, riñón y ovario están infracertificados. Los porcentajes de muertes por tumores o condiciones mal definidas, mayores en mujeres, han disminuido en el período estudiado, aunque la introducción de la CIE-10 ha invertido esta tendencia.

Conclusiones: En general, los certificados de cáncer pueden considerarse válidos y útiles para estimar el impacto del cáncer en España, aunque la certificación de algunas localizaciones importantes tendría que mejorar. Debería estudiarse el posible efecto de la introducción de la CIE-10.

Palabras clave: Certificados de defunción. Mortalidad. Cáncer. Control de calidad. España.

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Background

One of the most usual approaches to studying the situation of cancer worldwide is to analyse the geographic distribution of mortality rates and their trends. Information on the quality of cancer mortality data is thus essential for interpreting differences in mortality statistics.

In Spain, mortality represents the only comprehensive and homogeneous source of information on cancer for the whole country. The source of mortality statistics is the medical death certificate (DC), a compulsory administrative document completed by the practitioner who certifies the death. This certificate is subsequently transcribed onto a second document, the Statistical Bulletin of Death (SBD), and both are sent to the Municipal Civil Registry. Usually, the Civil Registry forwards the SBDs to the regional offices of the National Statistic Institute (Instituto Nacional de Estadística [INE]) on a monthly basis, where all items except cause of death are digitally recorded. When the data have been duly screened to detect errors and ensure quality control, the underlying causes of death (Causa básica de defunción) are coded at the Regional Authority Mortality Registries by trained teams, applying common criteria in accordance with International Classification of Diseases (ICD) guidelines. National coding protocols have been established to guarantee homogeneity of data[1], while specific methods have also been implemented to validate accuracy systematically. Digital data files are then sent to the INE head office, which releases them once they have been rendered anonymous.

Quantitative data that would enable to asses the quality of cancer death certificates in Spain are relatively scarce. Several studies have addressed this topic, but all refer to areas of the country or to specific populations, and some have been published in local epidemiological bulletins or in symposium proceedings, which are not easily accessible. In this paper, we sought to synthesize information derived from these studies and to complement such data with a short description of the temporal distribution of the proportion of deaths due to ill-defined tumours in Spain, as an indirect indicator of the quality of cancer death certification.

Methods

For review purposes, DC and SBD were deemed to be death certificates, as a very high concordance between both documents has been reported[2]. Studies into the quality of cancer death certification in Spain were identified through: *1)* a MEDLINE and EMBASE search using broad search criteria (January 1966 to January 2006); *2)* a similar search in Spanish bibliographical databases, the Spanish Medical Index (*Índice Médico Español* [IME]), and IBECS; and *3)* references in identified papers. In two studies[3,4], only abstracts of poster presentations at scientific meetings were published. In these cases, quality-indicator data presented in the poster were specifically searched for.

Studies were considered eligible if they reported quantitative estimates of the accuracy of death certificates containing any mention of cancer. In these studies, cancer death certificates were compared against a second source of information, mainly comprising clinical or anatomo-pathological reports (which were taken as the «gold standard»). Agreement between both sources was measured using detection and confirmation rates.

According to Percy et al[5], the detection rate (DR) or sensitivity for a specific site is defined as the proportion of hospital diagnoses (available clinical/anatomopathological information) with cancer of a certain site, with a death certificate where this disease is considered to be the basic cause of death, whereas the confirmation rate (CR) or positive predictive value is the proportion of cancer deaths in which the underlying cause specified in the death certificate is confirmed by hospital diagnosis.

DRs and CRs can be computed as: *a)* site-specific cancer rates at three digits of the ICD, that is considering an indicator per cancer-site; *b)* all-site three-digit rates, an overall indicator for cancer where the rates' numerator contains all cancer cases (ICD-9 codes 140-208) in which the site specified in the death certificate and clinical information agree; and *c)* all-tumour rates, also an overall indicator where the rates' numerator includes all cases that just mention «cancer» in both the death certificate and gold standard, even though there might be site misclassification. These figures are logically expected to be higher than overall comparisons at a three-digit level. A graphical scheme that might help understand these concepts is shown in figure 1.

Identified papers were classified into three main categories:

I. *Studies focusing on all-cause death certificates*, which provide accurate detection and confirmation rates (fig. 1).

II. *Studies based solely on death certificates that mention cancer*. These could be subdivided into two groups:

a. Studies with an additional source of information on c_g or b_g (fig. 1) that allows them to estimate accurate detection and confirmation rates. In some cases, these data[6] were not considered for the purpose of calculating site-specific cancer rates, thereby leading to overestimated rates.

Figure 1. Cross-tabulation of cause of death according to clinical diagnoses and medical death certificates and quality-indicator formulae.

a) Three-digit agreement rates

Clinical/anatomo-pathological information

		+	−
DC/SBD	+	a	$b_g + b_s$
	−	$c_g + c_s$	d

Site-specific detection rate = $a / (a + c_g + c_s)$
Site-specific confirmation rate = $a / (a + b_g + b_s)$

All-site three-digit detection rate = $\sum a / \sum(a + c_g + c_s)$
All-site three-digit confirmation rate = $\sum a / \sum (a + b_g + b_s)$

b) All-tumour agreement rates

Clinical/anatomo-pathological information

		+	−
DC/SBD	+	$a + b_s + c_s$	b_g
	−	c_g	d

All-tumour detection rate = $a + b_s + c_s / a + b_s + c_s + c_g$
All-tumour confirmation rate = $a + b_s + c_s / a + b_s + c_s + b_g$

a = site-concordant cases
b_g = global false positive (corresponds to a non-cancer cause of death)
b_s = site false positive (corresponds to cancer at other location
c_g = global false negative (cancer case certified outside ICD cancer codes)
c_s = site false negative (cancer case certified as cancer at other location)
d = true negative cases

b. Studies without information on cancer deaths not certified as such, or on non-cancer cases erroneously certified as cancer (c_g or b_g). This rules out the possibility of computing all-tumour or three-digit agreement detection rates, and means that site-specific detection rates and confirmation rates are likely to be overestimated (fig. 1). In some cases[4,7,8], it was possible to find information on global false positives within the text of the paper. We used these data to calculate unbiased all-tumour confirmation rates.

III. *Necropsy-based studies.* Since necropsies are relatively scarce in this country[9], the main problem with these studies is external validity, as they tend to focus on very specific populations.

Many of the detection and /or confirmation rates offered in the summary tables were directly taken from the selected studies, though, where possible, the tables were completed by computing DRs and CRs using data provided in the papers.

In a second stage, a pooled CR and DR was calculated for each specific cancer location using data from all studies that had covered that location, and then all main cancer sites were classified according to Percy's criteria, the bench-mark for these types of studies[5]. Finally, as a complementary approach, we calculated the percentage of deaths due to ill-defined tumour versus all-tumour deaths and the percentage of deaths of ill-defined conditions versus all-cause deaths for the period 1980-2002, using whole country mortality figures supplied by the INE.

Results

Published studies on quality of cancer death certificates in Spain

A total of 14 studies providing quantitative data on quality of cancer death certification in Spain were found. The main characteristics of these studies, their classification according to the above criteria and, where available, all-tumour (ICD-9 codes 140-208) and all-site three-digit detection and confirmation rates are shown in table 1. In addition, figure 2 depicts the geographical location of the respective study populations.

Six of these studies belonged to categories I and II(a)[3,6,10-14], those furnishing the most accurate estimators, with detection rates ranging from 75.2-100% for all tumours as a whole and 64.8-100% for all-site three-digit rates. On average, confirmation rates were higher than detection rates, ranging from 91.5-99.3% for all-tumour and 68.2-80.8% for all-site three-digit rates.

Another five studies were classified as category II(b)[7,8,15-18]. In general, they supplied data on all-tumour and all-site three-digit confirmation rates. Yet, with two exceptions[4,8], these studies failed to consider global false positives when estimating three-digit confirmation rates, an approach that implies a certain overestimation of the agreement. Where possible, therefore, we calculated a

Figure 2. Geographical location of published studies furnishing data on quality of cancer death certification in Spain.

corrected confirmation rate by including global false positives in the denominator. Only one study[8] had adopted this approach and, in this case, the «biased» confirmation rate (excluding global false positives) was reckoned for comparison purposes. Both «biased» –denoted by «*»– and corrected confirmation rates are shown in table 1. On average, biased confirmation rates were three points higher than corrected rates. In these stu-

Table 1A. Quality of cancer death certification in Spain. Characteristics and classification of published studies sorted by publication year

Study category	Author	Geographic location	Institution	Period analysed	Death certificates or SBD[a] All-cause/cancer
I	García-Benavides, 1986[10], 1989[11]	Valencia (city)	University of Alicante	1984	1,068/279
I	Pañella, 1989[12]	Barcelona (city)	Municipal Institute of Health	1985	1,480/197[a]
I	Ruiz Liso, 1989[13]	Soria (province)	Provincial Hospital	1985	993/260[a]
I	Giménez, 2002[3]	a) National	CISATER	1981-1995	1,465/284
		b) National	CISATER	1987-1998	773/224[a]
II(a)	Cáffaro, 1995[6]	Island of Majorca	Cancer Registry	1989	–/1,255
II(a)	Sánchez-Garrido, 1996[14]	Girona (province)	Catalonian Institute of Oncology Provincial Hospital Cancer Registry	1985-1989	–/244[a]
II(b)	Bosch, 1981[15], 1983[16]	Barcelona (city)	Hospital, Municipal Institute of Health	1979	–/2,945
II(b)	Navarro, 1984[17]	Murcia (province)	Public Health Authority, Cancer Registry	May 1981-Oct 1983	–/2,928[a]
II(b)	DGA, 1988[18]	Zaragoza (city)	Cancer Registry	1983	–/1,366[a]
II(b)	Izarzurgaza, 1994[4]	Euskadi (Basque Country) (region)	Cancer Registry	1989	–/3,945[a]
II(b)	Martínez, 2000[8]	Granada (province)	Cancer Registry	1991-1994	–/4,772
II(b)	Cirera, 2002[7]	Murcia (region)	Cancer Registry	1992	–/1,658
III	Nava, 1985, 1986[19,35]	Terrassa (city)	Comarcal Private Hospital	1980-1981	49/7
III	Carballeira, 1989[9]	Galicia (region)	Public Health Authority	1987	90/19[a]

SBD: Statistical Bulletin of Death.
[a]The study uses SBD.

Table 1B. Quality of cancer death certification in Spain. Characteristics and classification of published studies sorted by publication year

Author	Cancer DC with Savailable information All-cause/cancer	Cancer deaths detected only by validating source from validating source	DR (%) (global false positives)	CR (%)	Notes
García-Benavides, 1986[10], 1989[11]	279	30 (revised DC without mention of cancer)	89.9(G) 71.7(3D)	95.3(G) 76.9(3D)	Studies all DC of this period
Pañella, 1989[12]	154	36 (revised SBD without mention of cancer)	79.9(G) 64.8(3D)	92.9(G) 68.2(3D)	
Ruiz-Liso, 1989[13]	233	0	100(G) 100(3D)	91.5(G) 80.8 (3D)	Studies all DC of this period. Validating source: histopathological records. Unconfirmed cases are considered ill certified No additional cases found
Giménez, 2002[3]		91 (clinical follow-up) 29 (clinical follow-up)	75.2(G) 88.1(G)	97.5(G) 96.0(G)	Toxic Oil cohort
Cáffaro, 1995[6]	1,173	65 (Cancer registry)	94.7(G)	99.3(G)	Excludes multiple tumours
Sánchez-Garrido, 1996[14]		61 (Cancer registry)	93.3(3D)	73.0(3D) 77.2(3D)[a]	Only gynaecological cancer
Bosch, 1981[15], 1983[16]	1,557	Not searched		81%(3D)*	Excludes ill-defined & multiple tumours and non-residents in the province
Navarro, 1984[17]	644	Not searched		64.4(3D)*	
DGA, 1988[18]	685	Not searched		73.1(3D)*	Exclude multiple tumours, in situ, skin non-melanoma and non-residents in this region
Izarzurgaza, 1994[4]	3,298	Not searched		99.1(G) 79.5(3D) 0.80.1(3D)*	
Martínez, 2000[8]	4,231	Not searched		96.2(G) 74.0(3D) 76.9(3D)*	Excludes multiple tumours
Cirera, 2002[7]	1,371	Not searched		98.5(G) 76.7(3D) 79.4(3D)*	
Nava, 1985, 1986[19;35]	7	6 (cancer deaths only detected by necropsy)	50.0(G) 38.5(3D)	85.7(G) 71.4(3D)	Necropsy-based
Carballeira, 1989[9]	19	5 (cancer deaths only detected by necropsy)	73.7(G) 42.1(3D)	73.7(G) 42.1(3D)	Necropsy-based

CR: Confirmation rate; DR: Detection rate; G: all-tumour agreement rates (ICD-9 codes 140-208); 3D: all-site three-digit agreement rates.
3D*: all-site three-digit agreement rates with only those death certificate (DC) / Statistical Bulletin of Death (SBD) that really corresponded to malignant tumours used as denominator.

dies, all-tumour and corrected all-site three-digit confirmation rates were comparable to those obtained for categories I and II(a).

Only two papers came within category III (necropsy-based studies)[9,19]. Their results were slightly worse than others, but it should be borne in mind here that in Spain most autopsies are restricted to cases with uncertain diagnosis.

Table 2 summarises available information in Spain on detection and confirmation rates for malignant neoplasms by the main specific locations. The data, sorted by the period analysed, revealed that in the interim between the early 1980's and the most recent study (1992 data), the quality of certification had improved. Highest indices were found for cancer of the stomach, colon and rectum, pancreas, lung, melanoma, female breast, brain and haematological tumours. In contrast, other sites, such as ill-defined tumours and non-melanoma skin cancer, displayed lower rates of agreement.

Furthermore, in order to have a brief overview of the quality of cancer certification for specific sites, pooled estimators were calculated to classify the accuracy of death certification for specific cancers according to Percy's criteria[5], which depend on detection and confirmation rates (table 3).

Ill-defined tumours and ill-defined causes

Figure 3 shows the trend in the percentage which ill-defined tumours and ill-defined causes represent of all-cancer and all-cause deaths, respectively, over the calendar period 1980-2002, in both sexes. During the 1980's, Regional Mortality Registries became respon-

Table 2. Spanish cancer-death-certificate detection and confirmation rates by site

		Murcia 1992 (Cirera, 2002)[6]		Granada 91/94 (Martínez, 2000)[17]		Euskadi 1989 Basque Country)		Majorca 1989 (Cáffaro, 1995)[6]		Girona 85-89 (Sánchez, 96)[14]		Barcelona 1985 (Pañella, 1989)[12]		Soria 1985 (Ruiz Liso, 1989)[13]		Valencia 1984 (García Benavides, 1986,1989)[9,12]		Zaragoza 83 (DGA, 1988)[18]		Murcia 1981 (Navarro, 1984)[17]	
Location	ICD-9 codes	DR	CR	DR	CR	DR	CR	DR	CR	DR	CR	DR	CR	DR	CR	DR	CR	DR	CR	DR	CR
Mouth & pharynx	140-149	56.6	81.1	55.5	89.2	67.5	87.7	57.8	92.9					100.0	100.0	60.0	75.0	57.1	80	41.4	57.1
Oesophagus	150	95.2	69.0	79.4	72.5	90.1	85.5	92.9	76.5					75.0	100.0	85.7	75.0	84.6	68.7	86.4	76.0
Stomach	151	82.0	88.5	80.7	87.8	88.2	90.8	75.0	84.2			79.3	85.0	89.2	90.6	71.4	86.9	83.1	90.2	75.3	84.1
Colon-rectum	153-154	87.0	96.2	75.6	93.4	91.6	83.9	86.8	92.3					90.3	93.3	82.6	82.6	82.7	90.5	70.5	77.1
Colon	153	90.5	69.8	69.3	71.1	70.1	70.1	81.2	68.3							75.0	71.4	63.9	79.3	52.0	60.5
Rectum	154	48.6	97.2	48.8	84.4	62.6	77.7	51.5	82.9							33.3	50.0	69.6	66.7	55.6	83.3
Liver	155	82.1	50	89.9	47.5	90.6	47.5	80.7	41.2					66.6	14.3	53.8	38.9	85.7	37.5	53.3	29.6
Gallbladder	156	73.3	91.7	59.7	93.6	67.5	81.3	52.2	85.7					75.0	85.7	37.5	100	70.0	66.7	40.0	84.6
Pancreas	157	97.4	78.7	83.0	86.6	79.5	77.4	82.9	87.2					100.0	85.7	100	66.7	100.0	60.0	71.4	52.6
Larynx	161	83.3	62.5	81.4	64.2	83.5	68.6	85.0	63.0					100.0	100.0	80.0	80.0	96.4	79.4	75.0	65.9
Lung	162	93.8	89.8	91.6	89.9	93.7	92.4	95.4	95.4			67.6	88.5	100.0	94.9	84.6	91.7	93.3	91.2	92.3	86.6
Skin	172-173	66.7	80.0	59.3	90.0			22.2	100							50.0	50.0	44.4	85.7		
Melanoma	172	90.9	83.3	76.9	100	76.7	88.5											50.0	50.0		
Others	173	46.2	75.0	46.2	80.0													44.0	91.7	15.4	50.0
Breast-♀	174	92.1	97.5	87.9	98.6	92.2	98.7	91.7	100			94.1	88.9	100.0	100.0	88.0	95.7	86.7	98.6	78.8	100.0
Uterus	179,180,182	78.0	86.7	78.0	81.4	73.7	90.3	86.0	88.0	93.0	82.0					83.3b	62.5	62.5	68.2	76.9	62.5
Cervix	180	51.7	88.2	57.6	97.1	50.0	93.8	68.0	94.4	43.2	86.4			100.0	50.0	75.0	100.0	0.0	0.0	20.0	50.0
Corpus	182	50.0	83.3	41.9	88.6	52.6	45.5	37.5	85.7	43.9	82.8			100.0	100.0			7.1	33.3	14.3	33.3
Ovary	183	82.1	85.2	70.1	90.1	71.2	78.7	71.4	71.4	83.7	77.9			100.0	100.0			36.4	44.4	58.3	87.5
Prostate	185	93.2	84.6	87.6	81.3	90.8	91.4	91.4	85.5					90.9	76.9	68.8	84.6	88.2	65.2	90.0	33.3
Other genital-♂	186-187	0.0	0.0	70.0	70.0	77.8	100.0	50.0	100											100.0	100.0
Testicular	186		0.0	100.0	100.0	60.0	100.0														
Bladder	188	77.9	91.4	76.4	90.2	87.3	88.7	74.4	91.4					100.0	77.8	50.0	70.0	63.8	95.0	58.8	100.0
Kidney	189	75.0	80.0	79.0	84.5	80.6	92.1	58.8	83.3							100	66.7	70.0	77.8	66.7	25.0
Brain	191	96.2	92.6	95.5	83.6	94.4	87.9	100	84.4									100	77.7	91.7	78.6
Endocrine Glands	193-194	100.0	71.4	75.0	75.0	73.7	100.0	100	80											100.0	80.0
Thyroid	193	100.0	75.0	64.7	78.6	80.0	100.0											75.0	100	100.0	100.0
Ill-defined tumours	195-199	58.2	55.4	50.6	30.0	56.5	51.7	52.6	42.4									31.6	30.0	5.8	23.1
Lymphomas	200-202			90.2	83.0	87.0	77.7	85.7	91.3					100.0	100.0	86.7[a]	92.9[a]	62.5	76.9	50.0	50.0
Hodgkin	201	50.0	50.0			75.0	85.7	100.0	40.0									60.0	75.0		
Others	200,202	81.6	75.6			71.9	85.3	84.8	90.3									63.6	77.8		
Multiple Myeloma	203	100.0	94.4			100.0	92.3	81.3	92.9					100.0	100.0			100.0	100.0		
Leukaemia	204-208	92.6[b]	96.2[b]	96.4[c]	96.4[c]	89.1	88.2	100.0	100.0					100.0	100.0	100.0	87.5	95.0	86.3	85.7[c]	80.0[c]

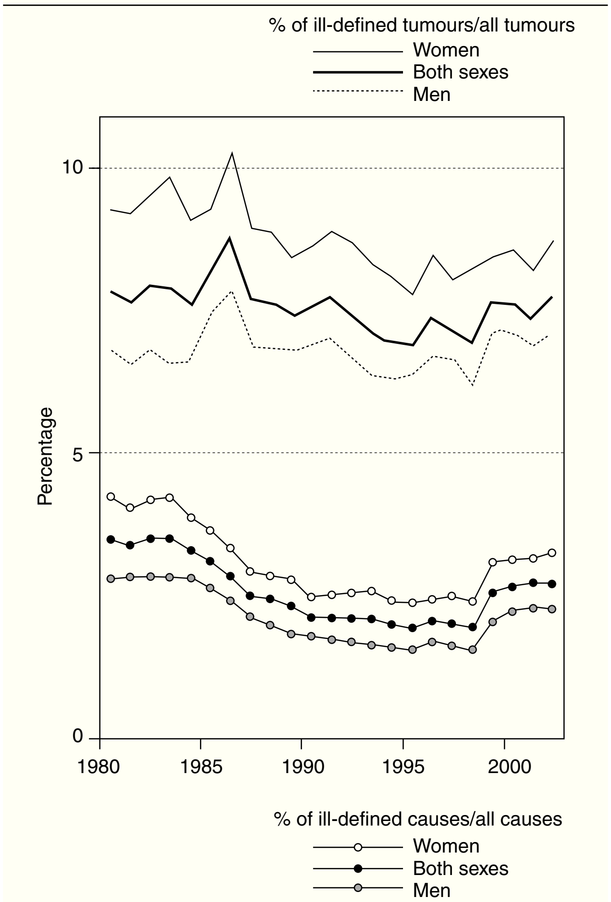
CR: confirmation rate; DRI: detection rate. [a]Includes ICD 200-203; [b]Only lymphoid cases were found (ICD 204); [c]Haematopoietic and reticular system (ICD-O 169).
Rates from reviewed studies, though in some cases Detection Rates (DR) and Confirmation Rates (CR) were calculated with data supplied in the papers.

Table 3. Accuracy of death certification for specific cancers in Spain according to Percy's criteria (Percy 1981). Pooled analysis

Well-certified (DR ≥ 80 and CR ≥ 80)				Over-certified (DR ≥ 80 and CR ≤ 80)				Under-certified (DR ≤ 80 and CR ≥ 80)				Ill-certified (DR ≤ 80 and CR ≤ 80)			
Location	ICD-9	DR	CR	Location	ICD-9	DR	CR	Location	ICD-9	DR	CR	Location	ICD-9	DR	CR
Stomach	151	83	89	Oesophagus	150	87	78	Mouth & pharynx	140-149	59	85	Colon	153	72	70
Colon-rectum	153-154	83	90	Liver	155	85	45	Rectum	154	54	82	Gallbladder	156	58	79
Pancreas	157	84	80	Larynx	161	83	67	Skin	172-173	54	87	Corpus uterus	182	42	76
Lung	162	92	91					Melanoma	172	78	91	Ill-defined tumours	195-199	53	39
Breast-♀	174	90	98					Skin (non-melanoma)	173	42	80	L. Hodgkin	201	69	69
Uterus	179,180,182	82	83					Cervix uterus	180	51	91				
Prostate	185	89	82					Ovary	183	74	81				
Brain	191	96	85					Other genital-♂	186-187	69	82				
Lymphomas	200-202	86	80					Testicular	186	78	88				
Multiple Myeloma	203	96	94					Bladder	188	76	91				
Leukaemia	204-208	93	93					Kidney	189	76	83				
								Endocrine Glands	193-194	79	83				
								Thyroid gland	193	76	89				
								Lymphomas, others	200,202	76	83				

CR: confirmation rate; DR: detection rate.

Figure 3. Percentages of deaths due to ill-defined tumours and ill-defined conditions versus all-tumour and all-cause mortality. Trends for the period 1980-2002 by sex and for both sexes.



sible for the coding process. This change led to an improvement in the quality of the information, which is reflected in the downward trend in the proportion of ill-defined causes. The initial decline in the percentage of ill-defined causes was accompanied by an increase in the proportion of ill-defined tumours, which registered a less clear pattern. Nevertheless, it should be noted that, coinciding with the introduction of ICD-10 in Spain, 1999 witnessed an increase in these indicators, with the percentage of ill defined causes and ill defined tumours rising by 31% and 10% respectively over the previous year's figures, followed by an apparent levelling-off. Interestingly, women registered higher values for these two indicators of bad certification, in all cases. When proportional mortality was computed using adjusted rates, women continued to have worse results (data not shown).

Discussion

Though quality at a national level has not been studied, available data suggest that, overall, cancer death certificates in Spain possess an accuracy comparable to that reported for other industrialised countries[5,20,21]. Indirect estimations such as the proportion of ill-defined causes in Spain show similar percentages to those registered by other developed countries[22].

The first Spanish study to address death certificate reliability was published in 1981[15]. Specifically focused on cancer death certificates, this study solely covered the Barcelona metropolitan area. Several authors subsequently studied the quality of death certificates in other parts of the country. In this paper, we summarised all available information to provide a global view of the quality of Spanish cancer-mortality statistics.

In Spain, published quality estimators are basically drawn from regional studies, many of which are sponsored or undertaken by Cancer Registries. Accordingly, it should be borne in mind that, despite the existence of national coding protocols, inferring quality indicators for the country, such as our pooled estimators, might also be problematic, since decentralisation of the coding process could cause inter-regional variability, and there are huge areas of the country where death certification quality studies have not been conducted (fig. 2). Only Giménez et al[3], in their study on a toxic-oil poisoned cohort, provide national data, though their results could also be misleading as they refer to a cohort of sick people, subjected to a thorough follow-up over time. The progressive increase in the number of Cancer Registries in the country might go some way towards having more representative data about quality of cancer death certification in Spain in the future. Nevertheless, results from the different studies were quite similar for most cancer sites.

Compared to other causes of death, cancer (ICD 140-208) seems to be well certified in Spain, with detection rates being as much as 9 points higher for all tumours than for all causes together, and confirmation rates over 20 points higher than for all causes[11,12], which could be due to the fact that cancer is usually a well-characterised diagnosis, and in most cases has histological confirmation.

All-tumour detection rates ranged from 79.9 to 100 and the CRs exceeded 90%. Depending upon their results, some studies have classified this broad category as well-certified[3,11,13], while others have viewed tumours as being slightly underreported[3,12]. However, the percentage of underreporting in Spain, as estimated by García-Benavides et al[11] and Cáffaro et al[6], seems to be around 5-6%, which is comparable to international figures[20,23,24]. Hence, global cancer mortality figures can be considered accurate and useful for estimating the burden of this group of diseases.

As expected, when site misclassification was taken into account, agreement estimates were lower. All-site three-digit detection rates from categories I and II(a) studies range from 64.8 to 100 and confirmation rates from 68.2 to 80.8. Based on these indicators, cancer could be deemed to be ill-certified according to Percy's criteria. It is remarkable that, in general, Ruiz-Liso et al[13] obtained better results than other studies. The CR range in category II(b) studies was similar (64.4-81%). The design used in such studies excludes global false positives, thus slightly overestimating this indicator. According to three studies[6-8], in which both correct and biased estimators were available, biased data were on average three points higher. In the USA[5] and France[20], CRs were slightly higher than in Spain (82.7 and 86%, respectively). Nevertheless, it should be noted that those studies belong to category II(b) and are also biased.

If some problematic categories are grouped (this is the case of cervical –ICD 180–, corpus –ICD 182– and unspecified uterine cancer –ICD 179–; or colon –ICD 153– and rectal neoplasms –ICD 154–), all-site three-digit agreement rates improve. This can be seen in Cirera and Navarro[7], where the proportion of agreement using three-digit ICD was close on 80%, and aggregation of problematic locations raised it to 83%. A comparable increase was previously described in the USA[5] (4%) and in Ontario[21] (6%).

Analysis of specific anatomic locations shows that, in general, the main leading cancer sites are well certificated. Thus, lung, colon-rectum (ICD 153-154), prostate, stomach, pancreas, female breast, uterus (ICD 179-180,182) and brain cancer, as well as leukaemia, lymphomas, myeloma belong to this category. Together, they represented around 69% of all cancer deaths registered in Spain in 2002[25]. Nonetheless, it should be noted that colon and rectal cancers are respectively ill and undercertified unless they are considered together, since mutual misclassification of the two sites has been reported[7,21]. A similar situation can be observed with respect to uterus. Overall, this location has good accuracy rates, but cervix and corpus uterus are under –and ill– certified, respectively. Mortality due to uterus cancer in Spain registered a steady decrease since 1976, contrasting with the slightly increasing trend in cervix mortality[26], which has been explained mainly as a consequence of a reassignment of cases previously coded as «uterus non-specified»[14]. Nevertheless, if uterus is regarded as a single category, its certification has improved with time and, in more recent studies, achieves acceptable figures.

Some other frequent locations, such as larynx, bladder or ovary, which rank among the ten leading causes of cancer death in Spain, evince problems in certification. A certain degree of overreporting has been described for laryngeal cancer, due to misclassification of head and neck tumours[6,8,18]. Similarly, there is certain measure of overreporting for oesophageal cancer, mainly attributable to the inclusion of stomach cases[6-8,18], as well as for liver, largely due to misclassification of gallbladder and ill-defined neoplasms[6-8,13,18]. Percy et al[27] warned that inclusion in ICD-9 code 155 of liver cancer that was not specified as primary or secondary, was a possible cause of misclassification for these tumours, as it might lead to some coders registering secondary liver cancers under this category.

Furthermore, there have been reports of underestimation of urinary bladder cancer, erroneously certified as prostate neoplasm[6-8,13,17,18]. It should, however, be noted that, even with this underestimation, Spain had the second highest bladder mortality rate within the European Union in 2000[26]. In addition, some Spanish authors have reported undernotification of skin cancers due to lack of information on their anatomic location[6], thereby implying their inclusion as ill-defined and unspecified tumours (ICD-9 195, 199).

Accuracy of ovary-neoplasm certification seems to vary widely among studies, though it can be regarded as undercertified according to pooled estimators. While some reported cases of death due to ovarian cancer were really due to abdominal or uterine neoplasms, in some studies[7,8,14], «unspecified uterus tumours» would appear to include some ovarian cancers as well as tumours of the cervix and endometrium[6,8,14,17,18].

Ill-defined tumours were badly certified according to Percy's criteria. Cirera and Navarro[7] reported there was clinical information that would allow for almost half of these tumours to be included in other categories. The selfsame problem has been described in other countries, such as Brazil[28].

Our results show that all cancer sites classified as well certified in Spain have been reported as such in the USA by Percy et al[5]. However, this author also encountered good agreement rates for oesophagus, bladder, gallbladder, thyroid gland and kidney, locations that did not display a good standard in Spanish studies. In Ontario, Canada, Reynolds[21] similarly observed good DRs and CRs for all those neoplasms classified as well-certified in Spain, with the exception of pancreas, and also found high rates for cervix uterus, bladder, kidney, ovary and endocrine glands. In France, Laplanche et al[20] reported CRs of over 80% for breast, colon-rectum, lung and pancreas, values similar to Spanish figures. In contrast, they found CRs of under 80% for head and neck and cervix, tumours which in Spain register good CRs. Stomach cancer was also well classified in Brazil[29] and Italy[30]. In international comparisons, however, a relevant factor to be considered are differences in international coding practice, since divergences up to 30% have been described by Percy and Muir[31] among western countries using the ICD-9.

With respect to accuracy of certification, Percy mentioned the influence of several factors such as age, sex, geographic area, presence of an autopsy or place of death[5]. In Spanish studies, a lower quality has been reported for older ages and for women[6-8,18]. These sex-related differences are reflected in the percentage of ill-defined tumours and ill-defined causes, which are regularly higher in females and could in part be due, both to gynaecological neoplasms[18] and to the older age of women. Insofar as place of death is concerned, a lower quality of death certification has been associated with death at home[6,7], though other authors have failed to find any difference[11]. Finally, the quality of certification has been shown to be slightly lower in rural areas[18].

As Navarro et al[17] points out, clinical information is needed to validate death certificates, thus implying the exclusion of those cases where this information is not available. Death certificates lacking complementary clinical or anatomo-pathological data could be of worse quality, as they probably include more home deaths. Navarro found that death certificates excluded for this reason belonged to subjects who were, on average, seven years older than those included in her study. All this may well lead to overestimation of the quality reported in many studies.

Several strategies have been proposed to motivate and improve physicians' certification[28] such as a periodic assessment of coding practices along with the education and motivation of medical students and physicians. In Spain, several Regional Health Authorities implemented specific workshops that showed their efficacy in enhancing death certificate quality indicators[32]. Yet, these interventions are questioned by Swift's study[33], which failed to find significant changes in the state of certification after the introduction of formal education into the medical syllabus.

A further point of discussion is the effect of the introduction of the ICD-10 on the quality of mortality data. To date, we have been unable to find any validation study in Spain covering the ICD-10 coding period. In 1999, Ruiz et al[34] compared ICD-9 and ICD-10 coding in a huge sample of Spanish death certificates. They reported that, whereas ill-defined condition figures increased almost a 14% with the use of this latest version, neoplasms seemed quite stable. In contrast, our data indicate that the ICD-10 effect might be greater than thought, and that it has also affected tumours coding. This could suggest a worsening in the quality of data, and careful surveillance is thus called for.

In conclusion, the quality of cancer death certification in Spain for all tumours and all main sites has improved over the last two decades and can be considered comparable to internationally published data. Thus, mortality data constitute a valid indicator to estimate the burden of cancer. However, for some locations, such as the oesophagus or bladder, death certificate information should be approached with caution. Misclassification may generate problems for studying mortality trends and planning future needs. It should be noted that, in general, most available information on the quality of death certification reflects the situation from 1970 to 1990, when the ICD-9 was in use. The relatively recent introduction of the ICD-10 may have affected quality indicators and should thus be carefully monitored. Finally, our results point to the need to improve death certification in the case of Spanish women.

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