The effectiveness of health systems in influencing avoidable mortality: a study in Valencia, Spain, 1975-90

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Abstract

Objectives – To measure variations in the Holland and Charlton classifications of avoidable death causes and to estimate the effect of the Spanish national health system on avoidable mortality.

Design – Mortality in the Valencian Community was assessed between 1975 and 1990. The classifications of Holland and Charlton, used to assess avoidable causes of death, were compared. Holland's classification was then used to divide avoidable mortality into two groups – medical care indicators (MCI), which show the effectiveness of health care, and national health policy indicators (NHPI), which show the status of primary prevention. Comparisons were made with rates, group rates, and population rates. Trends and indices were also studied.

Setting – Valencia, Spain, 1975-90.

Results – During the study period, avoidable mortality (only assessed by MCI) fell 63%, whereas the remainder of the mortality (non-MCI causes, that is all the non-avoidable causes together with the NHPI group) fell by 17%. If it is assumed that the mortality due to non-MCI causes indicates the overall effect of the environmental, social, nutritional, and genetic influences, then the difference between this and the MCI group would take us nearer the actual effect of the intervention of the health system.

Conclusions – It is concluded that in this community, the health system has been responsible for approximately 47% of the total reduction in mortality from avoidable causes in the period studied.

(*J Epidemiol Community Health* 1996;50:320-325)

It is obvious that the objective of a health system is the application of the best current scientific knowledge in real conditions. However, when the theoretical foundations indicate that a specific pathology is avoidable while practice shows the opposite, it seems necessary to assess the quality of the health care.

Rutstein¹² made a list of "unnecessary untimely mortality" in order to assess the quality of the health care; however, it was Charlton *et al*³ who carried out the study of the community referring to those causes as avoidable and as possible indicators of the effectiveness of the health services. Numerous studies have been

done since,⁴⁻⁹ the most important being the *Project of Coordinated Action of the European Community*, directed by Holland and published in 1988, which became the *Atlas of Avoidable Death*,¹⁰ with a second update in 1991.¹¹ This study attempted to unify the list of avoidable mortality causes.

In practical terms, all studies on avoidable mortality use a selection of causes based on Rutstein's original list and generally omit infrequent causes of mortality. Many also omit causes, such as lung cancer and hepatic cirrhosis (originally included in Rutstein's list) and motor accidents (not included), whose avoidance is outside the scope of the health care services and belongs instead to the primary prevention field. The separation into causes that are amenable to secondary prevention or medical treatment (medical care indicators (MCI)) and those that are avoidable through primary prevention (national health policy indicators (NHPI)) comes from Holland's work,^{10,11} and has been continued in some national^{12,13} and international studies.

To study the evolution of avoidable mortality in the Valencian Community between 1975 and 1990 we compared the two most representative lists of death causes – those of Holland and Charlton. We aimed to assess mortality trends for both the MCI and NHPI.

Methods

The autonomous Valencian Community is in the east of Spain and has an approximate population of 4 million people, a 2.5% vegetative growth rate, and a birth rate of 11 per 1000 inhabitants. The work force is mainly involved in the service sector, specifically in tourism but industry and farming are also important and represent 15% of the gross domestic product of Spain.

DATA

The data were collected directly from the National Statistics Institute (1975-86) and from the mortality registry of the Valencian Community (1987-90). Mortality data bases were created. These included five year age groups up to 75 years (the first five year period was divided into two groups, 0-1 and 1-4 years, as there are causes which are avoidable for the first year) and sex groups for each of the selected death causes and for the total of causes, during the period 1975-90.

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Accepted for publication
November 1995

Table 1 Avoidable mortality selected causes, Holland's classification

Cause	Age (y)	ICD-8	ICD-9
Secondary prevention, or medical care indicators			
1 Tuberculosis	5–64	010–19	010–018
2 Malignant neoplasms of cervix uteri	15–64	180	179
3 Malignant neoplasms of cervix and body of uterus	15–64	180, 182	179, 180, 182
4 Hodgkin's disease	5–64	201	210
5 Chronic rheumatic heart disease	5–44	393–398	393–398
6 Respiratory diseases	1–14	460–519	460–519
7 Asthma	5–44	493	493
8 Appendicitis	5–64	540–543	540–543
9 Abdominal hernia	5–64	550–553	550–553
10 Cholelithiasis and cholecystitis	5–64	574–575	574–575
11 Hypertensive and cerebrovascular disease	35–64	400–404	401–405
		430–438	430–438
12 Typhoid	5–64	001	001
13 Whooping cough	0–14	033	033
14 Tetanus	0–64	037	037
15 Measles	1–14	055	055
16 Osteomyelitis	1–64	720	720
17 Maternal deaths*	all	630–678	630–676
18 Perinatal mortality†			
Primary prevention, or national health policy indicators			
19 Cirrhosis of liver	15–64	571	571
20 Malignant neoplasms of trachea, bronchus, and lung	5–64	162	162
21 Motor vehicle accidents	all	E810–823	E810–825

* Number of maternal deaths associated with 100 000 live and stillbirths.
† Number of deaths in the first week plus late foetal mortality per 1000 live and stillbirths.

POPULATIONS

The population “inhabitants/year at risk” was the total of the Valencian Community during the same period, although it always referred to 1 July of the corresponding year. For the calculation, we used data from the municipal census (31 December 1975),¹⁴ from the population census (28 February 1981),¹⁵ from the municipal census (1 April 1986),¹⁶ and from the population census (28 February 1991)¹⁷; the intercensal growth rate was used as an instrument and was defined as the inter-annual and accumulative growth rate¹⁸:

$$P_b = P_a * (1 + r)^{tb - ta}$$

where P_b is the population in the date tb , P_a is the population in the ta date, and r is the intercensal growth rate, r being equal to:

$$r = \text{antilog}[1/(tb - ta) * (\log(P_b/P_a)) - 1]$$

We used the classifications of Holland⁹ and Charlton.³ These classifications of avoidable death causes, and the corresponding codes (ac-

cording to the *International Classification of Diseases, Injuries, and Causes of Death*, ICD-8 and 9) are displayed in tables 1 and 2.

As the classifications used are not the same, we carried out an individual study of those death causes on Charlton's list which included different codes, for instance arterial hypertension (5 to 64 years), pneumonia and bronchitis (5 to 49 years), acute respiratory infections (5 to 49 years), bacterial infections (5 to 64 years), and deficiency anaemias (5 to 64 years), which are included in subsequent tables as Charlton's classification (diseases which did not coincide). Likewise, other avoidable causes of mortality only differed in relation to age (cervical cancer, asthma, Hodgkin's disease, and maternal mortality) and an individual study was not carried out (they were included in the overall research). We followed some reports^{10–12} in which avoidable death causes (Holland's classification) were grouped as national health policy indicators (NHPI) and medical care indicators (MCI).

Table 2 Avoidable mortality selected causes, Charlton's classification (CC). Differences in relation to Holland's classification (HC)

Cause	Age (y)	ICD-8	ICD-9
1 Hypertensive disease*	5–64	400–404	401–405
2 Pneumonia and bronchitis*	5–49	480–486	480–483
		490	485–486
			490
3 Acute respiratory infections*	5–49	470–474	487
4 Bacterial infections*	5–64	004–034	004–034
		320	320–322
		381–383	381–383
		390–392	390–392
		680–686	680–686
		710–720	711–730
5 Deficiency anaemias*	5–64	280–281	280–281
6 Tuberculosis†	5–64	010–019	010–019
7 Chronic rheumatic heart disease‡	5–44	393–398	393–398
8 Appendicitis‡	5–64	540–543	540–543
9 Abdominal hernia‡	5–64	550–553	550–553
10 Cholelithiasis and cholecystitis‡	5–64	574–575	574–575
11 Perinatal mortality‡			
12 Malignant neoplasms of cervix uteri‡	5–64	180	180
13 Asthma‡	5–49	493	493
14 Hodgkin's disease‡	5–34	201	201
15 Maternal mortality‡	10–44	630–678	630–678

* CC causes which differ, in some codes, from HC codes (see table 1).
† CC causes with codes and ages equal to those in HC.
‡ CC causes with different ages from those in HC.

DESIGN OF THE STUDY

The annual evolution between 1975 and 1990 for the whole Valencian population was studied. Avoidable mortality rates were calculated, always per 100 000 inhabitants/year at risk, except for maternal mortality (per 100 000 live born), perinatal mortality (per 1000 live born) and for malignant neoplasms of the cervix uterus (per 100 000 women). Rates were also determined for the age group 5 to 64 years for the groups Holland classification, NHPI, MCI, and Charlton classification, as well as the general non-MCI (without including the deaths that measure the efficiency of the health system – that is, the MCI cases).

Standardisation was direct. It was undertaken in relation to three populations; firstly using the 1981 census of the Valencian Community, secondly the Spanish population in order to make national comparisons; and thirdly by using the standard population of

Table 3 The mean number of deaths per 100 000 for “avoidable deaths indicators” and the proportion of deaths by age and sex. Valencian community (1975–90)

Age groups	Total mortality*	MCI rate*	NHPI rate*	Charlton classification rate*	MCI %†	NHPI %†	Charlton classification %†
Males							
0–4‡	249.6	4.1	6.1	—	1.63	2.44	—
5–14	32.4	2.6	6.3	2.5	7.92	19.47	7.74
15–44	145.3	7.9	46.2	7.7	5.41	31.79	5.3
45–64	940.4	102.5	187.8	20.8	10.9	19.96	2.21
65–74	3803.7	—	325.3	—	—	8.55	—
≥ 75	12 111.7	—	68.9	—	—	0.57	—
Females							
0–4‡	195.4	3.7	4.2	—	1.89	2.14	—
5–14	21.3	2	3.2	2.2	9.45	15.12	10.21
15–44	64.5	7.6	10.5	6.5	11.77	16.22	10.09
45–64	466.5	69.1	40.1	14.4	14.81	8.6	3.08
65–74	2059.7	—	40.5	—	—	1.96	—
≥ 75	9747.8	—	22.8	—	—	0.23	—

* Standard mortality rates per 100 000. Reference population: Valencian Community, census 1981.
† Percentages based on the total mortality rate.
‡ Perinatal mortality not included.
MCI=medical care indicators; NHPI=national health policy indicators.

the European Community,¹⁹ for international comparisons. The male rate was also established.

Both linear and non-linear regression (quadratic or second order) of the changes in mortality standardised over time were used to describe the mortality trend. This type of modelling reduces the effect of random variation on mortality. The Student’s two tailed *t* test was used to determine the statistical significance of the trends. Significance levels were established at *p* = 0.001, *p* = 0.01, and *p* = 0.05.

Logarithmic transformation did not significantly improve the explanation of the variables (based on adjusted *R*²). Because of this, the linear model is the only representation. In some cases, when the adjusted *R*² in the linear model was too low, the quadratic model was used. This model is an adequate test for determining the degree of non-linearity in the mortality trend, and it was also used to estimate changes in some causes of death during the period studied (ie, asthma, motor accidents, hypertension, acute respiratory infections and deficiency anaemias), which improved the adjustment. By using this procedure, even the motor accident trend turned out to be significant.

There was no adjustment study of individual mortality causes with low numbers of deaths

such as typhoid, whooping cough, tetanus, measles and osteomyelitis.

We followed the method of Poikolainen and Eskola²⁰ in estimating the impact of medical services on avoidable causes of mortality. This was achieved by comparing the estimated value of the regression in the mortality rates with an expected rate (considering that if the impact of the medical services were to remain constant, mortality from avoidable and unavoidable causes would also remain constant). Variations in the explained rates were also calculated according to the equation model and real data, in order to establish the percentage of the relative adjustment level of the trends.

Results

Our research first took into account a total of 42 403 deaths (Holland’s classification) for the whole of the period studied. Altogether 13 050 deaths were included in the MCI group (excluding perinatal mortality), and more than twice this number, 29 353, were included in the NHPI. In the Charlton classification a total of 4152 deaths were processed (also excluding perinatal mortality).

With regard to mean values for the period per 100 000 inhabitants and sex (table 3), the results showed that the NHPIs have high rates

Table 4 Evolution of the age adjusted mortality rates per 100 000 for “avoidable death indicators” (5–64 years). Period 1975–90. Index numbers and differences

Year	Non-MCI general mortality			HC			NHPI			MCI			CC		
	Rate*	Index		Rate*	Index	D†	Rate*	Index	D†	Rate*	Index	D†	Rate*	Index	D†
1975	237.00	100		83.69	100	0	40.06	100	0	43.63	100	0	17.30	100	100
1976	229.45	97		78.23	93	–3	41.45	103	7	36.78	84	–13	12.13	70	–27
1977	229.20	97		76.17	91	–6	42.54	106	9	33.63	77	–20	11.14	64	–32
1978	227.13	96		77.56	93	–3	44.46	111	15	33.10	76	–20	11.91	69	–27
1979	222.46	94		77.02	92	–2	44.43	111	17	32.59	75	–19	10.10	58	–35
1980	219.68	93		75.85	91	–2	44.68	112	19	31.17	71	–21	9.47	55	–38
1981	215.54	91		72.06	86	–5	43.54	109	18	28.52	65	–26	8.58	50	–41
1982	209.18	88		69.05	83	–6	41.93	105	16	27.12	62	–26	7.86	45	–43
1983	208.49	88		67.69	81	–7	42.49	106	18	25.20	58	–30	7.42	43	–45
1984	210.78	89		69.12	83	–6	44.78	112	23	24.34	56	–33	7.10	41	–48
1985	209.02	88		69.70	83	–5	45.02	112	24	24.68	57	–32	7.50	43	–45
1986	207.82	88		66.05	79	–9	44.82	112	24	21.23	49	–39	6.57	38	–50
1987	201.70	85		63.00	75	–10	44.70	112	26	18.30	42	–43	6.09	35	–50
1988	204.23	86		65.93	79	–7	46.23	115	29	19.70	45	–41	6.40	37	–49
1989	205.84	87		66.57	80	–7	49.84	124	38	16.73	38	–49	5.49	32	–55
1990	197.81	83		65.89	79	–5	49.87	124	41	16.02	37	–47	5.68	33	–51

* Standard mortality rate, the 1981 Valencian Community population has been taken as a standard.
† Differences in index numbers, compared with the non-MCI general mortality index. CC = Charlton’s classification; Non-MCI general mortality = general mortality rate minus MCI mortality rate (both for 5–64 years); HC = Holland’s classification; NHPI = national health policy indicators; MCI = medical care indicators.

Table 5 Annual mean rates (standardised for Spain and the European Community) per 100 000 inhabitants

Cause	Age (y)	Valencia, adjusted rates			European population, adjusted rates			
		Males	Females	Total	Males	Females	Total	MR
Medical care indicators								
Tuberculosis	5–64	3·19	0·78	1·93	3·66	0·87	2·21	4·21
Malignant neoplasms of cervix uteri	15–64	—	1·81	1·81	—	1·97	1·97	—
Malignant neoplasm cervix and corpus of uterus	15–54	—	2·77	2·77	—	3·09	3·09	—
Hodgkin's disease	5–64	1·09	0·43	0·75	1·21	0·47	0·83	2·57
Chronic rheumatic heart disease	5–44	1·12	1·39	1·26	1·34	1·7	1·52	0·79
Respiratory disease	1–14	2·68	2·22	2·46	2·77	2·31	2·55	1·2
Asthma	5–44	0·24	0·24	0·24	0·27	0·29	0·28	0·93
Appendicitis	5–64	0·27	0·14	0·2	0·3	0·16	0·23	1·88
Abdominal hernia	5–64	0·19	0·31	0·26	0·22	0·36	0·3	0·61
Cholelithiasis and cholecystitis	5–64	0·39	0·39	0·39	0·45	0·45	0·45	1·00
Hypertensive and cerebrovascular disease	35–64	62·76	38·35	49·83	62·16	38·02	49·36	1·63
Maternal mortality*	All	—	11·55	11·55	—	11·55	11·55	—
Perinatal mortality†	—	—	—	14·04	—	—	14·04	—
Typhoid	5–64	0·03	0·02	0·02	0·03	0·02	0·02	1·5
Whooping cough	0–14	0·01	0·06	0·03	0·01	0·07	0·04	0·14
Tetanus	0–64	0·17	0·07	0·12	0·18	0·08	0·13	2·25
Measles	1–14	0·09	0·14	0·11	0·1	0·15	0·12	0·67
Osteomyelitis	1–64	0·01	0·004	0·01	0·01	0·004	0·01	2·5
National health policy indicators								
Malign cancer of trachea, bronchus, and lung	5–64	22·62	7·22	14·57	26	8·27	16·73	3·14
Cirrhosis of liver	15–74	57·37	5·37	29·01	58·3	5·48	29·57	10·64
Motor vehicle accidents	Todos	29·49	8·03	18·29	29·8	7·98	18·43	3·73
Charlton's classifications (disease that differ from Holland's classification)								
Hypertensive disease	5–64	1·67	0·97	1·3	1·91	1·1	1·48	1·74
Pneumonia and bronchitis	5–49	2·58	1·32	1·94	2·79	1·4	2·09	1·99
Acute respiratory infections	5–49	0·31	0·19	0·25	0·34	0·2	0·27	1·7
Bacterial infections	5–64	0·64	0·43	0·53	0·68	0·44	0·56	1·55
Deficiency anaemias	5–64	0·08	0·06	0·07	0·09	0·06	0·08	1·5
Disease groups (total)								
Medical care indicators‡§	All avoidable	26·73	18·44	22·32	30·69	21·15	25·61	1·45
National health policy indicators§	All avoidable	87·95	17·62	50·38	94·05	18·74	53·87	5·02
Charlton's classification‡§	All avoidable	8·19	6·12	7·12	9·13	6·83	7·94	1·34

* Rate per 100 000 born alive; † rate per 1000 born alive (data from 1975–90).
‡ Perinatal mortality is not included; § from 5 to 64.
MR = Male rate.

for ages 65 to 74 and more than 75 years for both sexes, although rates are even higher for men. Charlton classification rates are a lot lower, the highest rate was in the 45–64 years age group for both men and women. In the Holland classification, however, avoidable causes of death for men were most important in the 15–44 years age group which accounted for approximately 38% of the total mortality (especially due to NHPI (32%)) followed by the 45–64 age group which accounted for 31% (the NHPI represented 20%). The results for women were similar. The 15–44 age group was most important, representing approximately 28% of the total mortality for the age group; however, the MCI proportion was larger (12%) than in males. The next highest group was the 5–14 age group, with a 10% MCI, and the 45–64 age group in which we observed the highest MCI, approximately 15%, which was higher than the NHPI.

With regard to the evolution of mortality during the period (table 4) and referring to the indices, a reduction in unavoidable mortality of approximately 17% was observed, whereas for avoidable mortality the Holland classification was reduced by 21%, especially due to the MCIs, which were reduced to 63%, while NHPI increased to 24%. A transverse comparison shows the differences on an annual basis. The NHPI presented a clearly growing trend with some years of intense growth, whereas the opposite happened in the case of MCI.

The mean rates per 100 000 inhabitants for the period were then studied according to cause of death and adjusted to the standard of the

Spanish population and that of Europe (table 5). The NHPI was the most important with a mean rate of 50·38, whereas men reached values of up to 87·95. We can make practically the same comments when applying the adjusted rates to the European Community, although the values increased proportionally. The Charlton classification chart, however, retained low values – 7·12 for the total. The male rate was also noteworthy – it was 11 in the case of cirrhosis, 4 in tuberculosis, and 3 in motor accidents and lung cancer. However, in women (excluding specific causes for this group) we found values of 0·15 for deficiency anaemias and whooping cough, 0·6 for hernias, and 0·8 for chronic rheumatic heart disease.

Adjustment of the trends of the standardised rates to the Valencian Community population (1981) for the period 1975–90 (table 6) was carried out, and a positive trend for the adjusted NHPI slope was found, showing a growth of 0·5 points per year. The rest of the slopes were negative. The β coefficients of MCI ($t = -17·8$), Holland classification ($t = -9·27$) and Charlton classification ($t = -7·98$) were negative and significant ($p < 0·001$). With regard to the different avoidable causes, all were negative, except for cervical cancer, hepatic cirrhosis, and motor accidents.

The figure shows the evolution of the standardised mortality rates (general and avoidable mortality – Holland's classification – and mortality for the MCI and NHPI) from age 5 to 64 years for the period 1975–90 in the Valencian Community (in a logarithmic scale). General mortality shows a slightly falling trend and the evolution of the avoidable mortality rates are

Table 6 Parameters of adjustment to the avoidable cause trend (1975–90), on calendar year and rate variation

Cause	Age (y)	Per 100 000 inhabitants		Regression coefficient	Rate variation 1975–90 (%)	
		α coefficient	β coefficient		by regression	by standard*
Medical care indicators						
Tuberculosis	5–64	3.148	–0.1608††	0.83	–76.5	–71.21
Malignant neoplasms of cervix uteri†	15–64	0.941	0.1086††	0.546	73	89.56
Malignant neoplasms of cervix and body of uterus†	15–54	4.764	–0.2579††	0.514	–81.11	–57.54
Hodgkin's disease	5–64	1.14	–0.0512††	0.729	–67.57	–66.13
Chronic rheumatic heart disease	5–44	2.533	–0.1690††	0.791	–100.09	–84.95
Respiratory diseases	1–14	4.489	–0.2494††	0.687	–83.29	–58.05
Asthma (QR)	5–44	9739	–9824NS	0.266	–23.91	–34.92
Appendicitis	5–64	0.374	–0.0222††	0.535	–89.33	–88.78
Abdominal hernia	5–64	0.428	–0.0224††	0.684	–79.02	–74.19
Cholelithiasis and cholecystitis	5–64	0.572	–0.0244††	0.419	–63.32	–66.67
Hypertensive and cerebrovascular disease	35–64	67.564	–2.4616††	0.931	–54.65	–59.8
Maternal mortality‡	All	21.344	–1.4013††	0.733	–98.5	–76.65
Perinatal mortality§		17.316	–1.0749††	0.508	–62.07	–56.46
National health policy indicators						
Malignant neoplasms of trachea, bronchus and lung	5–64	15.693	–0.1837††	0.652	–17.54	–11.8
Cirrhosis of the liver	15–64	21.837	0.8451††	0.878	58.03	52.91
Motor vehicle accidents (QR)	All	209 946	211.82**	0.423	16.83	18.24
Charlton's classification (disease that differ from Holland's classification)						
Hypertensive disease (QR)	5–64	15 596	–15.7NS	0.41	–34.28	–40.93
Pneumonia and bronchitis	5–49	3.031	–0.1453††	0.738	–71.96	–77.95
Acute respiratory infections (QR)	5–49	26 242	–26.46**	0.45	–91.13	–94.81
Bacterial infections	5–64	0.745	–0.0291††	0.587	–58.43	–53.05
Deficiency anaemia (QR)	5–64	4426	–4.457NS	0.33	–90.16	–100
Disease groups (total)						
Medical care indicators	5–64	39.043	–1.5997††	0.957	–61.45	–63.29
National health policy indicators	5–64	41.031	0.4527††	0.661	16.54	24.49
Holland's classification	5–64	80.08	–1.147††	0.86	–22.98	–21.3
Charlton's classification	5–64	13.25	–0.5950††	0.819	–67.34	–67.17
Total mortality	5–64	270.989	–3.8810††	0.952	–21.45	–23.67

* Standardised rates according to the Valencian Community population (census 1981); † Rates per 100 000 women; ‡ Rates per 100 000 live born; § Rates per 1000 live born (data from 1975–86). NS = Non-significant; ** $p < 0.05$; †† $p < 0.01$; ‡‡ $p < 0.001$. QR = Quadratic regression.

Evolution of age adjusted mortality rates, avoidable mortality (Holland classification), and National health policy indicators and medical care indicators in the Valencian Community 1975–90.

very similar. However, the evolution of NHPI and MCI is different. NHPI shows an increasing trend and MCI a clearly falling one.

Discussion

Firstly, and with regard to the 5 to 64 years age group, we must emphasise the influence of the classifications on the contribution of avoidable mortality to global mortality. For the period 1955–90, the Holland classification represented 30% of general mortality whereas the Charlton classification represented only 4%. The practical usefulness of the Holland classification stems from its ability to differentiate between two groups that have differing

importance – the MCI group and the NHPI, representing 11% and 19% respectively of the total mortality. Some similarities between the Charlton classification and the MCI must be taken into consideration as well as the fact that their relative difference is a result of cerebrovascular diseases, which accounted for 70% of the total MCI. In fact, the rates for the 5–14 and 15–44 year groups, both for men and women, are practically equal as cerebrovascular diseases are more common in old age.

Secondly, it is important to mention the contribution of men to avoidable mortality, especially in the NHPI group, which showed a male rate of 5. The male rate was also important in the MCI group (1.45), despite the existence of diseases which only affect women, such as cervical cancer and maternal mortality. The same applies to the Charlton classification, although the male rate (1.3) was slightly lower than the value for Spain, published in another paper covering the period 1975–84.²¹

The rapid decline in mortality for both the MCI group and in Charlton's classification seems interesting, as both showed a homogeneous answer in the research. On the other hand, the reduction in causes derived from health policies, promotion, and prevention present us with an important increase in other areas. As to specific causes, we find important reductions in deaths due to deficiency anaemias, acute respiratory infections, appendicitis, and chronic rheumatic heart disease. This may point to the selective efforts of the health system, while there are causes that show considerable increases, such as cervical cancer, hepatic cirrhosis, and motor accidents. In other countries such as Sweden, however, there have

been decreases in all avoidable causes except for lung cancer for the period 1974–85.¹¹

The comparison between reductions in mortality due to avoidable and unavoidable causes suggests the impact level of the health services on mortality. Comparisons for the 1975–90 period for the Valencia Community indicate that approximately 46% of the decrease (taking into account the difference in the MCI indexes of avoidable mortality in the 5–64 age group) is due to the intervention of the health system, which implies a 2.9% annual decrease during the period. This assumption is based on the reasoning that in the absence of health services, the decrease in avoidable mortality would have been equal to that for unavoidable causes. Other authors showed for Finland²⁰ a reduction effect of the health system of 50% for the period 1969–81, which is equivalent to a 3.85% annual reduction, although we consider that this report was based on a somewhat different classification of avoidable causes and on a previous period of time.

Some aspects, such as the possible effects of the accuracy of the death certificates and the differences in coding, especially as a result of the code changes in ICD-8 and ICD-9, have to be taken into account. In a study in which 25% of the deaths in England and Wales¹⁰ were coded according to two classifications, the differences were lower than 10% for each of the avoidable causes, except for chronic rheumatic heart disease, which showed considerable differences. The present study did not show differences as a result of coding changes.

Variability in evolution over time could also arise as a result of uneven distribution in incidence, prevalence, and/or lethality; although control of the potentially avoidable factors which could lead to death should be the same.²² As proof of this potential control of the situation, confidential enquiries carried out for diverse death causes showed that the deficiencies in the services have been overcome.^{23–25}

The joint assessment of the indicator group could also function as an indicator for the distribution of resources in the health sector, whereas the individual use of MCI could be as a quality control of the results of the health care process, and even as an indicator in relation to the management of the services through the assessment of their effectiveness; the NHPI assessment would provide valuable information about the efficiency of the primary prevention measures at a collective level and public health measures applied previously. The slight fall in general mortality over the period studied obviously coincides with a situation in which it is difficult to obtain considerable reductions in the rates. We must also take into account the fact that increased life expectancy (with the subsequent increase of the older population) increases avoidable mortality rates in most developed countries. The same happens with the avoidable mortality rate, the reduction in its two components being most important. Indeed, the steeply falling trend in the MCI group points at achievements in health care; however, the

increase in NHPI mortality shows the difficulties in improvement in this regard without carrying out major reforms in the public health arena. Some examples of these – mortality linked to tobacco,²⁶ motor accidents,²⁷ and mortality related to dieting habits²⁸ – evidently require efficient measures, not only on a health basis, and results are not evident for some time as most of these diseases have a long latency period.

Supported by a grant of Conselleria de Sanitat i Consum de la Generalitat Valenciana, no ref 26/91.

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