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Regional and gender variation in mortality amenable to health care services in Italy

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Abstract

Background: Mortality amenable to health care services ("amenable mortality") has been defined as "premature deaths that should not occur in the presence of timely and effective health care" and as "conditions for which effective clinical interventions exist". Although it proved to be a reliable indicator of performance of health care services in the European countries at national level, evidence about its regional variation is limited. We analyzed the regional and gender variability in the performance of health care services using the amenable mortality rate and its contribution to all-cause mortality under age 75 for the period 2006–2009.

Methods: The national amenable mortality rate was calculated as the average annual number of deaths for specific causes defined according to the list of Nolte and McKee over the average population aged 0–74 years per 100,000 inhabitants in Italy. The contribution of amenable mortality to all-cause mortality (%AM) was calculated as the ratio of amenable mortality rate to all-cause mortality rate. Results were then stratified by gender, region, and year. Data were drawn from national mortality statistics for the period 2006–2009 provided by the Italian Institute of Statistics (ISTAT).

Results: During the index period, in Italy the age and sex-standardized death rate amenable to health care services (SDR) was 62.4 per 100,000 inhabitants: 65.8 per 100,000 for males and 59.0 for females. Amenable mortality accounted for about one-quarter (25.3%) of total mortality under age 75: one-fifth (20.1%) for males and one-third (32.9%) for females. Southern Italy generally had higher levels of amenable mortality, both in terms of SDR and %AM, except for Puglia. However, SDRs and %AM had a different geographical pattern, which was consistent for men and women. Examination of temporal trends revealed that SDR linearly declined between 2006 and 2009 (63.9 to 61.7 per 100,000; % change = –3.4%; $p = 0.021$), while %AM was almost stable (25.1% to 25.7%; % change = +2.4%; $p = 0.120$). Piedmont, Lombardy, the autonomous province of Trento, Veneto and Campania had a linear decrease in SDR, while Abruzzo had a linear increase in SDR. Puglia had a linear increase in %AM.

Conclusions: The present study contributes additional evidence on the role of amenable mortality as a synthetic indicator of the effectiveness of health care services. We argue that, in a decentralized health care system such as the Italian one, regional stratification is needed to put amenable mortality into the context of the regional specificities of health care provision. We also demonstrated that it is important to consider both SDRs and %AM, because this latter measure can give an insight on the extent to which health services can contribute to ameliorating the health of a population. Thus, consideration of both SDRs and %AM can be useful for national and regional comparisons, and can constitute the basis for evidence-based policy decision making.

Key words

Amenable mortality, Health care services, Performance, Population health, Gender

1 Introduction

During the last thirty years health care expenditure has been growing more rapidly than the gross domestic product in all European countries [1]. The economic crisis poses serious concerns about the long-term sustainability of health care systems with a universal coverage and calls for urgent solutions. An essential ingredient for sustainable health care systems is to ensure quality of care through a better organization that allows reducing public expenditure. This is particularly challenging in the Italian health care system in which the central government determines the required minimum benefit package and mostly controls the distribution of tax revenue, but the regions have responsibility for the organization and delivery of health services. In order to optimize public expenditure, explicit frameworks defining the goals of a health system against outcomes and performance indicators are required [2]. Dever was the first to emphasize in 1976 the relationship between health expenditure and mortality, using an epidemiological model for health policy analysis in which the system of health care accounted for 11% of mortality and 90.6% of health expenditures [3].

In recent years, mortality amenable to health care services (hereafter AM) has been used as an indicator of performance of health care systems following the definition of causes of "amenable" deaths by Nolte and McKee [4-6] and Tobias and Yeh [7], who revived the work done by European researchers in the 1980s and 1990s [5, 8]. Specifically, AM has been defined as "premature deaths that should not occur in the presence of timely and effective health care" [6] and as "conditions for which effective clinical interventions exist" [7]. As might be expected, AM rates highly correlate with population health indicators, such as life expectancy at birth [8] and disability-adjusted life expectancy [4]. In a recent Italian study [9], the convergent validity of AM was also supported by a high negative correlation between AM and life expectancy at birth and disability-free life expectancy at age 15 for both genders.

Although AM can be considered a reliable indicator of performance of health services at national level, evidence on the regional variability of this indicator is based on a limited number of studies carried out in Hungary [10] and more recently in the USA [11], Italy [9], Spain [12] and Israel [13].

Recently, Nolte and McKee [14] conceptualized AM both as the rate of amenable deaths and as the percentage of AM over all causes of death. They found that, in 2006/2007, the percentage of AM over all-cause mortality in the population aged <75 varied across high-income countries from 19.2% in France to 27.2% in New Zealand, and was higher among females (30.2%) than among males (21.2%). In Italy, this figure was 24.3% (males: 19.8%; females: 32.7%). Thus, the analysis of the contribution of AM to all causes may be crucial to identify inequalities in health care service provision.

The aim of this study was twofold. The first was to analyze the regional variability in health care services using the AM rate and the percentage of AM over all-cause mortality as performance indicators. The second was to examine the trends of these two indicators over four years (2006–2009), both at national and regional level. The present study builds on previous work carried out in Italy [8] by updating the period of observation and expands it by including trends over time and the calculation of the contribution of AM to all causes.

2 Materials and methods

2.1 Data

An observational study was carried out on individual data from national mortality statistics for the period 2006–2009, provided by the Italian Institute of Statistics (ISTAT), where causes of death are coded using the ICD-10 classification. The selected lists of causes of death amenable to health care is based on available evidence in the literature on the clinical effectiveness of existing medical interventions in treating different conditions in 2008 [6]. This evidence constitutes the basis for the list compiled by Nolte and McKee [4, 9] that we adopted in the present paper. The number of amenable deaths was 43,207 in 2006, 42,672 in 2007, 42,455 in 2008 and 42,972 in 2009 and the population below 75 years increased from 53,425,200 in 2006 to 54,252,368 in 2009.

2.2 Statistical analyses

Age and sex-standardized AM rate (SDR) and age and sex-standardized death rate for all causes (all-cause SDR) were calculated as the average annual number of deaths over the population aged 0–74 years per 100,000 inhabitants, with direct standardization to the 2005 OECD standard population. The contribution of AM to all-cause mortality (%AM) was calculated as the percentage of SDR over all-cause SDR. Then, we calculated age-standardized AM rates and %AM for males and females, separately.

We stratified SDRs and %AM by region and used the forest plots to compare the regional SDRs and %AM with the Italian average. We computed 95% confidence intervals using the normal approximation to Poisson distribution. Moreover, we used Pearson's r to analyze the relationship between regional SDRs and %AM.

Lastly, we analyzed the annual trends of SDRs and %AM for the period 2006–2009, using Poisson regression and logistic regression analysis.

Results are provided by region. Northwest Italy includes Piedmont, Aosta Valley, Lombardy and Liguria; Northeast Italy includes Veneto, Friuli-Venezia Giulia, Emilia-Romagna and the two autonomous provinces of Bolzano and Trento; Central Italy includes Tuscany, Umbria, Marche and Lazio; Southern Italy includes Abruzzo, Molise, Campania, Puglia, Basilicata and Calabria; Insular Italy includes Sicily and Sardinia. Statistical analyses were carried out using Stata software, version 12 (StataCorp. 2011. Stata Statistical Software: Release 12. College Station, TX: StataCorp LP).

3 Results

3.1 Differences in AM among Italian regions

During the study period (2006–2009), SDR in Italy was 62.4 per 100,000 inhabitants: 65.8 per 100,000 for males and 59.0 per 100,000 for females. AM accounted for just over one-quarter (25.3%) of total mortality under age 75 (men: 20.1%; women: 32.9%).

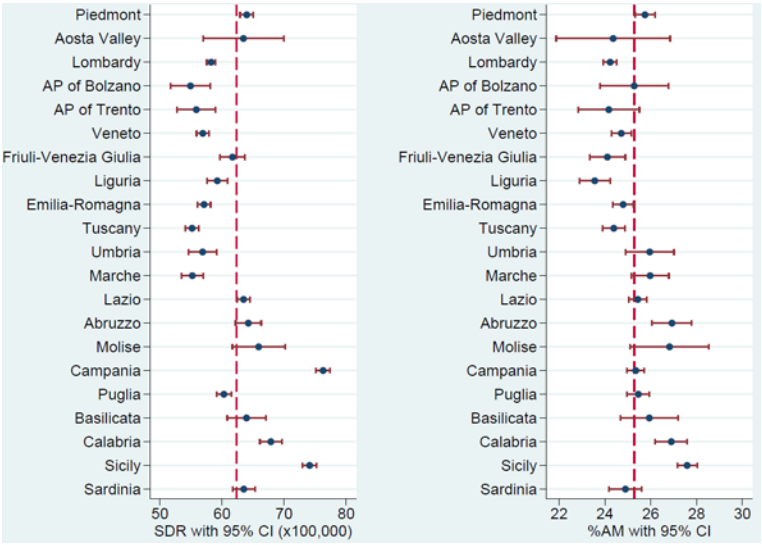

Figure 1. Forest plots showing the regional SDRs and %AM (with 95% CIs) in relation to the Italian averages (dashed lines) for the years 2006–2009.

SDR, age and sex-standardized amenable death rate; %AM, percentage of amenable mortality to all causes; AP, autonomous province; CI, confidence interval.

Figure 1 shows the forest plots of AM. Results indicate that for five regions (Piedmont, Lazio, Campania, Calabria and Sicily) SDRs were significantly higher than the Italian average; for three of these regions (Piedmont, Calabria and Sicily),

%AM was significantly higher than the national average. In ten regions (Lombardy, the autonomous provinces of Trento and Bolzano, Veneto, Liguria, Emilia-Romagna, Tuscany, Umbria, Marche, and Puglia), SDRs were significantly lower than the national average; for five of these (Lombardy, Veneto, Liguria, Emilia-Romagna and Tuscany) %AM was significantly lower than the Italian average.

Southern Italy generally had higher levels of AM, both in terms of SDRs and %AM, with the exception of Puglia.

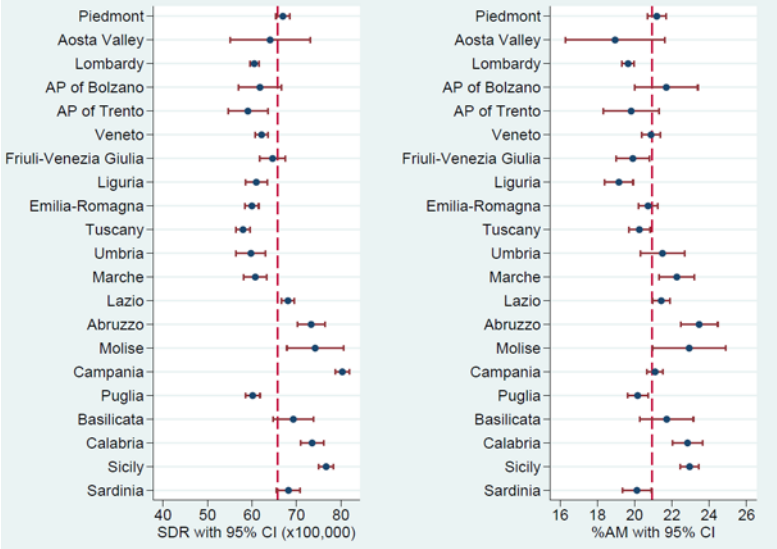

Figure 2. Forest plots showing the regional SDRs and %AM (with 95% CIs) in relation to the Italian averages (dashed lines) for the years 2006–2009 (males)

Figure 2 and Figure 3 show the regional distribution of AM for males and females, respectively. The ranges of SDRs among males and females were similar (males: range = 22.3 per 100,000; females: range = 24.2 per 100,000). However, among men we found a clear-cut divide in SDR values between Northern/Central and Southern Italy, while among women the distribution of regional SDRs did not reveal a clear-cut geographical pattern. The ranges of %AM for men and women were very similar (males: range = 4.5%; females: range = 4.1%).

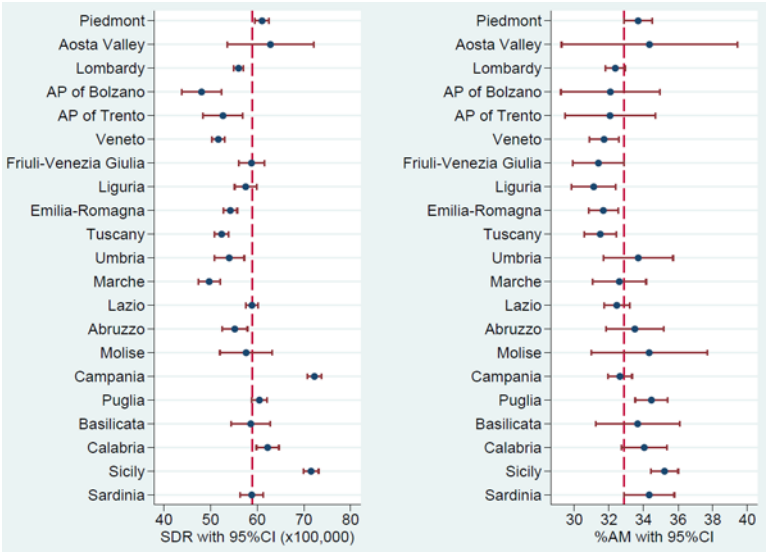

Figure 3. Forest plots showing the regional SDRs and %AM (with 95% CIs) in relation to the Italian averages (dashed lines) for the years 2006–2009 (females)

3.2 Relationship between regional SDRs and %AM

SDRs and %AM were strongly correlated (r = 0.64, p = 0.002). The scatter plot of regional SDRs and %AM is shown in Figure 4.

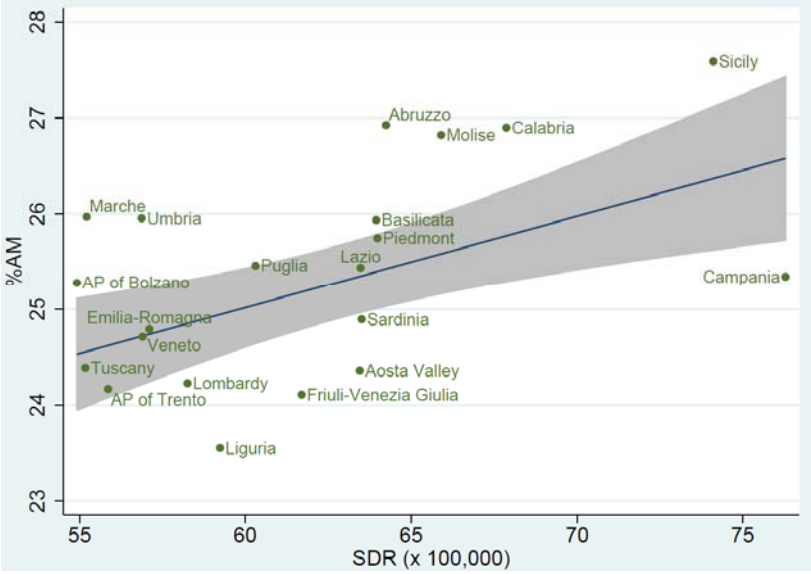

Figure 4. Scatter plot of %AM vs. SDR
Grey area: 95% confidence interval for the linear fit.

The correlation between SDRs and %AM was strong for both men and women (males: r = 0.65, p = 0.002; females: r = 0.58, p = 0.006).

3.3 Trends of AM

The trends of SDR declined significantly during the study period (p = 0.021) (Table 1). In particular, the SDR decreased from 63.9 to 61.7 per 100,000 (–3.4%) [males: 68.0 to 65.0 per 100,000 (–4.4%); females: 59.7 to 58.4 per 100,000 (–2.2%)]. The highest decrease in SDR values for both sexes combined was found between 2006 and 2007 (–2.2%), while between 2008 and 2009 SDR values were virtually unchanged (Table 1). Among men, the largest decrease in SDR values was found between 2006 and 2007 (–4.0%), and among women between 2007 and 2008 (–2.2%) (Table 1).

Over the study period only in five regions (Piedmont, Lombardy, the autonomous province of Trento, Veneto, and Campania) the SDR decreased significantly, while in Abruzzo we found a significant increase (Table 1). Specifically, the autonomous province of Trento showed the highest decrease in SDR values between 2006 and 2009 for both males and females (males: –11.8%; females: –21.7%), while Abruzzo showed the highest increase among males (+7.5%) and Marche among females (+17.6%).

In Italy, %AM did not change significantly over time (p = 0.120). Percentage change from 2006 to 2009 was +2.4% [males: from 20.8% to 21.5% (+3.4%); females: from 32.8% to 32.9% (+0.3%)]. Only in Puglia the %AM increased significantly during the study period (p < 0.001) (Table 2).

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Table 1. SDRs (per 100,000) in Italian regions for the years 2006 to 2009

Region	SDR				% change*	% change*	% change*	% change*	*p*-value of the
	2006	2007	2008	2009	2006–2007	2007–2008	2008–2009	2006–2009	linear slope†
Males and females									
Piedmont	67.8	63.7	62.5	62.0	–6.0	–1.9	–0.8	–8.5	0.001
Aosta Valley	62.5	70.7	65.1	56.0	13.1	–7.9	–14.0	–10.0	0.358
Lombardy	60.1	58.7	57.6	56.7	–2.3	–1.9	–1.6	–5.6	<0.001
AP of Bolzano	55.8	54.6	51.7	57.3	–2.2	–5.3	10.8	2.7	0.499
AP of Trento	61.1	53.4	58.2	51.0	–12.6	9.0	–12.4	–16.0	0.020
Veneto	58.0	60.3	54.8	54.6	4.0	–9.1	–0.4	–5.8	0.048
Friuli-VG	68.2	58.5	58.7	61.5	–14.2	0.3	4.8	–9.8	0.303
Liguria	62.5	54.6	59.1	60.7	–12.6	8.2	2.7	–2.8	0.924
Emilia-Romagna	59.0	57.1	55.4	57.0	–3.2	–3.0	2.9	–3.3	0.880
Tuscany	55.9	54.9	55.9	54.0	–1.8	1.8	–3.4	–3.3	0.795
Umbria	58.7	55.7	59.8	53.4	–5.1	7.4	–10.7	–9.0	0.403
Marche	55.6	52.2	55.6	57.5	–6.1	6.5	3.4	3.4	0.087
Lazio	64.5	62.5	64.4	62.5	–3.1	3.0	–3.0	–3.1	0.129
Abruzzo	62.6	64.9	63.0	66.5	3.7	–2.9	5.6	6.2	<0.001
Molise	68.0	65.2	68.0	62.5	–4.1	4.3	–8.1	–8.0	0.013
Campania	77.5	76.7	75.1	75.7	–1.0	–2.1	0.8	–2.3	<0.001
Puglia	59.8	61.7	60.0	59.8	3.2	–2.8	–0.3	0.0	0.404
Basilicata	70.0	56.8	65.3	63.9	–18.9	15.0	–2.1	–8.7	0.480
Calabria	70.0	66.5	65.9	69.1	–5.0	–0.9	4.9	–1.2	0.629
Sicily	73.4	76.2	71.6	75.3	3.8	–6.0	5.2	2.6	0.899
Sardinia	65.3	61.4	62.9	64.4	–6.0	2.4	2.4	–1.3	0.890
Italy	63.9	62.5	61.6	61.7	–2.2	–1.4	0.2	–3.4	0.021
Males									
Piedmont	72.4	67.0	63.8	64.7	–7.5	–4.8	1.4	–10.6	0.033
Aosta Valley	57.1	78.0	62.1	59.4	36.6	–20.4	–4.3	4.0	0.767
Lombardy	64.1	59.7	59.8	58.8	–6.9	0.2	–1.7	–8.3	0.018
AP of Bolzano	65.3	60.3	58.7	62.8	–7.7	–2.7	7.0	–3.8	0.741
AP of Trento	64.5	56.0	59.2	56.9	–13.2	5.7	–3.9	–11.8	0.162
Veneto	62.6	68.0	59.1	59.1	8.6	–13.1	0.0	–5.6	0.172
Friuli-VG	70.1	59.3	61.6	67.7	–15.4	3.9	9.9	–3.4	0.940
Liguria	63.3	57.5	59.3	63.8	–9.2	3.1	7.6	0.8	0.815
Emilia-Romagna	61.4	60.2	58.7	59.7	–2.0	–2.5	1.7	–2.8	0.908
Tuscany	59.4	57.4	59.1	56.1	–3.4	3.0	–5.1	–5.6	0.178
Umbria	62.7	56.8	63.4	56.1	–9.4	11.6	–11.5	–10.5	0.365
Marche	63.4	57.1	63.9	58.7	–9.9	11.9	–8.1	–7.4	0.664
Lazio	69.6	66.5	70.0	66.3	–4.5	5.3	–5.3	–4.7	0.598
Abruzzo	71.6	72.6	72.0	77.0	1.4	–0.8	6.9	7.5	<0.001
Molise	73.9	71.7	78.8	72.4	–3.0	9.9	–8.1	–2.0	0.945
Campania	81.6	80.1	79.7	79.6	–1.8	–0.5	–0.1	–2.5	<0.001
Puglia	58.7	62.7	60.1	59.2	6.8	–4.1	–1.5	0.9	0.769
Basilicata	75.1	64.3	68.8	69.0	–14.4	7.0	0.3	–8.1	0.268
Calabria	78.2	71.2	71.5	73.0	–9.0	0.4	2.1	–6.6	0.142
Sicily	77.5	75.4	74.0	79.8	–2.7	–1.9	7.8	3.0	0.620
Sardinia	72.9	63.0	65.0	71.9	–13.6	3.2	10.6	–1.4	0.976
Italy	68.0	65.3	64.9	65.0	–4.0	–0.6	0.2	–4.4	0.085
Females									
Piedmont	63.2	60.5	61.1	59.3	–4.3	1.0	–2.9	–6.2	0.001
Aosta Valley	68.0	63.3	68.2	52.6	–6.9	7.7	–22.9	–22.6	0.029
Lombardy	56.0	57.8	55.5	54.7	3.2	–4.0	–1.4	–2.3	0.552
AP of Bolzano	46.3	48.9	44.7	51.8	5.6	–8.6	15.9	11.9	0.026
AP of Trento	57.6	50.7	57.2	45.1	–12.0	12.8	–21.2	–21.7	0.074
Veneto	53.5	52.5	50.6	50.2	–1.9	–3.6	–0.8	–6.2	<0.001
Friuli-VG	66.3	57.6	55.7	55.3	–13.1	–3.3	–0.7	–16.6	0.002
Liguria	61.7	51.7	58.9	57.6	–16.2	13.9	–2.2	–6.6	0.702
Emilia-Romagna	56.6	54.1	52.1	54.3	–4.4	–3.7	4.2	–4.1	0.796
Tuscany	52.4	52.4	52.8	51.9	0.0	0.8	–1.7	–1.0	0.011
Umbria	54.7	54.6	56.1	50.7	–0.2	2.7	–9.6	–7.3	0.522
Marche	47.8	47.4	47.3	56.2	–0.8	–0.2	18.8	17.6	0.013
Lazio	59.4	58.6	58.7	58.8	–1.3	0.2	0.2	–1.0	<0.001
Abruzzo	53.5	57.1	54.1	56.0	6.7	–5.3	3.5	4.7	0.080
Molise	62.1	58.6	57.1	52.6	–5.6	–2.6	–7.9	–15.3	<0.001
Campania	73.4	73.3	70.6	71.7	–0.1	–3.7	1.6	–2.3	0.003
Puglia	60.8	60.8	59.8	60.3	0.0	–1.6	0.8	–0.8	0.002
Basilicata	64.8	49.3	61.8	58.7	–23.9	25.4	–5.0	–9.4	0.196
Calabria	61.7	61.8	60.3	65.2	0.2	–2.4	8.1	5.7	0.769
Sicily	69.2	77.0	69.2	70.8	11.3	–10.1	2.3	2.3	0.924
Sardinia	57.7	59.8	60.9	56.9	3.6	1.8	–6.6	–1.4	0.019
Italy	59.7	59.6	58.3	58.4	–0.2	–2.2	0.2	–2.2	0.108

* The % change is computed as (new SDR – old SDR)*100 / old SDR; † The p-value of the linear slope is derived from Poisson regression analysis; VG, Venezia Giulia.

Table 2. %AM in Italian regions for the years 2006 to 2009

Region	%AM				% change*	% change*	% change*	% change*	*p*-value of the
	2006	2007	2008	2009	2006–2007	2007–2008	2008–2009	2006–2009	linear slope†
Males and females									
Piedmont	26.0	25.6	25.5	25.9	–1.5	–0.4	1.6	–0.4	0.783
Aosta Valley	23.2	24.9	26.3	23.1	7.3	5.6	–12.2	–0.4	0.907
Lombardy	24.0	24.2	24.5	24.3	0.8	1.2	–0.8	1.3	0.220
AP of Bolzano	24.4	25.6	24.4	26.7	4.9	–4.7	9.4	9.4	0.204
AP of Trento	24.5	22.9	25.6	23.6	–6.5	11.8	–7.8	–3.7	0.998
Veneto	24.2	25.7	24.0	25.0	6.2	–6.6	4.2	3.3	0.810
Friuli-VG	25.1	23.1	23.2	25.1	–8.0	0.4	8.2	0.0	0.988
Liguria	24.3	22.0	23.6	24.3	–9.5	7.3	3.0	0.0	0.783
Emilia-Romagna	24.8	24.4	24.3	25.7	–1.6	–0.4	5.8	3.6	0.467
Tuscany	24.4	23.8	24.6	24.8	–2.5	3.4	0.8	1.6	0.322
Umbria	26.3	25.0	27.0	25.6	–4.9	8.0	–5.2	–2.7	0.975
Marche	25.5	25.1	26.0	27.2	–1.6	3.6	4.6	6.7	0.144
Lazio	24.9	25.0	26.3	25.6	0.4	5.2	–2.7	2.8	0.206
Abruzzo	26.3	27.4	26.6	27.3	4.2	–2.9	2.6	3.8	0.296
Molise	26.5	28.5	26.6	25.8	7.5	–6.7	–3.0	–2.6	0.497
Campania	25.2	24.8	25.4	25.9	–1.6	2.4	2.0	2.8	0.214
Puglia	24.6	25.2	25.7	26.3	2.4	2.0	2.3	6.9	<0.001
Basilicata	27.2	22.5	27.0	27.3	–17.3	20.0	1.1	0.4	0.671
Calabria	27.7	26.2	26.5	27.2	–5.4	1.1	2.6	–1.8	0.770
Sicily	27.1	28.0	27.0	28.2	3.3	–3.6	4.4	4.1	0.332
Sardinia	24.7	24.6	25.0	25.3	–0.4	1.6	1.2	2.4	0.084
Italy	25.1	25.0	25.3	25.7	–0.4	1.2	1.6	2.4	0.120
Males									
Piedmont	21.7	21.0	20.6	21.5	–3.2	–1.9	4.4	–0.9	0.735
Aosta Valley	16.6	20.6	19.4	19.0	24.1	–5.8	–2.1	14.5	0.483
Lombardy	19.7	19.2	20.0	19.8	–2.5	4.2	–1.0	0.5	0.419
AP of Bolzano	21.5	21.5	21.0	22.7	0.0	–2.3	8.1	5.6	0.405
AP of Trento	20.2	18.2	20.4	20.6	–9.9	12.1	1.0	2.0	0.523
Veneto	20.1	22.5	19.8	21.2	11.9	–12.0	7.1	5.5	0.890
Friuli-VG	20.4	18.7	18.7	21.9	–8.3	0.0	17.1	7.4	0.634
Liguria	19.5	18.1	19.0	20.1	–7.2	5.0	5.8	3.1	0.578
Emilia-Romagna	20.6	20.3	20.4	21.6	–1.5	0.5	5.9	4.9	0.326
Tuscany	20.0	19.6	20.6	20.8	–2.0	5.1	1.0	4.0	0.127
Umbria	22.3	19.7	22.4	21.5	–11.7	13.7	–4.0	–3.6	0.944
Marche	22.1	21.2	23.5	22.2	–4.1	10.8	–5.5	0.5	0.470
Lazio	20.8	20.9	22.6	21.5	0.5	8.1	–4.9	3.4	0.284
Abruzzo	22.6	23.6	22.9	24.7	4.4	–3.0	7.9	9.3	0.123
Molise	21.6	24.1	23.5	22.5	11.6	–2.5	–4.3	4.2	0.736
Campania	21.0	20.4	21.3	21.8	–2.9	4.4	2.3	3.8	0.230
Puglia	19.1	20.4	20.3	20.9	6.8	–0.5	3.0	9.4	0.067
Basilicata	22.5	19.5	22.3	22.8	–13.3	14.4	2.2	1.3	0.630
Calabria	24.0	21.9	22.6	22.8	–8.8	3.2	0.9	–5.0	0.543
Sicily	22.9	22.3	22.5	24.1	–2.6	0.9	7.1	5.2	0.393
Sardinia	20.2	19.0	19.8	21.4	–5.9	4.2	8.1	5.9	0.433
Italy	20.8	20.6	20.9	21.5	–1.0	1.5	2.9	3.4	0.199
Females									
Piedmont	33.6	33.7	34.1	33.3	0.3	1.2	–2.3	–0.9	0.777
Aosta Valley	34.8	33.3	38.9	30.6	–4.3	16.8	–21.3	–12.1	0.645
Lombardy	32.0	32.9	32.5	32.1	2.8	–1.2	–1.2	0.3	0.968
AP of Bolzano	30.2	33.2	30.8	33.9	9.9	–7.2	10.1	12.3	0.201
AP of Trento	32.4	32.0	34.8	28.8	–1.2	8.7	–17.2	–11.1	0.501
Veneto	31.9	31.4	31.9	31.8	–1.6	1.6	–0.3	–0.3	0.849
Friuli-VG	33.0	30.4	31.4	30.6	–7.9	3.3	–2.5	–7.3	0.233
Liguria	32.2	28.9	31.4	31.8	–10.2	8.7	1.3	–1.2	0.860
Emilia-Romagna	31.7	31.3	31.3	32.5	–1.3	0.0	3.8	2.5	0.448
Tuscany	32.3	31.1	31.5	31.2	–3.7	1.3	–1.0	–3.4	0.235
Umbria	32.9	34.6	35.0	32.3	5.2	1.2	–7.7	–1.8	0.856
Marche	32.0	32.4	30.3	35.7	1.3	–6.5	17.8	11.6	0.431
Lazio	32.4	32.3	32.7	32.5	–0.3	1.2	–0.6	0.3	0.291
Abruzzo	33.6	34.6	34.0	32.0	3.0	–1.7	–5.9	–4.8	0.371
Molise	36.2	36.5	32.5	32.3	0.8	–11.0	–0.6	–10.8	0.047
Campania	32.6	32.5	32.6	32.8	–0.3	0.3	0.6	0.6	0.280
Puglia	33.9	33.4	35.1	35.4	–1.5	5.1	0.9	4.4	0.090
Basilicata	35.9	28.0	35.2	35.6	–22.0	25.7	1.1	–0.8	0.729
Calabria	34.3	33.7	33.5	34.7	–1.7	–0.6	3.6	1.2	0.763
Sicily	33.9	37.5	34.4	35.0	10.6	–8.3	1.7	3.2	0.971
Sardinia	34.1	35.6	34.8	33.0	4.4	–2.2	–5.2	–3.2	0.514
Italy	32.8	32.9	32.9	32.9	0.3	0.0	0.0	0.3	0.208

* The % change is computed as (new %AM – old %AM)*100 / old %AM; † The p-value of the linear slope is derived from logistic regression analysis.

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4 Discussion

Our study shows that in Italy, for the period 2006–2009, SDR was 62.4 per 100,000 inhabitants (males: 65.8 per 100,000; females: 59.0 per 100,000). As to %AM, deaths from causes that are considered amenable to health care were an important contributor to the mortality experience under age 75. In particular, AM accounted for about one-quarter of the total mortality (one-fifth for men and one-third for women), in line with a recent study by Nolte and McKee [14].

Since national indicators may conceal potentially large variations within the country, we disaggregated AM by region. We found significant regional differences in SDRs, with a clear-cut divide being evident between Northern/Central and Southern Italy. In Italy, disparities in the geographical distribution have been documented for educational level (percentage of the population with only elementary education: 22.5% in the North and 27.2% in the South), income (family average net income: 37,440 EUR in the North and 27,971 EUR in the South), and poverty (incidence of relative poverty: 4.9% in the North and 23.0% in the South) [9].

The ranges of regional SDRs among males and females were similar, but the divergence in SDR values between Northern/Central and Southern Italy was more evident for males than females. Pinkhasov et al. [15] found gender-specific health-service utilization patterns, with females showing greater alacrity in accessing health care services, and suggested that low utilization of all and preventive health services contribute to the higher mortality and the higher and earlier morbidity in men.

We also found regional differences in %AM, but they did not reveal the same geographical pattern as that of the SDRs. However, the correlation between SDRs and %AM was strong ($r = 0.64$, $p = 0.002$). Similar results were found for men and women (males: $r = 0.65$, $p = 0.002$; females: $r = 0.58$, $p = 0.006$). These findings highlight that SDRs and %AM do not overlap. High levels of mortality amenable to health care do not necessarily correspond to a high contribution of AM to all-cause mortality. The cases of Campania and Sicily, the regions with the highest SDRs in Italy, are emblematic: in Campania %AM is in line with the national average, while in Sicily it is significantly higher than the national average. Therefore, we suggest examining not only the amount of deaths considered amenable to health care, but also their contribution to all-cause mortality.

As to the trends over time, SDR slightly decreased from 2006 to 2009 (63.9 to 61.7 per 100,000; % change = –3.4%), in line with many high-income countries [14] while %AM was almost stable (25.1% to 25.7%; % change = +2.4%). In order to discriminate changes in trends from random fluctuations in the data, particularly at regional level, we carried out a linear trend analysis, that revealed a significant decrease in SDR over the study period ($p = 0.021$), while %AM proved to be stable ($p = 0.120$). Among regions, only Piedmont, Lombardy, the autonomous province of Trento, Veneto and Campania showed a linear decrease in SDR, while Abruzzo showed a linear increase in SDR. Furthermore, Puglia showed a constant annual increase in %AM. A recent study [16] investigated the impact of the introduction of health care innovations for specific conditions (HIV, Hodgkin's disease, breast cancer and cerebrovascular disease) on AM rates in seven European countries over about 20 years. The authors reported that the timing of innovation and favorable change in AM trends coincided only for a few conditions. Therefore, our stable trends may depend on the absence of specific innovations for the conditions considered in the AM indicator.

A number of caveats should be noted in the use of AM as an outcome indicator of health-system performance. First, it is important to notice that the concept of AM is limited in that it captures mortality under age 75 and considers only a small number of deaths in high-income countries. This risks devaluing the role of curative care for those at older ages. However, extending the concept beyond age 75 poses the problem of obtaining evidence for the preventability of death at older ages because such patients are often excluded from trials [14]. Second, given the short period of observation, our evidence about trends needs to be confirmed using data for a longer period of time.

5 Conclusions

The present study highlights the role of AM as a synthetic indicator of the effectiveness of health care services at national level. We argue that, in addition to calculating AM at national level, the regional stratification is needed to put it into the context of the regional specificities of health care provision.

We also recommend the use of SDRs in conjunction with %AM, because this latter is a straightforward measure of the extent to which health services can contribute to ameliorating the health of a population. Thus, consideration of both SDRs and %AM can be useful for national and regional comparisons, and can inform evidence-based policy decision making.

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Conflict of interests

The authors declare that they have no conflict of interests.

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