Sozial- und Präventivmedizin Médecine sociale et préventive 1988; 33: 245–249

Descriptive Epidemiology of Perinatal and Infant Mortality in Various Italian Geographic Areas

Fabio Parazzini[1], *Carlo La Vecchia*[1,2], *Eva Negri*[1,3]

[1] *«Mario Negri» Institute for Pharmacological Research, Milan*
[2] *Institute of Social and Preventive Medicine, University of Lausanne*
[3] *Inter-University Consortium of Lombardy for Automatic Data Processing (CILEA), Milan*

Introduction

There are substantial differences in perinatal and infant mortality between various countries [1], largely reflecting their major determinants: economic, demographic factors and medical care [2].
Within a single country the expected variation is, of course, more limited, the standard of medical care and socioeconomic characteristics being more uniformly distributed.
Italian regions are historically characterized by marked socio-economic and cultural heterogeneity even though, over the last few decades, important changes have occurred in general life style and reproductive habits, and free medical assistance has spread more uniformely through the country with the introduction of a National Health System. Nonetheless, perinatal and infant mortality rates still vary considerably between various geographical areas [3]. Thus, analyses of temporal trends and geographical distribution of perinatal and infant mortality rates provide opportunities for the identification of high risk areas, and, in principle, may offer interesting clues for improving health care organization and generating hypotheses for further health care research and action.
Along the line of hypothesis generating, a correlational exercise of perinatal and infant mortality and selected environmental factors is also included in this overview.

Materials and Methods

Rate computation. Since 1955, the Italian Central Institute of Statistics (ISTAT) has published annually numbers of livebirths, stillbirths and deaths within the first year of life in each at the 20 Italian regions [4, 5]. On the basis of these data, stillbirths, and perinatal, neonatal, post-neonatal and infant mortality rates by region, region and sex were computed for each calendar year.
Environmental variables. Information on environmental variables was derived (latitude apart) from publications by the Central Institute of Statistics (ISTAT) as well [4, 6]. Information referring to the central year of the quinquennia 1960–64 and 1980–84 was selected. However, in some case, data for 1962 and 1982 were not available; thus the information for the nearest year was considered in the computation of correlation coefficients.
Information on *per capita* health expenditure and percentage of home deliveries was available for 1977 and 1983 respectively; so the correlation coefficients presented are referred only to the quinquennium 1980–84.
Correlation coefficient computation. Product moment and rank order correlation coefficients between Italian regional stillbirths, perinatal and infant mortality rates and the various environmental variables considered were computed: the former were chosen for presentation, since they make use of more information in the data and provide the most satisfactory partial correlation coefficients [7]. In any case, the coefficients obtained through rank order correlation were largely comparable with those presented. Formal tests of significance (which depend on the assumption that samples come from normally distributed populations and should be weighted against the different sizes of various samples) are largely imprecise. Furthermore, in view of many non-independent coefficients computed, a number of significant correlations can be expected by chance alone. With these cautions in mind, a value of 0.50 can be chosen as a guide for identifying correlations of interest.

Results

Between 1955 and 1984 the national stillbirth, perinatal and first year mortality rates declined steadily (respectively from 28.4, 46.2 and 51.0 to 7.1, 14.5 and 11.3, *Fig. 1–3)*. This reduction was mainly explained by proportionally comparable decreases of the rates in various geographical areas. The North/South ratio dropped by about 15% in stillbirth rates and 10% in 1st to 365th day rates, but remained fairly constant in perinatal mortality *(Table 1)*.
There was a substantial levelling between North and Center for stillbirth rates in the late 70's (Central regions had previously intermediate rates between North and South, Fig. 1). A similar trend was observed in perinatal rates, since Central Italy was intermediate between North and South until the late '60s. Then it became similar to the North of the country *(Fig. 2)*.
With regard to 1st to 365th day mortality, the North-South ratio remained substantially unchanged over the 30-year period considered. However, the North/South gradient was noticeably reduced for mortality occurring between the second and the 12th month of life *(Table 1)*. The rates for the Central regions, which were the lowest in the '50s and '60s, levelled around

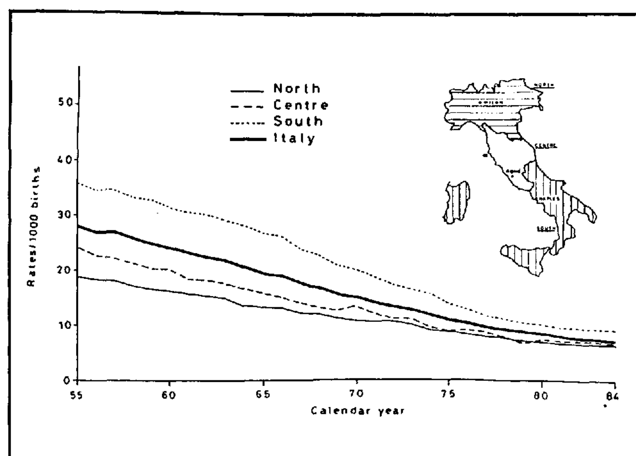

Fig. 1. Trends in stillbirth rates in North, Center and South Italy, 1955–84.

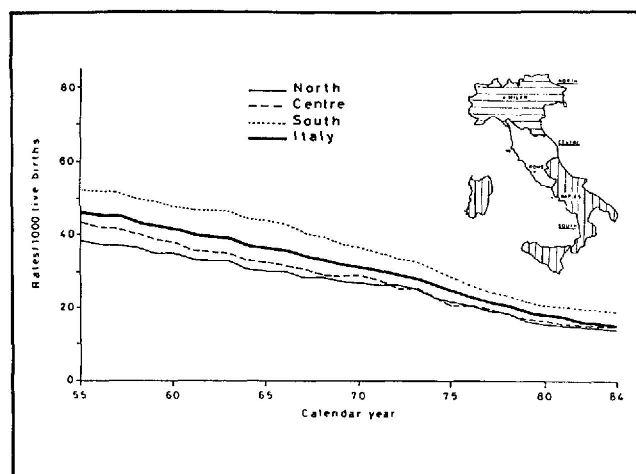

Fig. 2. Trends in perinatal (from the 180th day of pregnancy to the first week of life) mortality rates in North, Center and South Italy, 1955–84.

the Northern ones in the '70s *(Fig. 3)*. This trend was chiefly due to a reduction of 29th to 365th day deaths (representing in 1955 and in 1984 respectively 50% and 80% of infant mortality) since the Central areas had values lower than the other two geographical areas for this statistics.

The male/female stillbirth and infant mortality ratio was fairly constant during the study period and in all geographic areas, males showing a mortality risk higher than females ranging from 10% in stillbirth to 25% in perinatal mortality (data not presented).

Stillbirth, perinatal and 1st to 365th day mortality rates, and ratios for the quinquennia 1955–59 and 1980–84 in various Italian regions are presented in Table 2. The same information on perinatal mortality ratios is given in *Figure 4* in graphical form. Observing the regional trends, mortality rates decreased mainly in some small regions in Central and Southern Italy without large urban concentrations (i.e. cities with more than 250,000 inhabitants), such as Umbria, Molise, Basilicata whose rates fell more than the national one; this finding is common to various indicators considered.

The correlation coefficients between the environmental variables considered and stillbirth, perinatal and 1st to 365th mortality rates for selected periods are presented in *Table 3*. Mortality rates were negatively correlated with latitude, number of hospital beds/1000 inhabitants and positively with mean number of births/women aged 15–44 in both periods considered. The percentage of home deliveries (referring to 1980) was positively correlated with stillbirth and perinatal mortality rates. No significant coefficient emerged in both quinquennia between mortality rates and total

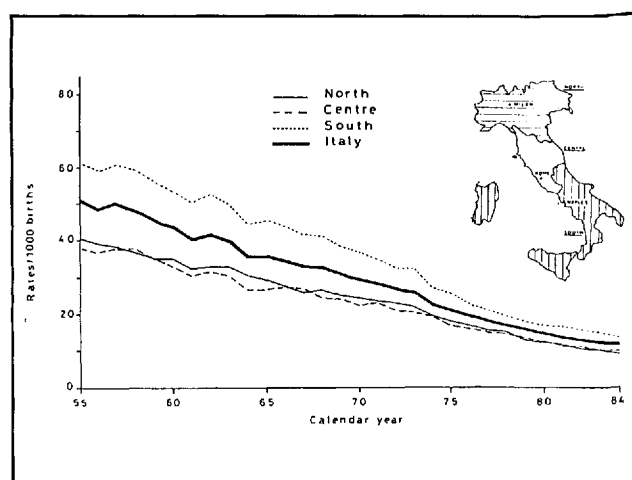

Fig. 3. Trends in first year mortality rates in North, Center and South Italy, 1955–84.

Tab. 1. Trends in stillbirth, perinatal, 1st to 365th, and 29th to 365th day mortality rates according to broad Italian geographic areas, 1955–84.

Calendar period	Stillbirth rate				Perinatal mortality rate				1st to 365th day mortality rate				29th to 365th mortality rate			
	North	Center	South	Italy	North	Center	South	Italy	North	Center	South	Italy	North	Center	South	Italy
1955–59	18.1	22.4	34.5	26.8	37.0	41.4	51.1	43.1	38.4	37.4	60.5	48.7	14.3	13.2	34.2	22.4
1960–64	15.4	18.4	30.2	22.6	33.1	35.7	46.8	39.7	33.0	30.6	50.7	40.4	10.7	9.7	26.6	17.5
1965–69	12.7	14.5	24.5	18.1	28.8	30.6	41.3	34.4	27.2	26.1	42.6	33.5	7.0	6.6	18.9	12.0
1970–74	10.5	11.8	18.1	13.8	25.5	25.9	34.0	29.1	22.9	21.6	33.1	26.9	4.7	4.5	11.3	7.4
1975–79	8.0	8.3	12.1	9.9	19.0	19.0	24.8	21.6	16.0	15.5	21.7	18.4	3.1	3.0	5.9	4.3
1980–84	6.4	6.5	8.9	7.6	13.6	14.4	18.6	16.0	10.8	10.5	15.4	13.0	2.1	1.8	3.5	2.7

Sozial- und Präventivmedizin Médecine sociale et préventive 1988; 33: 245–249

Tab. 2. Stillbirths, perinatal and 1st to 365th day mortality in the various Italian regions 1955–59 and 1980–84.

Region	1955–1959									1980–1984								
	Stillbirths			Perinatal mortality			1st to 365th day mortality			Stillbirths			Perinatal mortality			1st to 365th day mortality		
	No. deaths	Rate/ 1000 births	Ratio*	No. deaths	Rate/ 1000 births	Ratio*	No. deaths	Rate/ 1000 births	Ratio*	No. deaths	Rate/ 1000 births	Ratio*	No. deaths	Rate/ 1000 births	Ratio*	No. deaths	Rate/ 1000 births	Ratio*
Piemonte	4,425	19.9	74	8,834	38.3	89	8,732	40.0	82	1355	7.3	96	3034	16.3	102	2331	12.6	97
Valle d'Aosta	146	20.9	78	267	35.8	83	337	49.2	101	31	7.1	93	61	14.0	88	47	10.9	84
Lombardia	9,065	17.3	65	19,117	35.3	82	21,763	42.3	87	2575	6.1	80	5508	13.2	83	4473	10.8	83
Trentino	1,261	17.6	66	2,752	36.8	85	2,889	41.1	84	297	6.1	80	616	12.8	80	452	9.4	72
Veneto	5,854	17.1	64	11,766	33.3	77	11,698	34.9	72	1314	6.3	83	2711	13.0	81	2083	10.0	77
Friuli	1,303	17.3	65	2,577	34.1	79	2,429	32.9	68	293	5.9	78	518	10.5	66	371	7.6	58
Liguria	2,003	21.6	81	3,745	36.7	85	3,528	38.8	80	386	6.4	84	802	13.3	83	663	11.0	85
Emilia-Romagna	4,539	18.4	69	9,421	36.1	84	8,203	33.8	70	867	5.8	76	1983	13.4	84	1579	10.8	83
Toscana	4,334	20.5	76	8,536	38.4	89	6,921	33.4	69	879	6.1	80	2040	14.2	89	1539	10.8	83
Umbria	1,410	23.7	88	2,683	43.2	100	2,259	38.8	80	224	5.8	76	520	13.5	84	406	10.6	82
Marche	2,187	20.3	76	4,267	37.0	86	3,738	35.3	72	428	5.8	76	964	13.1	82	706	9.7	75
Lazio	8,379	24.0	90	14,675	40.7	94	13,752	40.3	83	1933	7.0	92	4088	14.8	93	3165	11.5	88
Abruzzo										499	7.4	97	1071	15.9	99	865	12.9	99
	5,132	34.6	129	7,901	49.5	115	7,333	51.2	105									
Molise										166	9.1	120	306	18.7	117	226	12.6	97
Campania	20,594	35.7	133	30,029	50.8	118	34,255	61.7	127	3994	9.2	121	8121	18.8	118	6788	15.8	122
Puglia	14,508	34.4	128	21,816	50.0	116	27,120	66.7	137	2350	8.8	116	5370	18.4	115	4495	15.8	122
Basilicata	3,662	44.2	165	5,246	60.9	141	6,096	76.9	158	331	9.9	130	693	19.0	119	590	14.6	112
Calabria	9,387	35.0	131	14,167	52.0	121	15,741	60.9	125	1468	8.5	112	2816	18.7	117	2147	16.1	124
Sicilia	18,806	34.9	130	27,342	50.1	116	28,472	54.8	113	3016	10.4	137	6596	18.0	113	5641	12.5	96
Sardegna	3,889	23.0	86	6,373	37.6	87	8,394	50.8	104	1113	7.7	101	1924	16.1	101	1319	12.8	98

* National ratio = 100

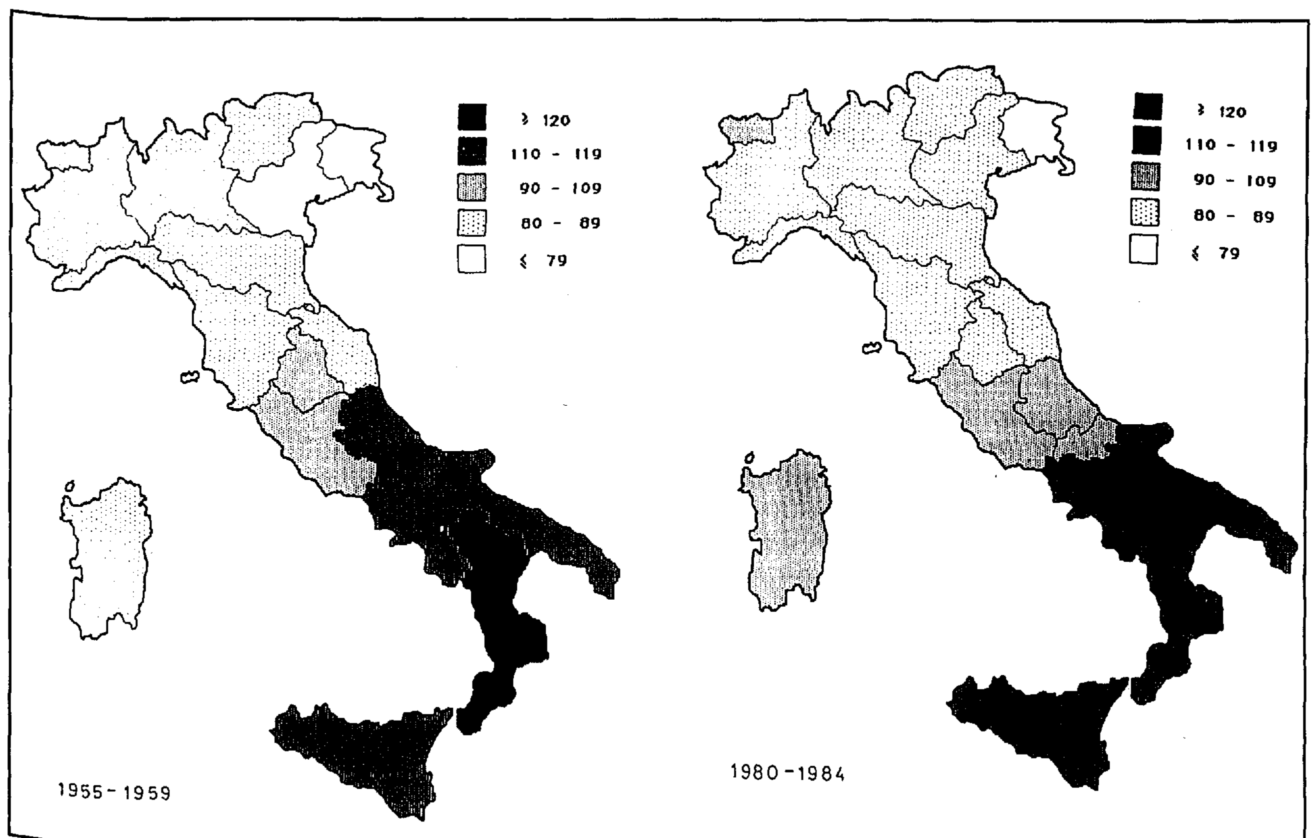

Fig. 4. Perinatal mortality ratio according to various Italian regions: 1955 to 59 and 1980 to 84 (Italian ratio = 100).

Tab. 3. Correlation coefficients between stillbirth, perinatal and infant mortality rates and the environmental variables considered in two selected periods.

	Stillbirth		Perinatal mortality		Infant mortality	
	1960–64	1980–84	1960–64	1980–84	1960–64	1980–84
Latitude	–.84	–.81	–.80	–.88	–.75	–.84
Total per caput consumption	–.71[1]	–.76	–.45[1]	–.79	–.48[1]	–.73
Number of beds/1000 inhabitants	–.62	–.63	–.71	–.60	–.75	–.54
Number of obstetric beds/1000 females	–.33	–.51	–.27	–.49	–.23	–.46
Mean number of births/women aged 15–44	.74	.83	.72	.86	.89	.82
Number of inhabitants	–.05	–.06	–.03	–.09	–.09	–.19
Percentage of home deliveries	–	.59	–	.72	–	.75
Per caput health expenditure	–	–.62[2]	–	–.62	–	–.56

[1] 1971
[2] 1983

population or numbers of obstetric beds/1000 inhabitants.

Most of these correlations were reduced after allowance for latitude through computation of partial correlation coefficients. These coefficients, however, are not presented, since their interpretation is extremely complex. In fact, socioeconomic indicators, reproductive and lifestyle habits, and health care organization in Italy are strongly associated with latitude and hence the decrease of first order partial correlation coefficients may partly or largely be attributed to overadjustement in statistical terms.

Discussion

The drops in stillbirth, perinatal and first year of life mortality rates (about 70, 60 and 70% respectively) observed in Italy between 1955 and 1984 compare well with trends in other countries [8–14]. However, there was no noticeable reduction in regional proportional variation in perinatal and infant mortality, large geographical differences in stillbirth rates and within the first year of life being still apparent in the early 1980's.

The largest drop in Northern/South ratio was in 29th to 365th day mortality. Possibly, improved lifestyle habits and better access to medical care played a large part in this improvement. Maternal age and socioeconomic status distributions did not totally explain the temporal trends and the geographical differences. In fact, stillbirth rates standardized for maternal age and socioeconomic status showed over the period 1955–1979 a decrease by about 65% (only slightly lower than the reduction observed in the crude rates). Similarly, standardized regional mortality ratios were largely comparable with the crude ones over the 1955–1979 period [3]. Likewise, the decline in stillbirth rates is not totally explained by an increase in the average birth weight: national and regional data, available for selected years, show indeed that the proportion of low weight at birth had slightly increased over more recent periods [15].

National trends are generally reproduced in various regions. However, some differences should be noted. The most striking finding is the considerable improvement in all the statistics considered in some small regions in Central and Southern Italy without large urban concentrations. These regions reached rates generally lower than the national average and the neighbouring regions within the same broad geographical area.

Although any inference from correlational analyses should, of course, be taken with large caution, there are same strengths and points of interest in the correlations presented. Latitude apart (an aspecific and indirect indicator in Italy of differences in socioeconomic status, reproductive habits, lifestyle and health care availability), strong correlation coefficients emerged between perinatal and infant mortality rates and general indicators of health care organization such as number of hospital beds/1000 inhabitants or *per capita* health expenditure and of socioeconomic conditions such as total *per capita* consumption. In contrast, little relation was observed between number of obstetric beds/1000 inhabitants and perinatal mortality.

The home delivery percentage was related to perinatal and infant mortality in this correlational exercise. However, a more detailed analysis of the role of place of birth and mortality conducted for 1980 [16] showed that perinatal mortality for home delivery was higher in Northern than in Southern Italy, probably reflecting different selection mechanisms (i.e. in the North where the absolute number of home deliveries is, lower, a higher proportions of them is probably represented by unplanned and unassisted births). Thus, any inference based on correlational analysis only can be misleading. More in general, the findings of correlational study are, of course, largely inconclusive, but the uniform source of data and the considerable differences in lifestyle and reproductive habits between the various Italian regions make the present exercise of potential interest in the field of perinatal and infant mortality epidemiology.

In conclusion, the results of present analyses, although confirming a marked reduction in stillbirths and first year mortality in various Italian regions, still show broad differences between geographical areas within the country which remained largely unchanged in proportional terms, since perinatal and infant mortality were still substantially lower in Northern and richer areas. If rates from Northern Italy for the year 1984 were applied to the whole of the country, over 1000 deaths under the first year of life could be avoided. There is, therefore, ample room for action to improve obstetrical, perinatal and infant assistance (in broad aspects). Such action in terms of cost/benefits is

probably among the most effective and favourable interventions within a general perspective of resources allocation for the health care system.

Summary
On the basis of the number of livebirths, stillbirths and deaths within the first year of life published annually by the Central Institute of Statistics and data on demographic, environmental variables, general indicators of health organization, and reproductive habits, the descriptive epidemiology of perinatal and infant mortality in Italy between 1955 and 1984 has been reviewed. Although a marked reduction in Italian stillbirth (from 28.4 in 1955 to 7.1/1,000 births in 1984), perinatal (from 46.2 to 14.5/1,000 births) and infant mortality rate (from 51.0 to 11.3/1,000 live births) was observed, still broad differences between geographical areas within the country remained largely unchanged in proportional terms, since perinatal and infant mortality remained substantially lower in Northern, richer areas. Strong correlation coefficients emerged between perinatal and infant mortality rates and general indicators of health care organization such as number of hospital beds/1,000 inhabitants (and less strongly with number of obstetric beds) or *per capita* health expenditure. If rates from Northern Italy for the year 1984 were applied to the whole of the country, over 1,000 deaths in the first year of life could be avoided.

Résumé
Epidémiologie descriptive des mortalités périnatales et infantiles en diverses aires géographiques italiennes
Sur la base du nombre de naissances vivantes et des décès périnatals, néonatals et postnéonatals publiés par l'Institut Central des statistiques et des variables démographiques ambiantes, indicateurs généraux de l'organisation de santé et d'habitudes reproductives, on a analysé l'épidémiologie descriptive de la mortalité périnatale et infantile en Italie entre 1955 et 1984.
Bien qu'une réduction substantielle des taux de mortalité (de 28,4 à 7,1‰ naissances), de mortalité périnatale (de 46,2 à 14,5‰ naissances) et infantile (de 51,0 à 11,3‰ naissances vivantes) ait été observée, les différences considérables entre les diverses aires géographiques italiennes ont peu changé dans une mesure appréciable en termes proportionnels, puisque les mortalités périnatale et infantile ont maintenu des taux largement plus bas dans les régions plus riches du Nord. Des coefficients de corrélation élevés ont été observés entre les taux de mortalité périnatale et infantile et des indicateurs généraux d'organisation des systèmes de santé, comme le nombre de lits hospitaliers par 1000 habitants (et, moins clairement, avec le nombre des lits obstétricaux), ou la dépense sanitaire *pro capita*.
Dans l'hypothèse que le taux du Nord de l'Italie pour l'année 1984 eût été applicable à l'ensemble du pays, plus de 1000 morts dans la première année de vie auraient pu être évitées.

Zusammenfassung
Deskriptive Epidemiologie der perinatalen Mortalität und der Säuglingssterblichkeit in den verschiedenen Regionen Italiens
Ausgehend von den Angaben über die Zahl der Lebendgeburten, Totgeburten und Todesfälle im ersten Lebensjahr, wie sie vom Statistischen Amt regelmässig publiziert werden, und im Vergleich mit Daten über die demographische Situation, die Familienstruktur und das Gesundheitswesen, wurde für die Jahre 1955–1984 die deskriptive Epidemiologie der perinatalen Todesfälle und der Säuglingssterblichkeit überarbeitet.
Obwohl für das ganze Land ein Rückgang festgestellt werden kann, für die Totgeburten von 28,4 auf 7,1/1000 Geburten, für die perinatale Sterblichkeit von 46,2 auf 14,5/1000 Geburten und für die Säuglingssterblichkeit von 51,0 auf 11,3/1000 Lebendgeburten, blieben die regionalen Unterschiede proportional gleich, mit wesentlich niedrigeren Werten im reicheren Norden. Es finden sich eindeutige Korrelationen zwischen der perinatalen Sterblichkeit wie auch der Säuglingssterblichkeit mit Indikatoren des Gesundheitswesens, der Spitalbettenzahl pro 1000 Einwohner (weniger ausgeprägt auch mit der Gebärbettenzahl) oder den Pro-Kopf-Ausgaben für das Gesundheitswesen.
Nimmt man an, dass die Sterblichkeit im ganzen Land auf die Werte des Nordens gesenkt werden könnte, so kommt man auf die Zahl von 1000 verhütbaren Todesfällen im ersten Lebensjahr.

References
[1] United Nations, Department of International Economic and Social Affairs Statistical Office. World Statistics in Brief. New York, United Nations (1983).
[2] *Alberman E.*: Prospects for better perinatal health. Lancet (1980) 1: 189–192.
[3] *Parazzini F., Negrello I., La Vecchia C.*: Natimortalità nel primo anno di vita nelle diverse regioni Italiane: analisi degli andamenti temporali dal 1955 al 1979. Ann Obstet Gynecol Med Perinat (1986) 107: 5–120.
[4] ISTAT. Annuario di Statistiche Demografiche vols. IV–XXVIII. Edizioni 1955–81, Roma (1958–84).
[5] ISTAT. Bollettino Mensile di Statistica (1982–86) nos. 1–9.
[6] ISTAT. Annuario di Statistiche Demografiche, 1960–IX, Roma, ISTAT (1962).
[7] *Armitage P.*: Statistical Methods in Medical Research. Blackwell, Oxford (1971).
[8] *Hobel C.J.*: Better perinatal health. U.S.A. Lancet (1980) 1: 31–33.
[9] *Khoury M.J., Erickson J.D., Adams M.J. Jr.*: Trends in postneonatal mortality in the United States, 1962 through 1978. JAMA (1984) 252: 367–372.
[10] *Beaufils F., Boue A.*: Better perinatal health. France. Lancet (1979) 2: 1352–1353.
[11] *Rooth G.*: Better perinatal health. Sweden. Lancet (1979) 2: 1170–1172.
[12] *Pharoah P., Morris J.N.*: Postneonatal mortality. Epidemiol Rev (1979) 1: 170–183.
[13] *Kaminski M., Bouvier-Colle M.H., Blondel B.*: Mortalité des jeunes dans la Communauté Européenne (de la naissance à 24 ans). I.N.S.E.R.M., Doin, Paris (1985).
[14] Bundesamt für Statistik. Geburtsgewicht und Säuglingssterblichkeit in der Schweiz. 1979–1981. Beiträge zur Schweizerischen Statistik/Heft 126, Bern (1985).
[15] *Parazzini F., Imazio C., Pampallona S., La Vecchia C.*: Trends in perinatal, neonatal and postneonatal mortality in Italy, 1955-84. Médecine Sociale et Préventive (1987) 32: 286–290.
[16] *Parazzini F., La Vecchia C.*: Perinatal, infant mortality and place of birth in Italy. Am J Public Health (1988)78: 706–707.

Acknowledgements:
This work was conducted within the framework of the CNR (Italian National Research Council) Applied Project «Preventive and Rehabilitative Medicine» (contracts no. 82.02038.56 and no. 82.02045.56). We wish to thank Ms. Judy Baggott, Flavia Boniardi and Ivana Garimoldi for editorial assistance.

Address for correspondence:
Fabio Parazzini M.D.
Istituto di Ricerche Farmacologiche
«Mario Negri»
Via Eritrea 62
I-20157 Milano