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VITAL STATISTICS

Mortality in children under 1 year of age due to congenital malformations of the central nervous system. Mexico, 1990-2012

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According to the World Health Organization (WHO), congenital malformations are defined as "all anomalies in morphological, structural, functional or molecular development found in a newborn that may be external or internal, familial or spontaneous, hereditary or not, single or multiple, resulting from a defective embryogenesis." The study of the causes is extremely relevant, not only for its growing impact on the levels of health and well-being of the newborn, but also because they are clearly avoidable problems.

Origin of congenital malformations is multifactorial: genetic history, environmental factors such as exposure of the fetus to toxic substances, advanced maternal or paternal age, maternal consumption of anticonvulsants, smoking, malnutrition, and in a relevant manner, vitamin B deficiency (specifically B9 or folic acid). According to the abundant literature, folic acid consumption prevents neural tube diseases in up to 50% of cases. A review of the infant mortality figures during the last 20 years show changes of great public health interest. Whereas infant deaths have declined by >57% between 1990 and 2012 (preliminary figure) from 65,000 to about 28,000 deaths, deaths due to congenital malformations have apparently remained stable (~9000 deaths per year), with a slight tendency to increase in such a way that the relative weight of these conditions with respect to the structure for causes has increased at an alarming rate. From representing 13.7% of the infant deaths in 1990, these increased to 24.8% in the year 2000 and to 33.8% in 2012 (Table 1). This behavior warrants the analysis of each of the groups of diseases that make up the mentioned chapter. The present contribution dealt only with figures of mortality from congenital malformations of the central nervous system, among which stand out those known as neural tube defects (NTD): anencephaly, spina bifida and encephalocele. These causes are a serious public health problem not only because of the burden of disease and death they imply, but also because of the serious consequences they cause, both for the individual as well as for society when the children survive and usually have severe disabilities.

According to the official death statistics, congenital malformations of the central nervous system are second in importance, surpassed only by cardiac malformations. With regard to its evolution, it can be seen that over the past two decades, deaths of children <1 year of age due to those causes have decreased almost by half, from 2281 deaths in 1990 to 1243 in 2012 (Table 1). With relation to the total group of malformations, this represents an important decrease in its relative weight as these make up a fourth of the cases in 1990, now representing only 13%. The behavior of the respective infantile mortality rates corroborates this downward trend. In 1900, 93.9 children would die for each 100,000 births vs. 54.8 children reported in the year 2012 (Figure 1). With respect to the analysis of each of the three selected diseases, a similar tendency

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in its evolution is observed in that in all cases there are significant decreases recorded, even when its rate of change varies considerably (Table 2).

As far as the distribution by sex, in all cases there was greater frequency seen in females, with values between 50 and 60%.

Table 1. Deaths due to congenital malformations and relation with infant mortality rate. México, 1990-2012

Year	Deaths <1 year	Deaths due to congenital malformations	Deaths due to CNS malformations NTD +E1	Percentage of malformations with respect to infant mortality	Percentage of NTD with respect to malformations	NTD mortality rate per 100,000 births
1990	65,497	8,969	2,281	13.7	25.4	93.9
1991	57,091	8,695	2,118	15.2	24.4	86.8
1992	52,502	8,750	2,148	16.7	24.5	87.8
1993	49,631	8,696	2,116	17.5	24.3	86.3
1994	49,305	9,249	2,121	18.8	22.9	86.5
1995	48,023	9,677	2,123	20.2	21.9	86.8
1996	45,707	9,478	2,025	20.7	21.4	83.3
1997	44,377	9,615	2,069	21.7	21.5	85.7
1998*	42,183	10,120	1,962	24.0	19.4	81.9
1999	40,283	9,714	1,759	24.1	18.1	73.9
2000	38,621	9,572	1,500	24.8	15.7	63.5
2001	35,911	9,178	1,377	25.6	15.0	58.7
2002	36,567	9,162	1,318	25.1	14.4	56.4
2003	33,355	8,881	1,279	26.6	14.4	55.0
2004	32,764	9,058	1,283	27.6	14.2	55.4
2005	32,603	9,255	1,267	28.4	13.7	55.0
2006	30,899	9,327	1,302	30.2	14.0	56.9
2007	30,425	8,836	1,191	29.0	13.5	52.2
2008	29,537	8,946	1,243	30.3	13.9	54.7
2009	28,988	9,072	1,234	31.3	13.6	54.5
2010	28,865	9,175	1,255	31.8	13.7	55.7
2011	29,050	9,527	1,235	32.8	13.0	54.7
2012*	27,849	9,400	1,243	33.8	13.2	54.8

Source: INEGI/SSA Mortality statistics, 1990-2012.
*Preliminary rates.
NTD, neural tube defects.

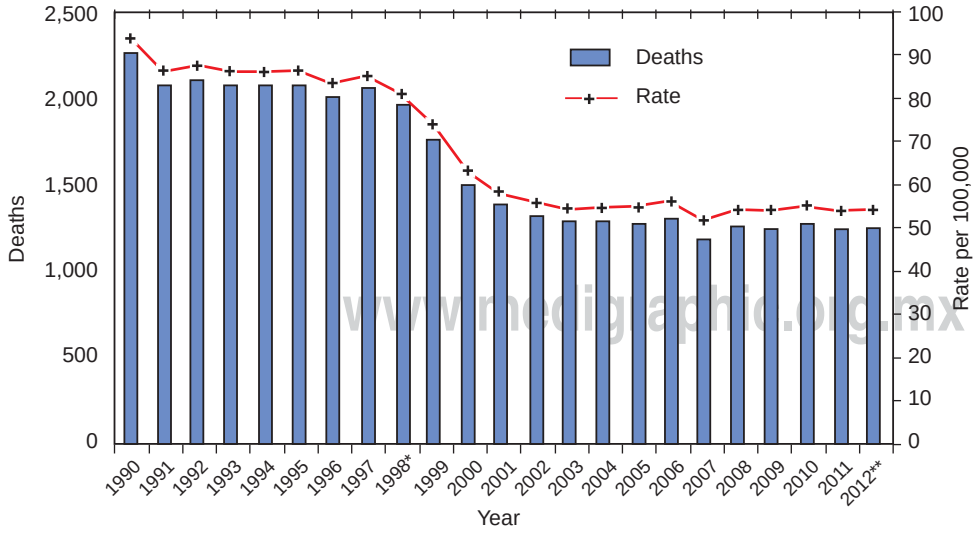

Figure 1.

Evolution of mortality due to congenital malformations of the central nervous system. Mexico, 1990-2012.

* Considered since 1998 because that is the year that the ICD-10 was initiated in Mexico.
** Rates corresponding to 2012 are preliminary.

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Between 1990 and 2012 there were 9501 deaths recorded for this cause (t00/CIE10). The annual frequency between both extremes of the period decreased (from 654 to 216 cases), with a reduction in the mortality rate of 26.9 to 9.5 deaths/100,000 births (Figure 2), with the percentage of reduction being 65% (Table 3). As far as the age distribution, most of the newborns die within the first hours of life (94% during the first week).

Table 2. Number of deaths due to CNS malformations in children under 1 year of age, 1998-2012*

Congenital malformations of the nervous system	Early neonatal (<7 days)	Late neonatal (7-28 days)	Postneonatal (>28 days and <1 year)	Age not specified	Age in years	Total deaths
Q00 Anencephaly and similar congenital malformations	4,366	219		57		4,642
Q01 Encephalocele	499	120	176	3	217	1,015
Q02X Microcephaly	138	31	197	1	475	842
Q03 Congenital hydrocephaly	1,130	639	2,521	13	2,802	7,105
Q04 Other cephalic congenital malformations	549	335	822	2	612	2,320
Q05 Spina bifida	587	515	895	5	1,272	3,274
Q06 Other congenital spinal malformations	5	1	15		168	189
Q07 Other congenital nervous system malformations	163	104	322	3	469	1,061
Overall total	7,437	1,964	4,948	84	6,015	20,448

*Includes codes Q00-Q07 of the ICD-10. These are considered from 1998 because it is the year that the ICD-10 was started in Mexico. The follow-up in previous years, with ICD-9, presents certain difficulties for comparison. Figures for 2012 are preliminary.
Source: INEGI/SSA Mortality statistics, 1990-2012

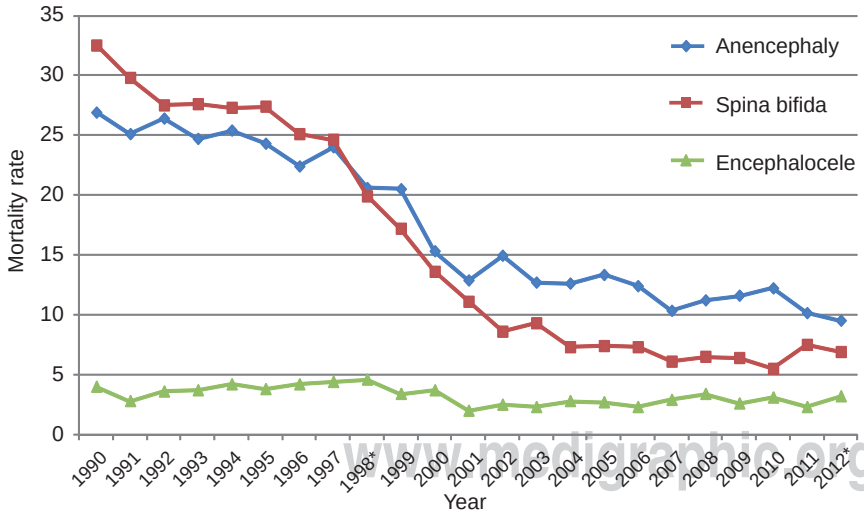

Figure 2.

Evolution of mortality rates for the three most important causes of neural tube defects. Mexico, 1990-2012.

* Considered since 1998 because that is the year that the ICD-10 was initiated in Mexico.
** Rates corresponding to 2012 are preliminary.

§ For calculation of infant mortality rates considered, for the period of 1990-2010 births were estimated proportional to the new population projections set forth by the National Population Council, with a base in the results of the 2010 census. From 2011, according to the INEGI/CONAPO/Technical Committee Section of the Health Sector, birth rates were used as taken from the National Birth Registry (SINAC).

Table 3. Deaths and mortality rate due to CNS malformations, 1990-2012

	Anencephaly		Spina bifida		Encephalocele			
Year registered	Deaths	Rate	Deaths	Rate	Deaths	Rate	Other malformations	Total
1990	654	26.9	789	32.5	97	4.0	741	2,344
1991	612	25.1	727	29.8	69	2.8	710	2,176
1992	646	26.4	673	27.5	87	3.6	742	2,205
1993	606	24.7	677	27.6	91	3.7	742	2,172
1994	623	25.4	669	27.3	104	4.2	725	2,178
1995	595	24.3	669	27.4	93	3.8	766	2,179
1996	544	22.4	610	25.1	102	4.2	769	2,077
1997	579	24.0	595	24.6	107	4.4	788	2,122
1998*	493	20.6	476	19.9	111	4.6	882	2,007
1999	489	20.5	410	17.2	82	3.4	778	1,800
2000	362	15.3	322	13.6	87	3.7	729	1,533
2001	300	12.8	261	11.1	48	2.0	768	1,403
2002	349	14.9	200	8.6	59	2.5	710	1,344
2003	294	12.7	217	9.3	53	2.3	715	1,303
2004	292	12.6	170	7.3	65	2.8	756	1,306
2005	307	13.3	170	7.4	62	2.7	728	1,290
2006	284	12.4	167	7.3	52	2.3	799	1,324
2007	236	10.3	140	6.1	67	2.9	748	1,210
2008	254	11.2	147	6.5	77	3.4	765	1,264
2009	263	11.6	144	6.4	59	2.6	768	1,255
2010	274	12.2	123	5.5	69	3.1	789	1,276
2011	229	10.1	170	7.5	52	2.3	784	1,255
2012*	216	9.5	157	6.9	72	3.2	798	1,243
Total deaths	9,501		8,683		1,765		17,500	38,266

Source: INEGI/SSA Mortality statistics, 1990-2012. *Preliminary rates.

CNS, central nervous system.

SPINA BIFIDA

During the 22-year period of analyses, there were 8683 deaths attributed to this cause (Table 3). The decline in the annual number of deaths is most notable because it is close to 80%: in 1990 there were 789 deaths compared with 157 in 2012. This reflects a decrease in the rate of mortality from 32.5 to 6.9 deaths/100,000 births (Figure 2). The distribution according to age at the time of death is congruent: 34% of deaths occur during the first month of life, whereas 40% survive 1 year and more.

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During the period analyzed there were 1765 deaths attributed to this cause (Table 3) whose percentage of decline is one of the most reduced with the group studied 25%, from 97 deaths in 1990 to 72 in 2012, whereas the rates of mortality decline 4.0 to 3.2 deaths/100,000 births (Figure 2). Fifty percent of the newborns die during the first 7 days of life, 30% within the second week and before their first year of age, and the remaining 20% die years later. It is important to insist on measures to prevent these diseases, especially in the administration of synthetic folic acid, which has proven its effectiveness in reducing not only cases of NTD but also of other birth defects.

The literature presents different strategies for intervention that can be used to increase the folate blood concentration by women. In this manner the incidence of nervous system malformations is reduced at a low cost. The choice of the strategy will depend on the population and the resources available. Monitoring and measurement of the effect of an intervention are important elements for the effectiveness of any strategy.

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