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Perinatal mortality in twin pregnancy: An analysis of birth weight-specific mortality rates and adjusted mortality rates for birth weight distributions

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1 Introduction

It is known that perinatal death is several times more frequent in twins than in single-born infants and that the delivery of low birth weight (LBW) infants appears to be the major factor in the elevated perinatal death rate in twin pregnancy [5, 6, 10, 11, 12, 13]. Comparisons between twin and single births are frequently made by means of overall perinatal mortality rates. This method has been criticized because no allowance is made for the varying incidence of LBW among different populations. Recently, several investigators have declared the need for the analysis of more refined mortality data, especially birthweight-specific mortality rates [3, 4] and standardization for birth weight [9], in order to obtain better insight into, and more meaningful interpretations of, perinatal mortality [7].

The authors report on the result of a retrospective survey which was carried out in 22 Hospital Centers in Spain which covered 1,956 twins births and 110,734 singleton births. The purpose of the present survey is to compare the mortality rates during the perinatal period of twin and single births by means of birth weight-specific mortality rates and the adjusted mortality rates for birth weight distribution.

2 Material and methods

The Perinatal Mortality National Survey of the Perinatal Medicine Section of the Spanish Gynecologists' Association recorded data of 113,436 births at 22 hospitals in different regions of Spain, between January 1 and December 31, 1980. Data include: 1) single and twin births (triplets and higher multiples were not included), 2) birth weight: separate tabulations were performed for single and twin births using 500 g intervals for birth weight, and 3) perinatal outcome: in stillborns, live births and early neonatal deaths. Rates were limited to those births and deaths for

Curriculum vitae

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which the birth weight was recorded and equal or greater than 500 g (1,956 twins born and 110,734 singletons born); unrecorded birth weight constituted 0.66% of the birth population (746/113,436).

Fetal mortality rate (FMR), early neonatal mortality rate (ENMR) and perinatal mortality rate (PMR) were calculated according to the definition of WHO-FIGO [14]. In addition, the birth weight-specific mortality rates in weight groups 500–999 g, 1000–1499 g, 1500–1999 g, 2000–2499 g, 2500 g and more were calculated. Crude rates were adjusted for birth weight differences by direct standardization with the entire population as standard. To enable a latter international comparison, the mortality rates were also calculated using only infants weighing 1000 g or more (standard perinatal statistics). Twins and singletons specific fetal, early neonatal and perinatal mortality rates were compared within each birth weight category, and relative risk (RR) of death was computed from the ratio of the twins mortality rate divided by the singletons' mortality rate. Comparisons of rates were evaluated for statistical significance by a "z" test. A Mantel-Haenszel chi-square test [8] was calculated for the adjusted mortality rates. All reported mortality rates are uncorrected for anomalies incompatible with life.

3 Results

During the period surveyed there were 1,956 twins births and 110,734 singleton's births, with weight recorded and equal or greater than 500 g. The total incidence of twins was 1.7% (1956/112,690). Among the 1,956 twin infants there were 71 fetal and 68 early neonatal deaths. Among the 110,734 single babies there were 976 fetal and 624 early neonatal deaths. The twins represent 6.8% of fetal deaths (71/1047), 9.8% of early neonatal deaths (68/692) and 8.0% of overall perinatal deaths (139/1739).

3.1 Fetal mortality rates

The FMR in twins was 36.3/1000 births (71/1956), significantly higher than 8.8/1000 births (976/110,734) for singletons ($P < 0.001$). The crude relative risk of a fetal death for twins compared to singletons was 4.12. After adjustment for birth weight, there was significant difference in the FMR between twins (12.6/1000) and singletons (9.8/1000); the relative risk was 1.29 ($P < 0.001$). Twins had a FMR: 1) equivalent to that of singletons for the birthweight group 500–999 g (538.5/1000 vs. 643.3/1000), 2) significantly lower than that for singletons for the birthweight groups 1000–1499 g ((107.1/1000 vs. 345.1/1000), 1500–1999 g (59.7/1000 vs. 174.6/1000), and 2000–2499 g (20.7/1000 vs. 43.5/1000), and 3) significantly higher (9.6/1000 vs. 3.1/1000) than that for singletons for the birth weight group 2500 g or more (table I). The standard FMR in twins was 22.6/1000 births (43/1904) and 7.0/1000 births for singletons (774/110;420); the relative risk was 3.22 ($P < 0.001$).

3.2 Early neonatal mortality rates

The ENMR in twins was 36.1/1000 live births (68/1885), compared with 5.7/1000 live births (624/

Table I. Comparison of birth weight-specific fetal mortality rates (FMR) in twin and single births

Birth weight (g)	Twins		Singletons		
	Births (%)	FMR	Births (%)	FMR	RR
500– 999	2.7	538.5	0.3	643.3	0.84
1000–1499	4.3	107.1	0.4	345.1	0.31*
1500–1999	10.3	59.7	0.8	174.6	0.34*
2000–2499	29.6	20.7	2.7	43.5	0.48[1]
2500 or more	53.1	9.6	95.8	3.1	3.10*
Total					
Observed	100.0	36.3	100.0	8.8	4.12*
Adjusted		12.6		9.8	1.29[2]

* $P < 0.001$

[1] $P < 0.05$

[2] Mantel-Haenszel summary chi $\wedge$ 2 = 24.74, $P < 0.001$

109,758) for singletons ($P < 0.001$). The crude relative risk of early neonatal death for twins compared to singletons was 6.35. After adjustment for birth weight, there was no significant difference in the ENMR between twins (5.9/1000) and singletons (6.4/1000). The relative risk was 0.92. Twins had an ENMR equivalent to that of singletons for the birth weight groups 500–999 g (750.0/1000 vs. 750.0/1000), 1000–1499 g (360.0/1000 vs. 323.8/1000) and 2500 g or more (2.9/1000 vs. 2.4/1000), and significantly lower for the birth weight groups 1500–1999 g (68.8/1000 vs. 132.4/1000), and 2000–2499 g (12.3/1000 vs. 31.0/1000) (table II). The standard ENMR (live born weighing 1000 g or more) in twins was 26.9/1000 live births (50/1861) and 4.9/1000 live births for singletons (540/109,646); the relative risk was 5.46 ($P < 0.001$).

3.3 Perinatal mortality rates

The PMR in twins was 71.1/1000 births (139/1956), compared with 14.4/1000 births (1600/110,734) for singletons ($P < 0.001$). The crude relative risk of a perinatal death for twins compared to singletons was 4.92. After adjustment for birth weight, there was significant difference in the PMR between twins (19.1/1000) and singletons (16.0/1000); the relative risk is 1.19 ($P < 0.001$). Twins have a PMR (table III): 1) equivalent to that of singletons for the birthweight groups 500–999 g (884.6/1000 vs. 910.8/1000) and 1000–1499 g (428.6/1000 vs. 557.2/1000), 2) significantly lower than that for singletons for the birth weight groups (1500–1999 g (124.4/1000 vs. 283.8/1000) and 2000–2499 g (32.8/1000 vs. 73.2/1000), and 3) significantly higher than that for singletons for

Table II. Comparison of birth weight-specific early neonatal mortality rates (ENMR) in twin and single births

Birth weight (g)	Twins		Singletons		
	Live births (%)	ENMR	Live births (%)	PMR	RR
500– 999	1.3	750.0	0.1	750.0	1.00
1000–1499	4.0	360.0	0.3	323.8	1.11
1500–1999	10.0	68.8	0.6	132.4	0.52[1]
2000–2499	30.0	12.3	2.6	31.0	0.40[3]
2500 or more	54.6	2.9	96.4	2.4	1.20
Total					
Observed	100.0	36.1	100.0	5.7	6.35*
Adjusted		5.9		6.4	0.92[2]

* $P < 0.001$
[1] $P < 0.05$
[2] Mantel-Haenszel summary chi $\wedge 2 = 3.58$; n. s.
[3] $P < 0.01$

Table III. Comparison of birth weight-specific perinatal mortality rates (PMR) in twin and single births

Birth weight (g)	Twins		Singletons		RR
	Births (%)	PMR	Births (%)	PMR	
500– 999	2.7	884.6	0.3	910.8	0.97
1000–1499	4.3	428.6	0.4	557.2	0.77
1500–1999	10.3	124.4	0.8	283.8	0.44*
2000–2499	29.6	32.8	2.7	73.2	0.45*
2500 or more	53.1	12.5	95.8	5.5	2.27[3]
Total					
Observed	100.0	71.1	100.0	14.4	4.92*
Adjusted		19.1		16.0	1.19[2]

* $P < 0.001$
[2] Mantel-Haenszel summary chi $\wedge 2 = 15.00$, $P < 0.001$
[3] $P < 0.01$

the birth weight group 2500 gm or more (12.5/100 vs. 5.5/1000). The standard PMR in twins was 48.8/1000 births (93/1904) and 11.9/1000 births for singletons (1314/110,420); the relative risk was 4.10 ($P < 0.001$).

4 Discussion

The overall mortality rate in the perinatal period is a fairly crude measure, and needs to be supplemented by birth weight-specific comparisons. When birth weight-specific PMR in twin and single births are compared, it is interesting to note that the levels for the under 1500 g birth weight groups are in close agreement. For birth weight groups of 1500–1999 g and 2000–2499 g, the rates for twins are about two times lower than those for single births. In contrast, PMR for 2500 g and over birth weight is about two times as high for twins as for singletons. The findings in our studies are consistent with those in other investigations [1, 10, 15].

The comparison of birth weight-specific mortality rates among populations will to confuse us if allowance is not made for the different birth weight distributions. Populations with a relatively high proportion of LBW will tend, all other things being equal, to exhibit a higher overall level of mortality than populations with lower proportion [2]. In this study, the LBW rates for twins was 46.8% and for single births 4.2%, while the crude PMR for twins was 71.1/1000 and for singletons 14.4/1000. Moreover, when LBW is common in a population, the PMR among LBW will tend to be lower than for a population where LBW is less common [2]. The data derived from the present study support this opinion. The relative risk of a LBW for twins compared to singletons was 11.1, and the PMR in LBW tins was 137.6/1000, significantly lower compared with 217.4/1000 for singletons.

In this situation, the need for standardizing mortality rates to compensate for differences in distribution of birth weight is accepted [1, 9]. As a result of standardization, the difference between twin and single birth FMR and PMR are markedly reduced, and the difference between ENMR disappear, indicating that most of the differences among crude rates are due to differences in the proportion of LBW births. Similar findings are reported by McCarthy [10], who suggested that one explanation was that twins are more likely to be growth retarded and thus more mature than singletons of an equivalent weight.

In this survey the FMR was nearly four times higher, ENMR six times higher, and PMR five times higher for twins than that for singletons. Moreover, the high percentage of perinatal deaths generated from a relatively low number of twin births should call attention to the importance of this problem. In summary, the excess in the overall fetal, early neonatal and perinatal mortality rates of the twins decreased or disappeared after adjusted for birth weight. These comparisons indicate that the higher overall mortality rates for twins in the perinatal period is due to the distribution of birth weights, and that the objetive is to reduce the incidence of LBW infants.

Abstract

The objective of this study is to compare the fetal mortality rate (FMR), early neonatal mortality rate (ENMR) and perinatal mortality rate (PMR) of twin and single births. It is based on a survey which was carried out in 22 Hospital Centers in Spain in 1980, and covered 1,956 twins born and 110,734 singletons born. The FMR in twins was 36.3/1000 and 8.8/1000 for singletons. The ENMR in twins was 36.1/1000 and 5.7/1000 for singletons. The PMR in twins was 71.1/1000 and 14.4/1000 for singletons. When birthweight-specific PMR in twin and singletons births are compared, there were no differences between the rates for groups 500–999 g and 1000–1499 g. For birthweight groups of 1500–1999 g (124.4 vs 283.8/1000) and 2000–2999 g (29.6 vs 73.2/1000) the rates for twins were about twice lower than those for single births. The PMR for 2500 g and over birthweight was about twice higher in twins than in singletons (12.5 vs 5.5/1000). After we adjusted for birthweight there was a difference in the FMR (12.6 vs 9.8/1000) and the PMR (19.1 vs 16.0/1000, and no difference in the ENMR between twins and singletons (5.9 vs 6.4/1000), indicating that most of the differences among crude rates are due to differences in distribution of birthweight.

Keywords: Adjusted mortality rates, birth weight-specific mortality, fetal mortality, neonatal mortality, perinatal mortality, twins.

Zusammenfassung

Perinatale Mortalität bei Zwillingsschwangerschaften: eine Analyse geburtsgewichtsspezifischer Mortalitätsraten und Aufstellung adaptierter Sterblichkeitsraten für verschiedene Geburtsgewichtsverteilungen

Ziel dieser Arbeit ist der Vergleich der Sterblichkeitsraten während der Perinatalperiode bei Einzel- und Zwillingsgeburten unter Berücksichtigung des Geburtsgewichtes und unterschiedlicher Geburtsgewichtsverteilungen. Wir berichten über die Ergebnisse einer retrospektiven Studie, die 1980 an 22 medizinischen Zentren in Spanien durchgeführt wurde und in der 1956 Zwillings- und 110 734 Einzelgeburten mit einem Gewicht ≥ 500 Gramm erfaßt wurden. Die fetale Sterblichkeitsrate (FSR), die neonatale Frühsterblichkeitsrate (NFSR) und die perinatale Sterblichkeitsrate (PSR) wurden nach der Definition der WHO-FIGO berechnet.

Die Zwillingsgeburten repräsentieren 1,7% der Gesamtgeburten sowie 6,8% der fetalen, 7,5% der frühneonatalen und 8% der perinatalen Todesfälle. Die Gesamt-FSR für Kinder mit einem Gewicht ≥ 500 Gramm war bei Zwillingen 36,6/1000 im Vergleich zu 8,8/1000 bei Einzelgeburten ($p < 0.001$). Das relative Risiko (RR) war 4,12. Die NFSR bei Zwillingen betrug 36,1/1000 gegenüber 5,7/1000 bei Einzelgeburten ($p < 0.001$; RR = 6,35). Die Gesamt-PSR bei Zwillingen lag bei 71,1/1000 im Vergleich zu 14,4/1000 bei Einzelgeburten ($p < 0.001$; RR = 4,92). Für Kinder von 1000 Gramm und mehr war die FSR bei Zwillingen 22,6/1000 bzw. 7,0/1000 bei Einzelgeburten, die NFSR bei Zwillingen betrug 26,9/1000, bei Einzelgeburten 4,9/1000 und die PSR bei Zwillingen lag bei 48,8/1000 gegenüber 11,9/1000 bei Einzelgeburten.

Beim Vergleich der geburtsgewichtsspezifischen PSR von Zwillings- und Einzelgeburten ergeben sich keine signifikanten Unterschiede zwischen den Gruppen 500–999 Gramm und 1000–1499 Gramm (884,6 versus 910,8/1000; RR = 0,97 und 428,6 versus 55,7/1000; RR = 0,77). In den Gewichtsgruppen 1500–1999 Gramm und 2000–2499 Gramm waren die Sterblichkeitsraten für Zwillinge ca. zweimal niedriger als für Einzelgeburten (124,4 versus 283,8/1000; RR = 0,44 und 29,6 versus 73,2/1000; RR = 0,45). In der Gruppe ≥ 2500 Gramm war die PSR bei Zwillingen mehr als doppelt so hoch wie bei den Einzelgeburten (12,5 versus 5,5/1000; RR = 2,27).

Das RR für ein niedriges Geburtsgewicht (LBW) betrug bei Zwillingen im Vergleich zu Einzelgeburten 11,1 (46,8% versus 4,2%). Die PSR bei untergewichtigen Zwillingen lag bei 137,6/1000, d. h., sie war im Vergleich zu Einzelgeburten signifikant niedriger (217,4/1000).

Nach Adaption an das Geburtsgewicht gab es einen signifikanten Unterschied in der FSR zwischen Zwillingen und Einzelgeburten (12,6 versus 9,8/1000; RR = 0,92), bezogen auf die PSR war der Unterschied wiederum signifikant (19,1 versus 16,0/1000; RR = 1,19).

Die Unterschiede bei der Gesamt-FSR und PSR zwischen Zwillings- und Einzelgeburten sind gering und bei der NSFR nach Standardisierung verschwunden. Das deutet darauf hin, daß die meisten Differenzen innerhalb der Rohdaten auf eine unterschiedliche Geburtsgewichtsverteilung zurückzuführen sind. Diese Daten zeigen weiterhin, daß die höheren Gesamtsterblichkeitsraten für Zwillinge während der Perinatalperiode auf die Geburtsgewichtsverteilung zurückzuführen sind und deshalb die Inzidenz untergewichtiger Kinder gesenkt werden muß.

Schlüsselwörter: Adaptierte Sterblichkeitsraten, Fetalsterblichkeit, geburtsgewichtsspezifische Sterblichkeit, neonatale Sterblichkeit, perinatale Sterblichkeit, Zwillinge.

Résumé

Mortalité périnatale pour les grossesses gémellaires: analyse des taux de mortalité spécifiques du poids de naissance et des taux de mortalité ajustes aux distributions de poids de naissance

Le propos de cette étude est de comparer les taux de mortalité pendant la période périnatale pour les naissances de jumeaux et les naissances uniques. Nous avons fait la comparaison entre les taux spécifiques de mortalité par poids à la naissance et les taux de mortalité ajustés à la distribution du poids à la naissance. Nous vous donnons le résultat d'une étude que nous avons faite sur 22 hôpitaux en Espagne en 1980. Elle repose sur 1956 jumeaux et 110 734 naissances uniques dont le poids était égal où supérieur à 500 g. Le taux de mortalité fœtale (TMF), le taux de mortalité néo-natale précoce (TMNP) et même le taux de mortalité périnatale (TMP) ont été élaborés d'après la définition de l'O. M. S.-F. I. G. O.

Les jumeaux nés représentent 1,7% du total des naissances, 6,8% du nombre de naissance d'enfants morts, 9,8% du nombre de décès néonataux précoces et 8,0% du nombre de décès périnataux. Le TMF global pour les enfants dont le poids était de 500 g où plus est de 36,3/1000 pour les jumeaux et seulement de 8,8/1000 pour les naissances uniques ($P < 0,001$); le risque relatif (RR) est donc de 4,12. Le TMNP global pour les jumeaux est de 36,3/1000 et seulement de 5,7/1000 pour les naissances uniques ($P < 0,001$; RR = 6,35). Le TMP global pour les jumeaux est de 71,1/1000 et de 14,0/1000 pour les naissances uniques ($P < 0,001$; RR = 4,92). Pour les enfants dont le poids était égal à 1000 g ou plus, le TMF pour les jumeaux est de 22,6/1000 et de 7,0/1000 pourles naissances uniques; le TMNP pour les premiers est de 26,9/1000 et de 4,9/1000 pout les seconds et les TMP de 48,8/1000 et de 11,9/1000 respectivement. On n'a pas trouvé de différences significatives dans les

taux de mortalité périnatale parmi les jumeaux et les naissances uniques dont le poids était conpris entre 500–999 g (884,6 vs 910,8/1000; RR = 0,97) et 1000–1499 g (428,6 vs 557,2/1000; RR = 0,77). Les mêmes taux pour les poids de 1500–1999 g (124,4 vs 283,8/1000; RR = 0,44) et 2000–2499 g (26,6 vs 73,2/1000; RR = 0,45) sont 2 fois inférieurs pour les jumeaux par rapport aux naissances uniques. Le TMP pour les enfants avec un poids de 2500 g et plus est à peu près 2 fois supérieur pour les jumeaux en relation avec les naissances uniques (12,5 vs. 5,5/1000; RR = 2,27). Le RR des jumeaux de faible poids et d'un nouveau-né unique est 11,1 (46,8% vs.4,2%). Le TMP parmi les jumeaux de faible poids à la naissance est de 137,6/1000, très inférieur au TMP des nouveaux-nés uniques 217,4/1000.
Après le réajustement statistique selon le poids de naissance ont été trouvées des différences significatives entre le TMF des jumeaux et des enfants uniques (12,6 vs. 9.8/1000; RR = 1,29); mais on n'a pas trouvé de différence dans le TMNP (5,9 vs. 6,4/1000; RR = 0,92) alors qu'il y a des différences entre le TMP des jumeaux et des enfants uniques (19,1 vs. 16,0/1000; RR = 1,19).
Après la standardisation, les différences entre les taux globaux de TMF et de TMP des jumeaux et des enfants uniques sont beaucoup plus réduites et elles disparaissent pour les taux de TMNP, celà indique que la plupart des différences entre les taux globaux sont la conséquence de la distribution des poids à la naissance. On peut conclure aussi que les taux de mortalité globale pour les jumeaux dans la période périnatale sont une conséquence de la distribution des poids de naissance. Il est nécessaire, donc, de diminuer le nombre de nouveaux-nés de faible poids.

Mots-clés: Grossesse gemellaire, mortalité fœtale, mortalité néo-natale, mortalité périnatale, mortalité selon le poids à la naissance, taux de mortalité ajusté.

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