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Social Cost of Twin Births

Emile Papiernik

Department of Obstetrics and Gynecology, Faculté de Médicine, Paris-Sud, Unité de Recherches INSERM 187, Hôpital Antoine Béclère, 92141 Clamart, France

This study analyzes costs for neonatal care and costs for care of handicapped children related to twin pregnancies and births. These costs are highly related to the unfavorable birthweight distribution for twins. Each twin pregnancy may cost 10 times more than a single pregnancy. This economic analysis favors all kinds of preventive policies and a calculation is proposed for measuring the probable effect in costs of even a slight decrease in the proportion of very low and low birthweight for twins.

Key words: Twin pregnancy, Neonatal care, Birthweight, Social cost

INTRODUCTION

Most people, and particularly pregnant women and health practitioners, are not aware of the risks attendant upon twin births, and specifically the risk of preterm birth. Therefore, they do not take prevention into consideration seriously enough.

It seems to us that attention should be brought upon economic factors to convince these individuals of the need for a preterm prevention policy. Twin pregnancies involve a much higher preterm rate than single ones and a different repartition of birthweights (low birthweight being more frequent) [2,3,5,7,9,13,14,16,21,22,28].

The very low birthweight rate is held as the principal predictor in neonatal mortality in industrialized population [15].

Our analysis is based on the cost of one birth. The total cost and the share of each birthweight class in this cost can be calculated for one single birth. The same calculation can be done for twins and will take into account the frequencies of occurrences of different birthweight classes.

Hence, it is possible to calculate the saving that could be obtained if a preterm prevention policy that would permit the modification of the repartition of births within birthweight classes was applied.

Preventive policies have been proposed [1,10,12,17-20,24] but are not yet as generally accepted, as is prenatal care for twin pregnancies.

MATERIALS AND METHODS

Different ratios are known for each birthweight class: number of births, number of infants transferred to intensive care units, number of survivors, and number of handicapped infants among the survivors.

In each birthweight class, we can calculate per birth the cost of neonatal cares and of the care of handicapped infants. This calculation will be done for single and twin births, taking into account their respective repartition in each birthweight class.

The number of days spent in neonatal care units have been calculated from a publication giving the repartition of birthweights, the proportion of transferred infants, and the mean duration of stays in care units according to birthweight classes, for a localized population [25].

Let us call p1, p2, p3, and p4 the proportion for each birthweight class related to one birth:

1,000 g or less	0.002	(p1)
1,001–1,500 g	0.006	(p2)
1,501–2,500 g	0.035	(p3)
2,501 g and more	0.957	(p4)

Let us call q1, q2, q3, and q4 the proportion of children transferred to a neonatal care unit for each birthweight class related to one birth:

1,000 g or less	1	(q1)
1,001–1,500 g	0.8	(q2)
1,501–2,500 g	0.2	(q3)
2,501 g and more	0.01	(q4)

Let us call d1, d2, d3, and d4 the duration of stay in a neonatal care unit for each birthweight class and related to one birth:

1,000 g or less	35.1	(d1)
1,001 –1,500 g	30.5	(d2)
1,501–2,500 g	13.6	(d3)
2,501 g and more	4.8	(d4)

The price paid by the social security system for a day spent in an intensive care unit served as a basis for our calculation [about 3,000 French francs (FF) or $430, 1981 value].

A probability for surviving can be proposed by the same mean, using that published by Steward and Reynolds [26] reviewing many different publications. Let us call s1, s2, s3, and s4 the probability of surviving for each birthweight class. A proposed approximation could be:

1,000 g or less	0.4	(s1)
1,001–1,500 g	0.9	(s2)
1,501–2,500 g	0.98	(s3)
2,501 g and more	0.998	(s4)

Let us call h1, h2, h3, and h4 the proportion of handicapped children for each birthweight class. Following Hagberg [11]and Stanley, a proposed approximation could be:

1,000 g or less	0.2	(h1)
1,000–1,500 g	0.1	(h2)
1,501–2,500 g	0.01	(h3)
2,501 g and more	0.001	(h4)

The cost for care of handicapped infants had been estimated at 900,000 FF (1970 value) [29]. In French francs of 1982, this estimation would reach about 3,000,000 FF ($430,000).

The cost of twin births will be different because of a different repartition of births in each birthweight class [3,5,6,8,9]. Though the published series showed some differences, an average estimation could be:

1,000 g or less	0.040	(p1)
1,001–1,500 g	0.065	(p2)
1,501–2,500 g	0.425	(p3)
2,501 g and more	0.470	(p4)

Let us propose as a first hypothesis (A) a modification of birthweight distribution, with a reduction by half for the less-than-1,000 g p1 = 0.02 instead of 0.04 for the birthweight class 1,001–1,500 g; a reduction by one-third with p2 = 0.04 instead of 0.065, for birthweight class 1,501–2,500 g; and a reduction by one-third with p3 0.3 instead of 0.425. Then p4 would be p4 = 0.64 instead of 0.470.

A second hypothesis (B) with a more favorable outcome would postulate a better prevention of very low birthweights. Let us accept:

p1 0.01 instead of 0.04 (1,000 g and less)
p2 0.025 instead of 0.065 (1,001–1,500 g)
p3 0.250 instead of 0.425 (1,501–2,500 g)
p4 0.715 instead of 0.470 (2,501 g and more)

The rates of transfers and the duration of stay in intensive care units can be calculated in days for twin births on the same basis as for single ones, taking into account the different repartition of births in each birthweight class.

We admit that both the proportion of transferred twins and the duration of stay are the same as for single infants.

For each birthweight class the duration of stay in neonatal care unit would be p × p × d.

The cost in neonatal day care can be calculated for one whole group of single or twin birth, and will be called probable duration of neonatal care stay per birth (PDB).

It is:

$$PDB = [(p1 \times p1 \times d1) + (p2 \times q2 \times d2) + (p3 \times q3 \times d3) + (p4 \times q4 \times d4)]$$

A probability of deep handicap per birth (PHB) can be calculated by the same way. It is proposed to take into account in each birthweight class the proportion of survivor(s) and the probability of handicap (h) per birthweight class.

The probability of handicap per single or twin birth can be calculated by taking into account the fourth birthweight classes and the proportions of births in each of them.

Probability of handicap per birth is:

$$PHB = [(p1 \times s1 \times h1) + (p2 \times s2 \times h2) + (p3 \times s3 \times h3) + (p4 \times s \times h)]$$

If we admit that the rate of survivors and the rate of handicapped infants for each birthweight class is the same as for single births, the cost for a twin birth can be found. The cost for a twin pregnancy (two children) will be double that.

The savings resulting from a preterm labor prevention policy modifying the repartition of birthweights could be calculated.

RESULTS

The probability of the duration of stay in intensive care units is given in Table 1. It is 0.36 day for a single birth and 4.168 days for a twin birth.

The cost of neonatal care is 1,080 FF ($152) for a single birth and 12,504 FF ($1,800) for a twin birth.

The probability of deep handicap is given in Table 2 and is 0.001998 for a single birth and 0.01368 for a twin birth.

The cost of the care of handicapped infants is 5,994 FF ($860) for a single birth and 41,040 FF ($5,900) for a twin birth. The cost for a twin pregnancy will be twice the cost of a twin birth.

In an efficient preterm prevention policy (A) was applied, the duration of stay would be of 2.524 days and would cost 7,572 FF ($1,000) for a twin birth. The probability of deep handicaps would be 0.00877 and the cost of the care of handicapped infants would be 26,340 FF ($3,800) for a twin birth and 52,680 FF ($7,600) for a twin pregnancy.

The second policy (B) gives a mean duration of hospital stay in neonatal intensive care units per birth of 1.675 days, with a cost of 5,025 FF for neonatal care, a probability of deep handicap of 0.00621 and a cost of care taking of handicap per birth of 23,655 FF ($3,380).

The saving would amount to 39,318 FF ($5,620) for a twin pregnancy with the first hypothesis (A) and to 59, 778 FF ($8,540) with the second hypothess (B).

DISCUSSION

The repartition of birthweights is the best available indicator of neonatal distresses. We have used the figures given by Simpson and Walker [25] because they also gave us the figure for transferred infants and the duration of stay in care units. There are other figures, for a given country, which are very close to the first ones. For the United Kingdom in 1970, the proportions for single births were the following:

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TABLE 1. Probable Duration of Stay in Neonatal Intensive Care Unit Per Birth (PDB) and Probable Handicap Per Birth (PHB) for Single Birth and Twin Birth

	BW	P	Q	D	PD	PDB	S	H	PH	PHB
	1,000	0.002	1	35.1	0.07		0.4	0.2	0.00016	
Single	1,000–1,500	0.006	0.8	30.5	0.15		0.9	0.1	0.00054	
birth	1,501–2,500	0.035	0.02	13.6	0.09		0.98	0.01	0.00034	
	2,501+	0.957	0.01	4.8	0.05	0.36	0.998	0.001	0.00095	0.00199
	1,000	0.04	1	35.1	1.404		0.4	0.2	0.0032	
Twin	1,000–1,500	0.065	0.8	30.5	1.586		0.9	0.1	0.00565	
birth	1,501–2,500	0.425	0.2	13.6	1.156		0.98	0.01	0.00416	
	2,501+	0.47	0.01	4.8	0.022	4.168	0.998	0.001	0.00047	0.01368

Abbreviations: BW, birthweight classes; P, proportion of births in each birthweight class; Q, proportion of newborns transferred to neonatal intensive care units; D, probable mean duration of hospital stay for transferred newborns following birthweight class; PD, share of each birthweight class for hospital stay in a neonatal intensive care unit calculated for one single birth; PDB, total duration of stay per birth; S, survival rate by birthweight class; H, proportion of handicaps among survivors by birthweight class; PH, proportion of handicaps and share of each birthweight class; PHB, probability of handicaps for each birth calculated by adding the four results in PH.

Probability of use of intensive care unit per birth (PDB) can be calculated by adding the values obtained for the four birthweight classes (class 1: 1,000 g or less; class 2: 1,001–1,500 g; class 3: 1,501–2,500 g; class 4: 2,501 g and more). This value is the product of probability of birth in this birthweight class p, probability of transfer to a neonatal intensive care unit, and probability of duration of stay in such a unit d.

$$PDB = [(p1 \times q1 \times d1) + (p2 \times q2 \times d2) + (p3 \times q3 \times d3) + (p4 \times q4 \times d4)]$$

Probability of handicap per birth can be calculated in the same way, taking into account for each birthweight class the proportions of survivors s1, s2, s3, and s4; and the proportion of deep handicaps h1, h2, h3, and h4.

$$PHB = [(p1 \times s1 \times h1) + (p2 \times s2 \times h2) + (p3 \times s3 \times h3) + (p4 \times s4 \times h4)]$$

*TABLE 2. PDB and PHB for Twin Births After Success of Prevention Policy A or B**

	BW	P	Q	D	PD	PDB	S	H	PH	PHB
Policy A	1,000	0.02	1	35.1	0.702		0.4	0.2	0.0016	
	1,001–1,500	0.04	0.8	30.5	0.976		0.9	0.1	0.0036	
	1,501–2,500	0.3	0.2	13.6	0.816		0.98	0.01	0.00294	
	2,501+	0.64	0.01	4.8	0.03	2.524	0.998	0.001	0.00063	0.00877
Policy B	1,000	0.01	1	35.1	0.351		0.4	0.2	0.008	
	1,001–1,500	0.025	0.8	30.5	0.61		0.9	0.1	0.00225	
	1,501–2,500	0.25	0.2	13.6	0.68		0.98	0.01	0.00245	
	2,501+	0.715	0.01	4.8	0.034	1.675	0.998	0.001	0.00071	0.00621

*This table proposes the same calculations of probability of days spent in neonatal care unit per birth and of probability of handicap per birth for twin births after the success of a prevention policy A or B. Policy A and policy B modify the birthweight repartition.

Abbreviations as in Table 1.

$\leqslant$ 1,000 g: 0.3%
1,001–1,500 g: 0.6%
1,501–2,500 g: 5.9%

In France, the figures given by Rumeau-Rouquette et al (1979) [22] are close:

< 1,500 g: 0.7%
1,501–1,999 g: 0.9%
2,000–2,499 g: 4.9%
(i.e., 5.8% for 1,500–2,500 g)

Proportions vary little for industrialized countries in Western Europe. They can be different for some countries and for black people; for instance, in the United States [4].

The figures available on the proportion of transferred children are scarce since they depend on birthweights, hospital equipment, local habits, and on the policy followed in the different institutions. For Simpson and Walker [25] the proportion of transferred infants has changed quickly between 1972 and 1976. They have analyzed the needs for transfers in an ideal situation and the proportion they have drawn is variably reached according to localization and population but seems stable in industrialized countries.

It can also be higher when all infants weighing less than 1,500 g and a greater proportion of infants weighing between 1,501 g and 2,500 g are transferred such as in our institution.

The estimates proposed by Simpson and Walker [25] were reliable enough to serve as a basis for our calculations.

The cost of a day spent in a neonatal intensive care unit is quite variable because this term is not clearly defined. The distinction has to be made between resuscitation care units for life-threatened infants and specialized medical care units for infants out of life-threatening danger.

Infants weighing 1,500 g or less incur the greater risks for handicaps and the longer duration of stay in care units. At this point, the differences between single infants and twins are important. Published series show the distribution of results for low-birthweight classes. For infants weighing 1,000 g and less, variations are:

4.50% [14]
4.35% [9]
4.50% [24]
4.00% [5]

For the 1,001 to 1,500 g class, variations are obvious but figures are high:

6.75% [9]
5.00% [5]

with no evolution between 1960 and 1964 (8.2%) and between 1965 and 1969 (7.3%) [24].

CONCLUSIONS

It may be of interest to health planners to know that for each single birth, 0.36 days of intensive neonatal care unit is used. It is our aim to show that for a twin birth, this figure is 4.168 days and for any twin pregnancy 8.336 days.

It may be of interest that for any single pregnancy the probability of deep handicap is 0.00199. Our aim is to show that for twins the probable calculated rate is 0.01368, about

*TABLE 3. Cost of Neonatal Care (Cost 1); Cost Related to the Care of Handicapped Infants (Cost 2); Total Cost Per Birth (Cost 1 + Cost 2); Cost Per Pregnancy; and Expected Saving When a Prevention Policy is Applied (A or B)**

		Cost 1	Cost 2	Cost 1 + 2	Cost per pregnancy	Expected saving
Single	FF	1.080	5.970	7.050	7.050	
birth	$	155	852	1.000	1.000	
Twin birth	FF	12.504	41.040	53.544	107.088	
Actually	$	1.790	5.860	7.650	15.300	
Twin birth	FF	7.572	26.310	33.895	67.770	39.318
Policy A	$	1.080	3.760	4.840	9.680	5.620
Twin Birth	FF	5.025	18.630	23.655	47.310	59.778
Policy B	$	720	2.660	3.380	6.760	8.540

*Cost 1 is calculated for a probable use of neonatal intensive care unit bed per birth if the cost per day is 3,000 FF ($430). The mean probable need of days (PDB) per birth (single or twin) at present state is given. It is also given for twins if a policy, A or B, is applied.
Cost 2 is calculated for the care of handicapped infants for their lifetime and evaluated on the basis of 3,000,000 FF ($430,000) with the probabilities calculated in Tables 1 and 2 for a single birth and a twin birth at present state of care, and in case of success of a prevention policy, A or B.
Cost 1 + 2 is the addition of these previous costs. Costs per pregnancy are doubled for twins. The expected saving shows the difference between the cost for policy A or B compared to the present state of cost for each twin pregnancy.

seven times greater. Costs may be calculated by taking into account the cost of a single day of neonatal care, and the cost for care of any deep-handicapped child may be included.

These costs for twins as compared to those for singletons, are very much related to unfavorable birthweight distributions. We have shown that a very slight reduction in birthweight numbers of the group most at risk, would lower costs and result in important savings.

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Correspondence: Emile Papiernik, Department of Obstetrics and Gynecology, Faculté de Médicine, Paris-Sud, Unité de Recherches INSERM 187, Hôpital Antoine Béclère, 92141 Clamart, France.