

Recent trends in infant mortality rates and proportions of low-birth-weight live births in Canada



Evidence

Études

K.S. Joseph,* MD, PhD; Michael S. Kramer,† MD

Abstract

Objective: To identify spatial patterns of changes in infant mortality rates and proportions of low-birth-weight live births observed in 1994.

Setting: Canada.

Subjects: Live births and infant deaths in Canada between 1987 and 1994. Data for Newfoundland were unavailable for 1987 through 1990.

Outcome measures: Annual infant mortality rates (crude and after excluding live newborns weighing less than 500 g); proportion of live births by low-birth-weight category (500–2499 g).

Results: Nova Scotia, New Brunswick, Quebec and Manitoba had lower crude and adjusted infant mortality rates in 1994 than in 1993. Newfoundland, Saskatchewan, Alberta and British Columbia had higher rates in 1994 than in 1993. The crude rate in Ontario was lower, and the adjusted rate higher, in 1994 than in 1993. A downward trend in the proportion of low-birth-weight live births was observed in Quebec (χ^2 for trend = 29.2, $p < 0.01$). Conversely, an upward trend was observed in Ontario (χ^2 for trend = 241.3, $p < 0.01$). However, the increase may have been due to data errors, especially in 1993 and 1994, involving truncation of ounces in 2 digits to 1 digit (e.g., 5 pounds 10 ounces became 5 pounds 1 ounce).

Conclusions: Although the marginal increases in infant mortality observed in several provinces could be the result of random variation, future trends should be closely monitored. The proportion of low-birth-weight live births in Canada (excluding Ontario) appears to be stable, with Quebec showing significant reductions. The errors in data for Ontario need to be corrected before trends can be estimated for that province and for Canada as a whole.

Résumé

Objectif : Définir les profils spatiaux des changements des taux de mortalité chez les nouveau-nés et les proportions de naissances vivantes de faible poids à la naissance observés en 1994.

Contexte : Canada.

Sujets : Naissances vivantes et mortalité chez les nouveau-nés au Canada entre 1987 et 1994. On ne disposait pas de données sur Terre-Neuve de 1987 à 1990.

Mesures des résultats : Taux annuel de mortalité chez les nouveau-nés (bruts et après exclusion des nouveau-nés vivants pesant moins de 500 g); proportion des naissances vivantes par catégorie de faible poids à la naissance (500 à 2499 g).

Résultats : La Nouvelle-Écosse, le Nouveau-Brunswick, le Québec et le Manitoba ont enregistré des taux bruts et corrigés de mortalité chez les nouveau-nés plus faibles en 1994 qu'en 1993. Terre-Neuve, la Saskatchewan, l'Alberta et la Colombie-Britannique ont enregistré des taux plus élevés en 1994 qu'en 1993. Le taux brut en Ontario a été plus faible et le taux corrigé plus élevé en 1994 qu'en 1993. On a observé au Québec une tendance à la baisse de la proportion des naissances vivantes de faible poids à la naissance (χ^2 pour la tendance = 29,2, $p < 0,01$). À l'inverse, on a observé une tendance à la hausse en Ontario

From *the Bureau of Reproductive and Child Health, Laboratory Centre for Disease Control, Ottawa, Ont.; and †the Departments of Pediatrics and of Epidemiology and Biostatistics, McGill University, Montreal, Que.

This article has been peer reviewed.

Can Med Assoc J 1997;157:535-41

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(χ^2 pour la tendance = 241,3, $p < 0,01$). L'augmentation peut toutefois être attribuable à des erreurs de données, surtout en 1993 et 1994, erreurs qui mettent en cause la troncation d'onces de 2 chiffres à 1 chiffre (par exemple, 5 livres 10 onces devenant 5 livres 1 once).

Conclusions : Même si les augmentations marginales de la mortalité chez les nouveau-nés observées dans plusieurs provinces pourraient découler d'une variation aléatoire, il faudrait suivre de près les tendances futures. La proportion des naissances vivantes de faible poids à la naissance au Canada (sauf en Ontario) semble stable et l'on enregistre des réductions importantes au Québec. Il faut corriger les erreurs de données pour l'Ontario avant de pouvoir estimer les tendances pour cette province et pour le Canada au complet.

The crude infant mortality rate in Canada decreased from 6.4 per 1000 live births in 1991 to 6.1 per 1000 in 1992. It increased marginally to 6.3 per 1000 in 1993 and stayed at that value in 1994. We previously reported that the infant mortality rate among newborns weighing 500 g or more fell sequentially between 1987 and 1993 but increased in 1994.^{1,2} The increase was accompanied by a simultaneous increase in the proportion of low-birth-weight live births (500–2499 g).² Although the 1994 increase in infant mortality could have been the result of random variation, the concomitant increase in the proportion of low-birth-weight newborns suggests the possibility of a deterioration in maternal, fetal or infant health. Close attention to future trends in infant mortality rates and proportions of low-birth-weight live births is therefore indicated.

In this article, we present the results of an investigation undertaken to identify the spatial patterns of the changes in infant mortality rates and proportions of low-birth-weight newborns observed in 1994.

Methods

The numbers of live births and infant deaths were obtained from Statistics Canada publications^{3–14} for 1987 through 1994, the latest year for which such data were available at the time of the study. We excluded reports published before 1987 because they used different birth-weight categories from those used in and subsequent to 1987.¹⁵ Because the distribution of birth weights in Newfoundland was not published for 1987 through 1990, we included only data from 1991 through 1994 from that province.

We tabulated infant mortality rates by province and territory. Since the comparison of crude infant mortality rates across time appears to be confounded by the changing proportion of live newborns weighing less than 500 g,¹ we also compared the rates among live newborns weighing 500 g and over. We used 2 methods of comparison. First, we calculated the infant mortality rate for each province after excluding all newborns weighing less than

500 g, assuming that no neonate in this weight category would survive infancy.^{16,17} Second, we used a Poisson regression model to estimate the infant mortality rate adjusted for the proportion of live newborns weighing less than 500 g. The number of infant deaths in any province was the dependent variable, and the year, province/territory, sex and proportion of live newborns weighing less than 500 g were the independent variables. Adjusted infant mortality rates obtained in this analysis were similar to those obtained by the previous approach (i.e., calculation of infant mortality rates after exclusion of live newborns weighing less than 500 g).

As previously mentioned, we had reported that the proportion of live newborns weighing 500–2499 g increased in Canada in 1994.² We have now completed a supplementary analysis of gestational age distribution to assess national trends in the occurrence of preterm birth. Statistics Canada does not publish gestational age distributions by province. Because Newfoundland data were not included before 1991, we limited our analysis to trends between 1991 and 1994. We excluded live newborns weighing less than 500 g and those of less than 20 weeks' gestation from this analysis.

We determined trends by calendar year in the proportion of live newborns weighing 500–2499 g in each province. We used χ^2 tests for linear trend in proportions of low-birth-weight newborns to estimate the statistical significance of observed patterns.¹⁸ We also estimated the prevalence rate ratio for each low-birth-weight category by dividing the prevalence proportion for 1994 by that for 1987. Test-based 95% confidence intervals (CIs) were determined for these ratios.¹⁹ Trends in each low-birth-weight category were also estimated for provinces showing statistically significant changes in the proportion of live newborns weighing 500–2499 g.

(After this paper was submitted for publication, we gained access to the original non-nominal live-birth data files of Statistics Canada, excluding data from British Columbia. These data files were used to examine the birth-weight distributions of specific provinces.)



Results

Table 1 lists the crude infant mortality rates by province and territory and for Canada as a whole between 1987 and 1994 and the infant mortality rates excluding live newborns weighing less than 500 g. The rates in Prince Edward Island, the Northwest Territory and the Yukon Territory changed markedly over time because of the relatively small numbers of live births and infant deaths. Nova Scotia, New Brunswick, Quebec and Manitoba had lower crude and adjusted rates of infant death in 1994 than in 1993. In Newfoundland, Ontario,

Saskatchewan, Alberta and British Columbia the adjusted rates were higher in 1994 than in 1993, although the differences were not statistically significant. A similar increase in the crude rate was observed in 4 of these provinces; Ontario's crude rate decreased between 1993 and 1994. Such marginal increases in infant mortality have occurred in various provinces in previous years.

Among the live newborns having a stated gestational age (excluding those less than 500 g or of less than 20 weeks' gestation), the proportion born before 37 weeks increased steadily between 1991 and 1994, from 6.6% to 7.3%. This trend was statistically significant (χ^2 for trend

Table 1: Infant mortality rates in Canada from 1987 to 1994, by province or territory

Province/territory	Year; rate per 1000 live births							
	1987	1988	1989	1990	1991	1992	1993	1994
Newfoundland								
Crude	7.59	9.35	8.25	9.21	7.81	7.08	7.79	8.20
≥ 500 g	–	–	–	–	6.84	6.65	6.86	7.42
Prince Edward Island								
Crude	6.65	7.08	6.20	5.96	6.90	1.62	9.12	6.41
≥ 500 g	6.14	6.08	6.20	5.96	6.37	1.62	9.12	6.41
Nova Scotia								
Crude	7.43	6.48	5.82	6.29	5.74	5.98	7.09	6.04
≥ 500 g	6.45	5.91	5.35	5.75	5.16	5.39	5.80	5.14
New Brunswick								
Crude	6.99	7.17	7.14	7.23	6.11	6.28	7.18	5.35
≥ 500 g	6.37	6.86	6.62	6.32	5.58	5.54	6.85	4.90
Quebec								
Crude	7.09	6.50	6.84	6.24	5.94	5.43	5.73	5.59
≥ 500 g	6.65	6.20	6.47	5.60	5.28	5.00	5.23	5.19
Ontario								
Crude	6.60	6.59	6.78	6.27	6.29	5.88	6.24	5.98
≥ 500 g	6.09	6.21	6.41	5.93	5.14	5.45	5.10	5.48
Manitoba								
Crude	8.38	7.75	6.64	7.95	6.42	6.81	7.06	6.98
≥ 500 g	7.62	6.88	6.12	7.27	5.79	5.85	5.93	5.47
Saskatchewan								
Crude	9.10	8.35	8.05	7.64	8.23	7.33	8.06	8.90
≥ 500 g	8.69	7.88	7.33	6.90	7.65	7.00	7.02	8.34
Alberta								
Crude	7.48	8.25	7.50	8.05	6.66	7.23	6.65	7.39
≥ 500 g	7.41	8.16	7.50	7.08	6.01	6.55	5.84	6.34
British Columbia								
Crude	8.59	8.43	8.22	7.54	6.53	6.20	5.74	6.32
≥ 500 g	8.04	7.58	7.61	6.91	6.16	5.59	5.26	5.90
Northwest Territories								
Crude	12.48	10.29	16.23	11.99	12.24	16.73	9.62	14.56
≥ 500 g	12.48	9.65	15.56	10.75	11.64	16.73	9.62	14.56
Yukon Territory								
Crude	10.46	5.76	4.17	7.19	10.56	3.78	7.87	2.26
≥ 500 g	10.46	5.76	4.17	5.41	8.82	3.78	5.92	0.00
Canada*								
Crude	7.31	7.13	7.10	6.78	6.37	6.08	6.28	6.25
≥ 500 g	6.85	6.72	6.71	6.20	5.54	5.57	5.42	5.66

*Data for Newfoundland excluded.



= 196.0, $p < 0.01$). A rise in the proportion of live births between 32 and 36 weeks' gestation appears to have accounted for most of the increase. The proportion of births between 32 and 35 weeks' gestation increased from 2.8% in 1991 to 3.0% in 1994 (χ^2 for trend = 51.5, $p < 0.01$), and the proportion at 36 weeks' gestation increased from 2.9% to 3.3% (χ^2 for trend = 151.8, $p < 0.01$). During the same period, the proportion of live newborns without a stated gestational age declined sharply, from 1.5% in 1991 to 0.2% in 1994.

The proportions of low-birth-weight live births in each province and territory from 1987 through 1994 are listed in Table 2. The temporal trend was statistically significant for Quebec and Ontario, although the trends were in opposite directions. A downward trend was observed in Quebec (χ^2 for trend = 29.2, $p < 0.01$), especially between 1988 and 1993. In Ontario, conversely, the proportion increased by 22% (95% CI 18%–26%) between 1987 and 1994 (χ^2 for trend = 241.3, $p < 0.01$). The increasing trend achieved statistical significance by 1992 and was highly significant by 1993 (χ^2 for trend between 1987 and 1992 = 5.5, $p = 0.02$; χ^2 between 1987 and 1993 = 62.9, $p < 0.01$).

The proportion for Canada (excluding Newfoundland) increased significantly, from 5.5% in 1987 to 5.9% in 1994; however, the proportion was constant at 5.6% in 1987 and 1994 after Ontario was also excluded.

The decrease in proportions in Quebec occurred secondary to statistically significant decreases in the low-birth-weight categories 1250–1499 g, 1750–1999 g, 2000–2249 g and 2250–2499 g. The increase in Ontario occurred because of increases in the categories 500–749 g, 750–999 g, 1250–1499 g, 1500–1749 g (nominally significant), 1750–1999 g and 2250–2499 g. The increases were most apparent in 1993 and 1994. Temporal trends in mean birth weight in the 2 provinces showed a similar picture. The mean birth weight of live male newborns in Quebec increased from 3366 g in 1987 to 3404 g in 1994; during the same period in Ontario, it decreased from 3457 g to 3429 g.^{3,14} For live female newborns during the same period, the mean birth weight increased from 3238 g to 3282 g in Quebec and decreased from 3329 g to 3307 g in Ontario.^{3,14} This comparison of mean birth weights is confounded by changes in the proportion of live newborns weighing less than 500 g.

Table 2: Rates of low-birth-weight live births (500–2499 g) in Canada, by province or territory

Province/Territory	Year; rate per 1000 live births								1994:1987 ratio (and 95% CI)*	χ^2 value† (for trend)	p value
	1987	1988	1989	1990	1991	1992	1993	1994			
Newfoundland	–	–	–	–	55.2	55.8	56.4	61.7	1.12 (0.98–1.28)	2.5	0.11
Prince Edward Island	52.3	58.7	47.0	47.2	44.7	52.0	40.5	60.7	1.16 (0.89–1.52)	0.1	0.71
Nova Scotia	54.5	59.2	54.5	58.3	56.6	55.3	57.3	54.3	1.00 (0.90–1.11)	0.1	0.75
New Brunswick	52.6	52.8	57.9	49.3	55.1	53.3	55.0	58.7	1.12 (0.99–1.26)	2.2	0.14
Quebec	60.5	62.8	60.3	59.3	58.1	56.5	56.5	58.9	0.97 (0.94–1.01)	29.2	< 0.01
Ontario	53.6	54.6	52.9	53.5	55.5	55.3	60.6	65.4	1.22 (1.18–1.26)	241.3	< 0.01
Manitoba	54.1	53.6	49.4	54.1	53.1	49.5	52.6	51.3	0.95 (0.87–1.04)	1.3	0.26
Saskatchewan	50.4	50.4	52.8	48.3	50.1	48.3	50.6	52.8	1.05 (0.96–1.16)	0.0	0.88
Alberta	54.6	57.9	58.7	57.9	56.9	57.5	55.8	55.3	1.01 (0.96–1.07)	0.4	0.52
British Columbia	50.6	49.4	51.9	49.7	48.4	47.7	50.1	50.6	1.00 (0.94–1.06)	0.6	0.42
Northwest Territories	60.1	62.8	52.2	53.2	52.7	65.0	55.3	68.0	1.13 (0.86–1.48)	0.5	0.48
Yukon Territory	62.8	30.7	39.7	50.4	52.8	60.5	61.0	56.6	0.90 (0.54–1.51)	2.0	0.16
Canada‡	54.9	56.2	55.2	54.8	55.1	54.4	56.8	59.3	1.08 (1.06–1.10)	44.7	< 0.01

*Ratio for Newfoundland is 1994:1991.

† χ^2 test (1 degree of freedom) for linear trend in proportions;‡0 value for Newfoundland is based on data for 4 years only.

#Data for Newfoundland excluded.



The proportion of live newborns weighing less than 500 g increased significantly in Ontario between 1987 and 1994 (χ^2 for trend = 33.1, $p < 0.01$), but not in Quebec (χ^2 for trend = 0.65, $p = 0.42$). The trend in Ontario, although statistically significant, showed a complex pattern characterized by an approximate doubling and halving of the proportion from 1990 through 1994 (3.5, 11.7, 4.4, 11.5 and 5.0 per 10 000 live births respectively). Statistically significant increases in this birth-weight category were also observed in Manitoba (χ^2 for trend = 6.81, $p = 0.01$) and Alberta (χ^2 for trend = 68.8, $p < 0.01$).

Frequency distributions of birth weight in Ontario revealed a curious picture for 1993 and 1994. These distributions were characterized by steep peaks at 2749 g, 3203 g, 3657 g and so on. We graphed the birth-weight distribution after converting birth weights into ounces (Figs. 1 and 2). The spikes appear around 5, 6, 7 and 8 pounds, which suggests that numerous birth weights were truncated. The problem was more evident in 1994 than in 1993. No such pattern was observed in the birth-weight distributions for the rest of Canada or for Ontario before 1993.

Discussion

The crude and adjusted infant mortality rates indicate that several provinces registered increases in infant mortality from 1993 to 1994. These changes are not statistically significant and could be the result of random variation.

In Ontario, the crude and adjusted infant mortality rates showed different patterns in 1993 and 1994. Although the crude rate decreased across the 2 years, this improvement appears to be because of a decrease in the registration of live newborns weighing less than 500 g in the province in 1994. Trends in the occurrence of live births in this weight category provide useful information on birth registration practices; however, comparisons of infant mortality rates are more meaningful if they are restricted to live newborns weighing 500 g or more.^{1,2}

Our analysis by gestational age distribution indicates that the proportion of preterm births in Canada has increased sequentially between 1991 and 1994. However, this change in the gestational age distribution is susceptible to various interpretations. The decrease in the proportion of live births of unstated gestational age is one possible explanation. Changes in the method of ascertaining gestational age (by ultrasound early in pregnancy rather than by the date of the last normal menstrual period) and other aspects of obstetric care are also possible explanations.

Trends in the proportion of low-birth-weight live births in Quebec and Ontario present a contrasting picture. The proportion decreased in Quebec from 1987 to 1994, especially between 1988 and 1993; however, it in-

creased by 22% in Ontario during the same period. Even though the proportion in Quebec was higher in 1994 than in 1993, the overall downward trend through 1994 was statistically significant. Because of these opposing trends in Quebec and Ontario, the change in the proportion of low-birth-weight live births in Canada was not statistically significant between 1987 and 1993.¹

Our results suggest that the recent increase in the proportion of low-birth-weight newborns in Ontario occurred because of errors in the data for 1993 and 1994. Discussions with Statistics Canada have led us to believe that birth weights were truncated in some cases. Such speculation is based on the fact that the peaks in Figs. 1 and 2 appear at 5 pounds 1 ounce, 6 pounds 1 ounce, and so on. It appears that several birth weights in the range of 5 pounds 10–15 ounces were erroneously truncated to 5 pounds 1 ounce. Similar errors were made for birth weights between 6, 7 and 8 pounds 10–15 ounces. A truncation of birth weights in the range of 5 pounds 10–15 ounces to 5 pounds 1 ounce would shift a significant number of births into the low-birth-weight category (i.e., less than 2500 g or less than about 5 pounds 8 ounces). The increase in the proportion of low-birth-weight live births in Ontario between 1993 and 1994 is explained by the fact that the peaks in 1994 are larger than those in 1993, although the reason for the higher peaks in 1994 is unclear.

This explanation does not account for the increases observed in each of the 250-g birth-weight categories in Ontario. Simple truncation of 2-digit ounces should have led to either no difference or decreases in some of the categories. Similarly, the increasing trend in the proportion of low-birth-weight newborns in Ontario between 1987 and 1992 remains unexplained. It is possible that errors other than data truncation were responsible for this increase. In this connection, it is worth noting the trend in the proportion of live newborns weighing less than 500 g in Ontario from 1990 through 1994. The doubling and halving of the proportion during that period probably reflects birth registration procedures rather than a true change. Epidemiologists and other users of vital statistics data should be cautious when making inferences based solely on aggregated data (i.e., data tabulated in categories).

It is difficult to explain the difference in trends in the proportion of low-birth-weight live births in Ontario from 1987 through 1992 and in Quebec from 1987 through 1994. Current information on the determinants of low birth weight in Canada is seriously inadequate, even at the provincial level. For example, although fairly good data exist on trends in cigarette smoking among women (and men) of all ages, little information is available on smoking during pregnancy. Attempts are being made to rectify this situation through the Canadian Perinatal Surveillance System (a collaborative initiative of Health

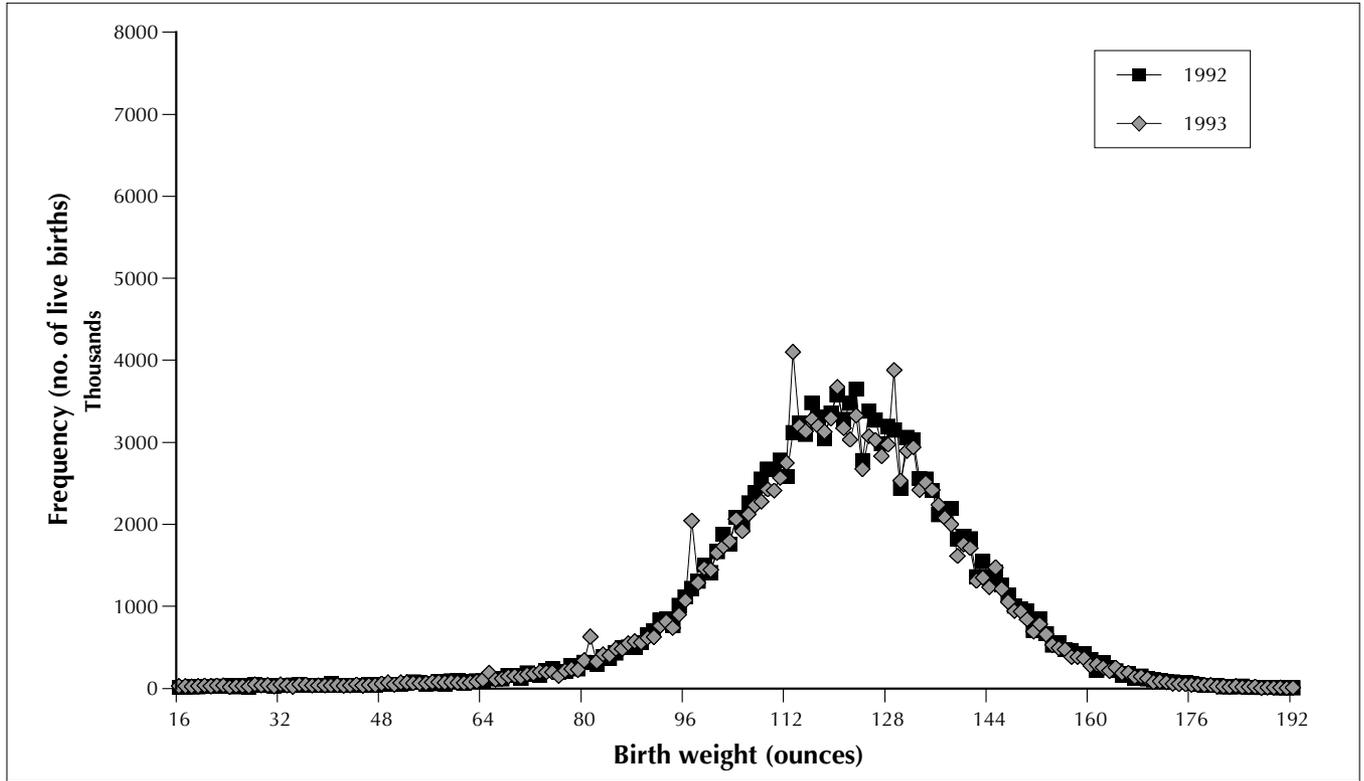


Fig. 1: Distribution of live births by birth weight in Ontario, 1992 and 1993. All weights have been rounded to the nearest ounce (1 oz = 28.35 g).

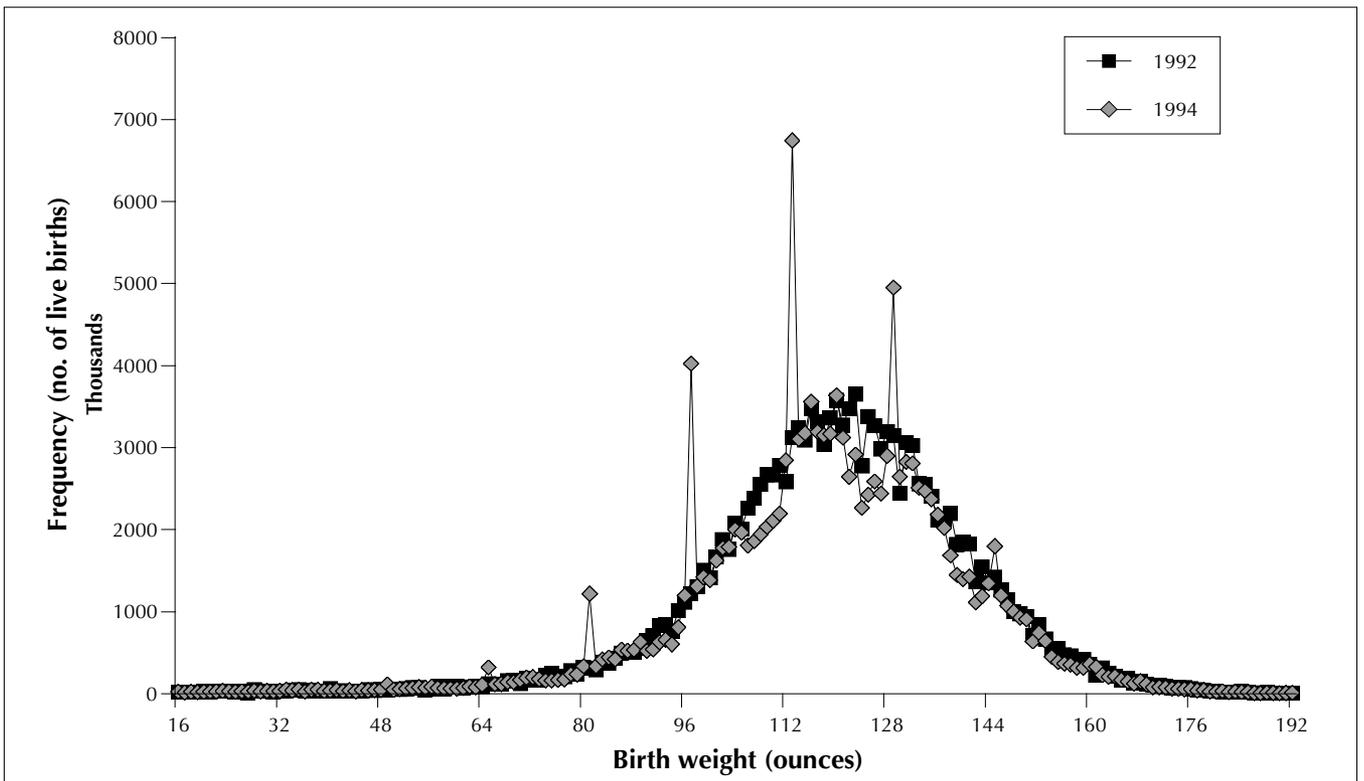


Fig. 2: Distribution of live births by birth weight in Ontario, 1992 and 1994. All weights have been rounded to the nearest ounce.



Canada); however, this system and other efforts toward perinatal surveillance require continued strengthening and support.

In summary, our study has revealed that several provinces registered marginal increases in infant mortality from 1993 to 1994. Although these increases could be the result of random variation, future trends should be closely monitored. The proportion of low-birth-weight newborns in Canada (excluding Ontario) appears to be stable, with Quebec showing significant reductions. The substantial increase in the proportion in Ontario appears to be the result of data errors; until these errors are corrected, no inferences can be made about the trends in low-birth-weight live births in Ontario or in Canada as a whole. We have informed the appropriate authorities in Ontario and Statistics Canada and anticipate that such problems will be resolved in future publications.

We thank the Vital Statistics Registrars of the provinces and territories who gave us access to their data files.

This study was conducted under the auspices of the Canadian Perinatal Surveillance System. Dr. Kramer is the recipient of a National Health Research Scientist award of the National Health Research and Development Program, Health Canada.

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Reprint requests to: Dr. K.S. Joseph, Bureau of Reproductive and Child Health, Laboratory Centre for Disease Control, Tunney's Pasture, AL 0601E2, Ottawa ON K1A 0L2

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