

Increasing Social Variation in Birth Outcomes in the Czech Republic After 1989

ABSTRACT

Objectives. This study investigated social variation in birth outcome in the Czech Republic after the political change of 1989.

Methods. Routinely collected records on singleton live births in 1989, 1990, and 1991 (n = 380 633) and 1994, 1995, and 1996 (n = 286 907) were individually linked to death records.

Results. Mean birthweight fell from 3323 g to 3292 g ($P < .001$) between 1989 and 1991 and then increased to 3353 g by 1996. The gap in mean birthweight between mothers with a primary education and those with a university education, adjusted for age, parity, and sex of infants, widened from 182 g (95% confidence interval [CI] = 169, 194) in 1989 to 256 g (95% CI = 240, 272) in 1996. Similar trends were found for preterm births. Postneonatal mortality declined most among the better educated and the married. The odds ratio for postneonatal death for infants of mothers with a primary (vs university) education, adjusted for birthweight, increased from 1.99 (95% CI = 1.52, 2.60) in 1989 through 1991 to 2.39 (95% CI = 1.55, 3.70) in 1994 through 1995.

Conclusions. Despite general improvement in the indices of fetal growth and infant survival in the most recent years, social variation in birth outcome in the Czech Republic has increased. (*Am J Public Health.* 1998;88:1343-1347)

Ilona Koupilová, MD, PhD, DrMedSc, Martin Bobák, MD, PhD, Jan Holčík, MD, DSc, Hynek Pikhart, MSc, and David A. Leon, PhD

Inequity in health within populations has been identified by the World Health Organization as a prime obstacle to its Health for All by the Year 2000 strategy.¹ The reduction of inequalities in health can be seen as an overall strategy for the improvement of a population's health and as helpful in maintaining and improving the population's human capital.²

Infant mortality is a key indicator of health status and has long been shown to reflect socioeconomic circumstances. Similarly, birthweight is considered to be an important measure of the health status of a population; birthweight is a strong predictor of both mortality and morbidity in infancy and reflects nutritional status and growth rates.³ More recently, indices of fetal growth have taken on a new significance in light of evidence suggesting that they may be predictive of chronic disease in adult life.^{4,5}

We previously reported a significantly lower mean birthweight of Czech newborns and greater social variation in size at birth and frequency of preterm birth in the Czech Republic, compared with Sweden.⁶ These findings indicated an unfavorable state of general health of the Czech population in the late 1980s. The purpose of the present analysis is to assess trends in social variation of several indices of fetal growth and infant mortality in the Czech Republic from 1989 through 1996.

The period of study coincides with the political and economic changes that Czech society has undergone since the collapse of communism in November 1989. It is possible that pregnancy outcomes are affected by such profound social changes. The analyses presented here investigated this possibility.

Methods

The data used for analysis consisted of information on all singleton live births reported to the Czech Statistical Office in 1989 through

1991 and 1994 through 1996; data for 1992 and 1993 were not available. The Czech Republic uses the World Health Organization definition of live birth. All live-born infants with birthweights of 500 g or more were included in this register until 1994; live-born infants with birthweights of less than 500 g have been included since 1995 (n = 6 in 1995, n = 5 in 1996). Information on maternal age, birth order, sex of the child, single or multiple birth, birthweight, gestational age (based on date of last menstrual period), and mother's marital status and education is also available from the register. Birthweight is rounded to the nearest 10 g. The data on demographic and social characteristics are collected by the medical staff from medical records or identification cards or are reported by the pregnant women themselves.

Maternal education was classified into 4 categories: primary education (up to 10 years of schooling), vocational training (an additional 2 to 3 years of apprenticeship), secondary education (A-level equivalent), and university (at least 4 years of education after secondary school, and a completed degree). Mother's marital status was classified as single, married, divorced, or widowed. Throughout

Ilona Koupilová and David A. Leon are with the European Centre on Health of Societies in Transition, London School of Hygiene and Tropical Medicine, London, England. Ilona Koupilová and Jan Holčík are with the Department of Social Medicine and Health Care Administration, Faculty of Medicine, Masaryk University, Brno, Czech Republic. Martin Bobák and Hynek Pikhart are with the International Centre for Health and Society, Department of Epidemiology and Public Health, University College London, London, England.

Requests for reprints should be sent to Ilona Koupilová, MD, PhD, DrMedSc, European Centre on Health of Societies in Transition, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, United Kingdom.

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TABLE 1—Distribution (%) of Age, Education, and Marital Status Among Mothers of Singleton Live-Born Infants in the Czech Republic, 1989–1996

	1989 (n = 125 873)	1990 (n = 128 008)	1991 (n = 126 752)	1994 (n = 104 558)	1995 (n = 94 034)	1996 (n = 88 315)
Maternal age, y						
<20	13.7	14.2	15.6	13.5	11.1	9.1
20–24	45.6	45.0	44.8	44.5	44.0	43.5
25–29	26.3	26.9	26.4	26.9	28.3	29.7
30–34	10.4	9.9	9.2	10.7	12.1	13.0
35–39	3.5	3.5	3.4	3.6	3.7	4.0
40+	0.5	0.5	0.6	0.7	0.7	0.8
Mother's education^a						
Primary	14.4	13.7	13.4	13.6	14.0	13.9
Vocational	38.1	38.8	39.8	43.1	42.8	41.9
Secondary	38.4	38.6	38.2	35.1	34.4	35.0
University	9.1	8.9	8.6	8.2	8.8	9.2
Mother's marital status						
Single	5.5	6.1	7.2	10.7	11.4	12.5
Married	92.1	91.5	90.2	85.4	84.4	83.0
Divorced	2.1	2.2	2.4	3.6	3.8	4.2
Widowed	0.3	0.2	0.3	0.3	0.3	0.3

^aInformation on maternal education was missing for 2 infants born in 1996.

the analyses, we used 5-year age categories (<20, 20–24, . . . 40+ years) and 6 categories of parity (parity 1, 2, . . . 6+). *Preterm birth* refers to a birth occurring at a gestational age of less than 37 weeks.⁷

Although no formal evaluation of the quality of data from the Czech birth registry is available, the register is virtually complete and it is generally believed that the quality of the information is good. There was no indication that the quality of data in the register changed significantly over the study period.

To permit the study of neonatal and postneonatal mortality, data from the birth registry were linked to the death register for all except the 1996 births by means of unique personal numbers. The linkage was successful for nearly 90% of infant deaths. The infant deaths that were not successfully linked to the birth register included a high proportion of infants with extremely low birthweights and early neonatal deaths. Mean birthweight was lower among infant deaths not linked to the birth register (2038 g, SD = 1142 g) than among those successfully linked (2082 g, SD = 1083 g). The proportion of neonatal deaths was higher among those not linked to the birth register (79% vs 62%). Neonatal mortality is probably underestimated by 12% and postneonatal mortality by up to 6% in this study. If the unlinked deaths were more likely to be from multiple births (which is conceivable, given the lower birthweights among the unlinked deaths), the underestimation of mortality rates in our study would be even smaller.

The effect of maternal characteristics on infants' size at birth was quantified by linear regression. Logistic regression was used to

study the variation in risk of preterm birth and death in infancy (0–365 days), the neonatal period (0–27 days), and the postneonatal period (28–365 days). All analyses were performed with and without adjustments for potential confounders. Analyses were carried out with the Stata statistical package.⁸

The release of the data was in accordance with statutory obligations to protect confidentiality. Individuals could not be identified from the data provided for analysis.

Results

Demographic Characteristics

Substantial demographic changes occurring in the Czech Republic over the study period are reflected in our data. There were 380 633 singleton live births reported to the Czech Statistical Office from 1989 through 1991, and only 286 907 in the 3 years from 1994 through 1996.

The mean age of mothers increased slightly, from 24.2 years (SD = 4.7) in 1989 to 24.7 years (SD = 4.9) in 1996 ($P < .001$). No appreciable changes were seen in parity: there were 47.9%, 37.3%, and 14.8% mothers of parity 1, 2, and 3 or more, respectively, in 1989, and 47.1%, 38.4%, and 14.5%, respectively, in 1996. There was an increase in the proportion of mothers with vocational training and a slight decrease in the proportion of mothers with secondary education (Table 1).

The most dramatic change concerns the proportion of infants born outside marriage. In 1989, only 5.5% of live-born singletons were

born to single mothers and 2.1% were born to divorced mothers; these proportions rose to 12.5% and 4.2%, respectively, in 1996. The mean age of single mothers increased in the last 3 years of the study. The proportion of teenagers among single mothers was highest in 1991 (43.3%) and lowest in 1996 (30.7%).

Birthweight

After a slight decrease in overall mean birthweight between 1989 and 1991 (from 3323 g to 3292 g, $P < .001$), overall mean birthweight increased to 3353 g in 1996. The significant increase in mean birthweight between 1994 and 1996 was seen in all age groups except the oldest (40+ years).

The decrease in mean birthweight from 1989 to 1991 was experienced by all educational categories, the less educated women tending to be more affected. The subsequent improvements in birthweight were seen in all except the primary education category (Figure 1). The widening of the difference in mean birthweight between educational categories persisted after adjustments for maternal age, parity, and sex of the infant (Table 2). The effect of mother's marital status on birthweight was substantial and remained relatively constant over the study period. A mutual adjustment for education and marital status slightly attenuated the strength of the effects but did not change the trends observed.

Preterm Births

The overall proportion of preterm births increased from 4.3% to 4.8% between 1989

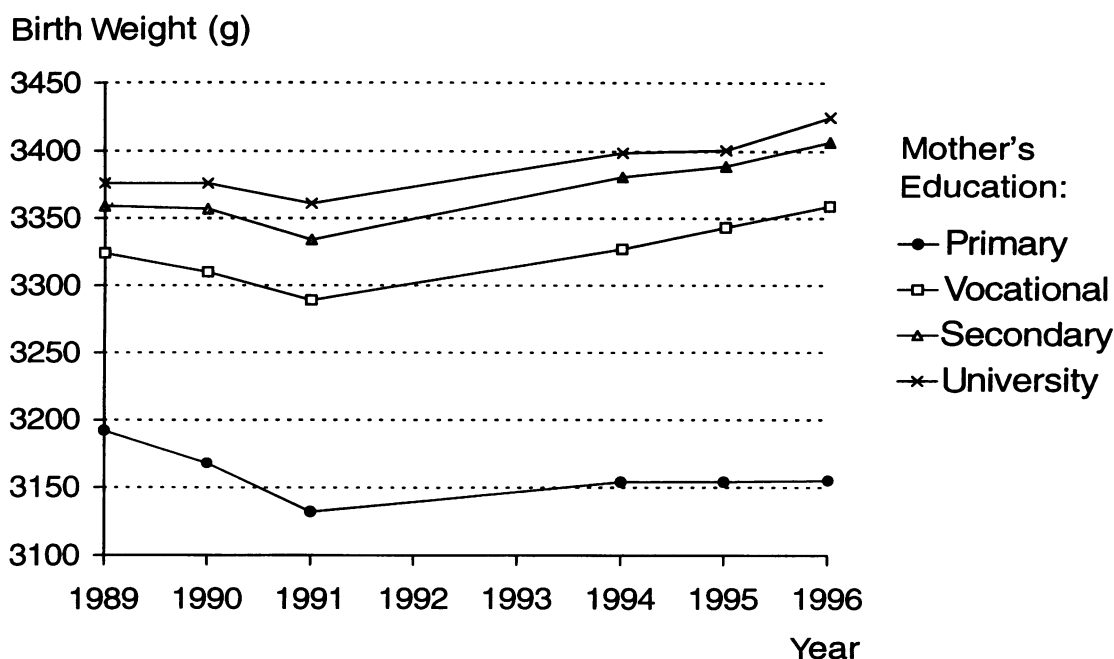


FIGURE 1—Mean birthweight of singleton live births by maternal education: Czech Republic, 1989–1991 and 1994–1996.

and 1991 but was 4.5% in 1994 through 1996. There was a tendency toward increasing variation in frequency of preterm births by maternal education. The odds ratio for preterm birth in mothers with a primary (vs university) education, adjusted for maternal age, parity, and sex of the infant, increased from 2.05 (95% confidence interval [CI] = 1.81, 2.32) in 1989 to 2.53 (95% CI = 2.18, 2.94) in 1996. On the other hand, the age-, parity-, and sex-adjusted odds ratio for preterm birth in single, vs married, mothers was lowest in 1996 (1.78; 95% CI = 1.63, 1.94).

Infant Mortality

Both neonatal and postneonatal mortality decreased between the 2 time periods (1989–1991 and 1994–1995). The decline in neonatal mortality was greatest (from 5.6 to 3.8 deaths per 1000 live births) and affected all educational and marital status categories to a similar degree. The social variation in neonatal mortality was largely eliminated by adjustment for maternal age, parity, and sex and birthweight of the infant.

In the population as a whole, postneonatal mortality decreased slightly over the study period. Among single mothers, postneonatal mortality increased between the 2 periods (1989–1991 and 1994–1995). There were marked and increasing differences in postneonatal mortality by maternal education and marital status (Table 3), which persisted after mutual adjustment for education and marital status.

Discussion

Our analyses of Czech national data for 1989 through 1996 show that despite overall improvements in indices of size at birth and infant survival, socioeconomic differences in mean birthweight and postneonatal mortality between infants born to mothers with a primary education and those born to mothers with a university education increased.

Validity

The validity of the time trend analysis clearly depends on the completeness and comparability of the data. The data were collected by a routine registration system that had been in operation since the mid-1980s. We are not aware of any administrative or other changes that would compromise the quality or completeness of the data in recent years. The inclusion of live births of 500 g or less in the register from 1995 did not appreciably affect the time trend.

We have addressed the potential bias of mortality analyses in the Czech data due to the linkage failure. Analysis of the infant deaths that were not successfully linked indicated that the unlinked deaths were more likely to be from multiple births and were more likely to occur in the early neonatal period. In singletons, the likely underestimation of the risk of death was about 10% in the neonatal period and was considerably smaller in the postneonatal period. We conclude that link-

age failure could not explain the strong social trends observed in our data.

Decline in Fertility

The substantial recent decline in fertility rates^{9,10} is reflected in the numbers of births over the period of our study. It is not known whether decreasing fertility affected different social groups to the same extent. Although the potential confounding effects of age and parity were taken into account in our analysis, it is conceivable that within the educational categories defined in our analyses, women with different levels of social resources or social support differed in their realized fertility. For example, it is possible that better educated women, who could foresee potential material or other difficulties related to childbearing, were more likely to avoid or postpone pregnancy. Such hidden effects of the sociodemographic processes cannot be excluded and require closer attention in future research.

The difference in mean birthweight between infants of single and married mothers did not seem to change appreciably over time, but the effect of mother's marital status on the risk of postneonatal death became stronger. The latter finding is surprising, as single mothers appear to have become a less marginal group: the proportion of single mothers in the population has increased, and the proportion of teenaged pregnancies among single mothers has declined.

TABLE 2—The Effect of Maternal Education and Marital Status on Birthweight (in grams) of Offspring: Czech Republic, 1989–1991 and 1994–1996

	1989	1990	1991	1994	1995	1996
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
Mother's education						
Primary ^a	...	...	...	...	...	...
Vocational	143 (4)	153 (4)	159 (5)	172 (5)	183 (5)	192 (5)
Secondary	178 (5)	197 (5)	199 (5)	223 (5)	228 (6)	238 (6)
University	182 (6)	203 (6)	209 (7)	236 (8)	237 (8)	256 (8)
<i>P</i> for trend (1 <i>df</i>)	<.001	<.001	<.001	<.001	<.001	<.001
Mother's marital status						
Single ^a	...	...	...	...	...	...
Married	169 (6)	191 (6)	180 (6)	163 (5)	166 (5)	165 (5)
Divorced	28 (12)	34 (11)	59 (11)	51 (10)	67 (10)	47 (10)
Widowed	61 (28)	138 (29)	127 (28)	140 (30)	92 (29)	92 (32)
<i>P</i> for heterogeneity (3 <i>df</i>)	<.001	<.001	<.001	<.001	<.001	<.001

Note. This analysis was restricted to singleton live births. The regression coefficients were adjusted for maternal age, parity, and sex of the infant.

^aReference category

TABLE 3—Mortality in the Postneonatal Period (28–365 days), by Maternal Education and Marital Status: Czech Republic, 1989–1991 and 1994–1995

	1989–1991				1994–1995			
	No. of Deaths	No. of Deaths per 1000	OR (95% CI)		No. of Deaths	No. of Deaths per 1000	OR (95% CI)	
			Crude	Adjusted ^a			Crude	Adjusted ^a
Mother's education								
Primary	280	5.3	2.69 (2.06, 3.51)	1.47 (1.09, 1.96)	143	5.2	3.68 (2.39, 5.67)	1.91 (1.19, 3.05)
Vocational	392	2.6	1.33 (1.03, 1.73)	1.00 (0.76, 1.32)	226	2.6	1.86 (1.22, 2.83)	1.47 (0.95, 2.30)
Secondary	266	1.8	0.92 (0.70, 1.20)	0.79 (0.60, 1.04)	96	1.4	0.97 (0.62, 1.52)	0.89 (0.56, 1.41)
University ^b	67	2.0	1.0	1.0	24	1.4	1.0	1.0
<i>P</i> for trend (1 <i>df</i>)			<.001	<.001			<.001	<.001
Mother's marital status								
Single	100	4.2	1.71 (1.39, 2.11)	1.25 (1.01, 1.56)	101	4.6	2.21 (1.77, 2.75)	1.60 (1.26, 2.04)
Married ^b	854	2.5	1.0	1.0	353	2.1	1.0	1.0
Divorced	42	4.9	2.00 (1.47, 2.74)	1.34 (0.97, 1.86)	34	4.6	2.21 (1.56, 3.15)	1.43 (0.98, 2.07)
Widowed	9	9.1	3.74 (1.93, 7.23)	2.61 (1.33, 5.15)	1	1.7	0.79 (0.11, 5.62)	0.47 (0.06, 3.43)
<i>P</i> for heterogeneity. (3 <i>df</i>)			<.001	.007			<.001	<.001
Total	1005	2.6			489	2.5		

Note. OR = odds ratio; CI = confidence interval. This analysis was restricted to singleton live births.

^aAdjusted for birthweight, maternal age, parity, and sex of the infant.

^bReference category.

Increasing Inequity

In light of the previous efforts to achieve equity in Eastern Europe, it is surprising to find such substantial differences in fetal growth indices between population subgroups in the Czech Republic at the beginning of the study period.⁶ It is plausible that the further divergence in birthweight and infant survival between socioeconomic groups in the Czech Republic is related to the divergence in living standards. This possibility is consistent with the literature, which has shown that both birthweight^{11,12} and infant mortality, particularly in the postneonatal period,¹³ are sensitive to socioeconomic factors.

The changes in pregnancy outcomes coincided with socioeconomic changes. The average real income in the Czech Republic decreased by almost 20% between 1989 and 1993 and was still 10% lower in 1995 than in 1989; real wages followed a similar trend.⁹ Although unemployment remained relatively low (around 3% in 1995),¹⁴ the socioeconomic differentials in the society clearly increased, as documented by an increase in the Gini coefficient (a measure of the degree of inequality of the distribution of earnings; 0 if total equality, 100 if total inequality) from 18.5 in 1989 to 23.4 in 1994.⁹

The economic benefits of education have clearly become increasingly important in the

Czech Republic in recent years: fewer than 5% of university-educated persons, vs as many as 35% to 40% of those with a primary education, declare subjective poverty.¹⁵ Although the current income differences in the Czech Republic are still smaller than those in the West,¹⁶ their appearance at a time of declining average real income almost certainly increased the vulnerability of some in the society, including single mothers and the less educated. This situation, together with the decline in social benefits, may have produced substantial hardship with the potential to affect health.

Our data provide some indication of the magnitude of the health impacts of social and economic reforms in the Czech Republic.

Infant mortality has not increased, even among the most disadvantaged, and the fall in birthweight was about 60 g. However, the social shock related to the reforms in the Czech Republic was relatively low; most Central and Eastern European countries experienced substantially larger declines in living standards.⁹ It can be expected that in these countries the impact of the reforms on pregnancy outcome and other health indicators will be larger.

There is evidence of increased social variation in the prevalence of smoking among Czech women from 1985 through 1992.¹⁷ While the overall prevalence of smoking remained unchanged, there was a marked drop in the proportion of university-educated women who smoked (from 20% to 11%) and an increase in the number of women with a primary education who smoked (from 24% to 30%). Thus maternal smoking, a powerful determinant of birthweight, may underlie some of the increase in social variation in birth outcome.

Health Care

The study period covered a transition toward a market economy, accompanied by a series of fundamental changes in the health care system. The main changes were the introduction of free choice of a general practitioner; direct access to specialists and specialist departments; a fee-for-service reimbursement system, which encouraged health care providers to increase productivity; and emergence of a private health care sector.

Recent improvements in neonatology services have been associated with the observed decrease in perinatal mortality in the Czech Republic.¹⁸ Whether and how the recent organizational changes in health care translate into social variation in birth outcome is less obvious. It is conceivable, however, that in the new system, which assumes a much more active role for patients and introduces direct payments for services, those with higher education or better social positions will bene-

fit most. Changes in health care may thus contribute to the widening social gradient in pregnancy outcomes.

Conclusion

We conclude that despite general improvements in the indices of size at birth and infant survival in recent years, there is a trend toward increasing social variation in birth outcomes in the Czech Republic. We suggest that the increase in social variation in birthweight and postneonatal mortality is related to the changing social circumstances of the families and mothers. Given the considerable extent of social variation in birth outcomes in the Czech Republic at the beginning of the study period, further widening of the social differences in recent years is a cause for concern. Trends in social inequalities should be further monitored and their underlying causes should be sought and addressed by policymakers. □

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