

Maternal-child health in Pelotas, Rio Grande do Sul State, Brazil: major conclusions from comparisons of the 1982, 1993, and 2004 birth cohorts

Saúde materno-infantil em Pelotas, Rio Grande do Sul, Brasil: principais conclusões das comparações de coortes de nascimento de 1982, 1993 e 2004

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Abstract

Important changes were observed in maternal characteristics, health care indicators, and child health during the 22 years covered by the three population-based birth cohort studies conducted in the city of Pelotas, Southern Brazil. Maternal education levels improved, cigarette smoking during pregnancy was reduced, and birth intervals became longer. Also, there were more single mothers, and maternal obesity increased. Coverage of antenatal and delivery care by professionals improved, but inductions and caesarean sections increased markedly, the latter accounting for 45% of deliveries in 2004. With regard to child health, the reductions in neonatal and infant mortality rates were modest, and the significant increase in preterm births – 14.7% of all births in 2004 – appears to have colluded with this stagnation. Other infant health indicators, such as immunization coverage and breastfeeding duration, showed improvements over the period. Regarding infant nutrition, malnourishment at age 12 months decreased, but the prevalence of overweight was higher in 2004. The existence of three population-based birth cohorts using comparable methodology allowed for the study of important secular trends in maternal and child health.

Infant Mortality; Perinatal Mortality; Breast Feeding; Nutrition; Cohort Studies

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Introduction

Life-cycle epidemiological studies, particularly those based on birth cohorts, are being undertaken with increasing frequency worldwide. Interest in such studies began to rise following the publication, throughout the last decade, of a series of studies proposing that alterations in fetal and infant growth may have permanent effects on adult health. Children suffering intrauterine growth retardation who later gained excess weight in proportion to their length are especially subject to developing chronic-degenerative diseases in adulthood, such as systemic arterial hypertension, myocardial infarction, cerebrovascular accidents, and diabetes¹. In the beginning of the new millennium, further prospective birth cohorts have been undertaken in the United Kingdom² and the United States³.

The three cohorts currently under follow-up in the city of Pelotas, Southern Brazil, which include all live births that took place in this city in 1982, 1993, and 2004, therefore constitute an invaluable source of information, as can be seen in the various articles in the present supplement.

The goal of this final article is to synthesize the major findings and trends detected across the three cohorts, and make certain points as to what these may mean. We would also like to suggest certain public health measures that may help to solve some of the problems encountered. In individual healthcare, the relationship established

between professional and patient determines the effect that this relationship will have on health. Likewise, in public health, the relationship established between the population, with all its attributes, and the quality and coverage of health services contributes to determining levels and trends in health indicators. Factors unrelated to healthcare – including socioeconomic characteristics – also strongly influence health indicators. The articles included in this supplement address the interaction between social and care-related factors, in an attempt to explain the evolution of maternal-infant health across a 22-year period.

Conditions of the maternal population

The number of births in the city of Pelotas fell markedly during the 22 years studied, from almost 6,000 in 1982 to a little over 4,000 in 2004, reflecting the important reduction in fecundity recorded among the Brazilian population⁴. Family income among mothers, measured as a multiple of the minimum wage, remained stable over the period. As reported in the methodological article in this same Supplement⁵, the purchasing power of the minimum wage fell considerably between 1982 and 2000, suggesting that the socioeconomic situation of families who had children in 2004 was worse than those who had them in 1982. However, maternal education improved markedly during the period, with a rise in the average number of years of schooling from 6.5 in 1982 to 6.7 in 1993 and 8.1 in 2004. The proportion of mothers with less than four years of schooling fell from 16% in 1993 to 8% in 2004. Likewise, household water supply and sanitation conditions, the presence of consumer goods, and the number of persons per household also showed considerable improvements in 2004.

From a race/ethnicity perspective, the proportion of mothers of African descent increased from 18% in 1982 to 23% in 1993 and finally 27% in 2004. As to anthropometric conditions – weight, stature, and body mass index (BMI) – mean pregestational weight increased markedly in the period – by about 5kg between 1982 and 2004 – while maternal stature increased more than 3cm between 1982 and 1993, but decreased by one centimeter between 1993 and 2004. As a consequence, the proportion of overweight women increased, from 22.4% in 1993 to 33.8% in 2004, when over 10% of mothers were obese⁶.

Regarding maternal demographic characteristics, the proportion of women without a partner increased from 8% in 1982 to 17% in 2004⁵. The proportion of adolescent mothers increased slightly; those aged between 12 and

16, which show the greatest risk of adverse perinatal results, increased in relative terms (from 2.9% in 1982 to 5.8% in 2004) as well as in absolute numbers, whereas for the 17-19 years range there was a very slight relative increase in the last decade, which corresponded to a reduction in absolute numbers. The prevalence of primiparas increased, reaching 44% in 2004, whereas the proportion of multiparas decreased. The interval between births increased significantly in the period, reaching a mean 66 months in 2004, with a median interval of 55 months⁶.

There was an important reduction in the proportion of women who smoked during pregnancy, a factor widely acknowledged as an important determinant for low birth weight and preterm birth. The general reduction was from nearly 36% in 1982 to about 25% in 2004, but this reduction was much greater among wealthy mothers than among the poor⁶. It is worth noting that changes in maternal characteristics may reflect both temporal trends among the female population of Pelotas as a whole, and changes that occurred only among pregnant women. For example, the increase in the proportion of mothers of African descent may be due to the fact that fecundity decreased less in this group than it did among other women.

Certain trends in maternal characteristics observed during the period, such as the reduction in smoking, are highly positive, and should have an impact on maternal and child indicators. Other trends, such as the increase in maternal overweight and obesity, can have negative effects on the health of mothers themselves as well as of their children. Table 1 summarizes our results in terms of maternal characteristics and antenatal care, stratifying indicators according to whether their outcomes are positive or negative with respect to their effects on maternal and child health.

Maternal and perinatal healthcare

The evaluation of antenatal care in the three cohorts shows that coverage increased in 2004, with less than 2% of women without any attendances. The number of attendances also increased significantly, and the first appointment took place earlier during the pregnancy, as recommended. In an earlier publication evaluating the quality of antenatal care⁷, we observed that certain basic procedures, such as gynecological examinations, tetanus vaccinations, and syphilis serology were less frequently performed than more costly procedures of doubtful effectiveness, such as ultrasonography. Labor and delivery care provided

Table 1

Changes that took place in the maternal population and in antenatal care in Pelotas, Southern Brazil, between 1982 and 2004.

Change *	Population	Healthcare
Improvement	↑ education	↑ early onset of antenatal care
	↑ water supply, sanitation, housing	↑ coverage and number of antenatal appointments
	↑ weight gain during pregnancy	↑ deliveries performed by qualified professionals
	↓ fecundity	↑ presence of a pediatrician during delivery
	↑ birth intervals	↑ deliveries financed by health plans
Stagnation or decline	↓ multiparity	
	↓ smoking	
	↓ or = in family income	↑ use of ultrasonography (of doubtful quality)
	↓ stature (1993- 2004)	↑ interruption of pregnancy (c-sections and induction of labor)
	↑ maternal overweight and obesity	
	↑ mothers without partner	
	↑ adolescent mothers (< 17 years)	
	↑ primiparity	

* Changes expressed as: increase (↑), little or no change (=), and reduction (↓).

by qualified professionals was almost universal; there was also an increase in the proportion of deliveries in which a pediatrician was present at the time of birth, which reached 78% in 2004⁸.

In 2004 there was a significant increase in the number of interventions used to interrupt pregnancy; cesarean sections were performed in 45% of all deliveries. This proportion was 36% among deliveries financed by the Unified National Health System (SUS), 83% among those financed by health plans, and 88% among private patients. The c-section rate was 41% among mothers with high gestational risk and, paradoxically, 54% among low-risk mothers. This last finding shows that indications for c-sections were not primarily medical in character. Although data on labor inductions are not entirely reliable, there is strong evidence of an important increase in this procedure as well⁹.

Perinatal and infant health indicators.

Table 2 presents the major findings, both positive and negative, in terms of health in the first year of life. The most impressive result emerging from the comparison of the three cohorts was the marked increase in preterm deliveries, which in 2004 accounted for 14.7% of all births. Similar phenomena have been reported in other parts of the country^{10,11} and seem to be partially produced by the above-described increase in the interruption of pregnancy, be it by labor induction

or c-section. As the increase in preterm births was also observed among vaginally-born babies, especially those from the poorest families, other causes are also certainly responsible for this epidemic. The prevalence of preterm births was so marked that the percentage of children born weighing under 2,500g, instead of decreasing, actually increased from 9% to 10% in the 22-year period, with a corresponding decrease in mean birth weight⁹. It will be essential to develop health policies capable of controlling this epidemic, which, as we shall discuss later, is having an impact on infant mortality.

It appears that improvements in several maternal indicators (schooling, reductions in smoking, greater weight gain during pregnancy, and wider coverage of antenatal care) led to a reduction in the prevalence of small for gestational age babies, between 1982 and 1993; but the prevalence increased again in 2004, and the causes for this occurrence must be determined.

Perinatal mortality as a whole decreased in the period under study. The excess number of c-sections may simultaneously be contributing towards a reduction in intra partum mortality – given that vaginal delivery is becoming rarer – as well as neonatal deaths due to asphyxia. On the other hand, deaths due to immaturity increased substantially from 1993 to 2004¹².

The impressive increase in preterm delivery seen in Pelotas in 2004 was partly responsible for the stagnation in neonatal and infant mortality rates in the last decade⁷. Even though specific

Table 2

Changes that took place in the infant population and healthcare in Pelotas, Southern Brazil, between 1982 and 2004.

Change *	Population	Healthcare
Improvement	↓ intrauterine growth retardation	↑ vaccine coverage
	↓ perinatal mortality	↑ child care appointments
	↑ exclusive and total breastfeeding	↑ death reporting
	↑ neuro-psychomotor development	↓ hospitalizations due to diarrhea
	↓ malnutrition at 12 months	
	↓ deaths due to diarrhea	
	↓ deaths by asphyxia	
	↓ infant mortality (1982-1993)	
Stagnation or decline	↑ preterm births	
	↓ birthweight	
	↑ deaths due to immaturity	
	↑ overweight at 12 months	
	= infant mortality (1993-2004)	= total hospitalizations

* Changes expressed as: increase (↑), little or no change (=), and reduction (↓).

mortality coefficients fell throughout the decade for most gestational age strata, the marked increase in the proportion of preterms prevented the decrease in overall infant mortality. It is also worth noting that deaths due to diarrhea virtually disappeared in our settings, probably due to improvements in breastfeeding, sanitation, and the use of oral rehydration therapy¹³. The decrease in hospitalizations due to diarrhea corroborate this finding¹⁴.

Among the most important improvements in maternal and child health indicators in 2004 is the significant increase in breastfeeding, which showed a median duration of almost seven months. At age three months, over 30% of children were being exclusively breastfed¹⁵. Breastfeeding promotion policies have been established in the whole country¹⁶, resulting in an increase in the duration of breastfeeding.

Our results regarding nutritional status at 12 months provide evidence of a nutritional transition, with a reduction in malnutrition, as measured by weight-for-age or length-for-age, and a concomitant increase in infant overweight¹⁷. The increase in overweight was markedly higher among poorer children. It is a cause for concern that the obesity epidemic is affecting both Pelotas mothers and their children.

Finally, another important finding was the marked reduction in the prevalence of suspected neuro-psychomotor retardation, from 37% in 1993 to 21% in 2004¹⁸. The test administered at age 12 months for both cohorts (Denver II scale¹⁹) lacks diagnostic precision at the indi-

vidual level, but allows for populational comparisons. Possible factors associated to such a reduction include improved perinatal care, greater surveillance of development during the first year of life, and longer duration of breastfeeding, as well as the increase in maternal schooling.

Health care for children under age one year

The prevalence of hospitalization during the first year of life remained unchanged in the period under study, with one out of every five children having been hospitalized before their first birthday¹⁴. Unnecessary hospitalizations are traumatic to both the child and their family, and Brazilian rates are very high compared with other middle-income countries. If on one hand these rates suggest that access to hospital services is widespread due to the universalization of healthcare, on the other, they may reflect unnecessary hospital admission, be it due to the lack of medications at the outpatient level, or to issues pertaining to how hospitals are reimbursed by the SUS.

As described in a previous article⁸, the primary healthcare facility network has expanded significantly over the 22 years of the study, resulting in important increases in the number of appointments among infants, which in 2004 reached a mean 13.5 per child, well above the number recommended by the Brazilian Ministry

of Health. With such a heavy appointment load, it is surprising that vaccine coverage remains at around 90%, with one out of every ten children experiencing a delay in relation to the vaccination schedule at 12 months. Missed opportunities for vaccination thus still seem to occur with a certain frequency in Pelotas. A positive indicator, also related to healthcare, is the fact that underreporting of infant deaths is currently nil, whereas in 1982 one in four deaths went unreported²⁰.

Social inequities

The subject of social inequities has received special attention in the Pelotas studies, since the very first cohort²¹. All articles included in the present supplement provide evidence of the profound effects of Brazilian social stratification on health, nutrition, and healthcare conditions among the city's mothers and their children. Systematically, children and mothers from poor families are worse off than those from wealthy families, as was made explicit in all of the previous articles. This was true for almost all indicators evaluated, including maternal characteristics (schooling, stature, parity), use of antenatal and delivery care services, perinatal mortality, hospitalization, and the prevalence of growth and neuro-psychomotor deficits. Social differences tended to persist throughout these 22 years, despite improvements in many indicators within each social group.

There were few exceptions to this rule. The clear reverse association between family income and the frequency of low birth weight observed in 1982 disappeared in 2004 due to the epidemic of preterm deliveries. The iatrogenic effects of excess obstetric interventions especially among wealthier mothers therefore seem to have been sufficiently strong to counteract marked social inequities.

According to the "inverse care law", proposed by Hart in 1971²², mothers and children in greatest need of healthcare are those who have the least access to such interventions. In 2000, when comparing the results of the 1982 and 1993 cohorts, we proposed a corollary to this law. This corollary proposes that innovations in the health area, when incorporated initially by the rich, would tend to increase social inequi-

ties in the short term. Subsequently, its gradual adoption by the poor would lead to a reduction in inequity, since the wealthy would have reached a plateau where further improvements would no longer be possible²³. This principle is useful to interpret some of the results of the comparison of our three cohorts. For instance, infant overweight, which in 1982 was notably more frequent among wealthy families, showed a similar frequency among the five income groups in 2004, possibly reflecting the adoption of preventive measures among the rich. Analogously, the increase in breastfeeding took place between 1982 and 1993 among the wealthy, and only between 1993 and 2004 among the poor.

A detailed investigation of the impact of the implementation of the SUS on maternal and child health is beyond the scope of the present analysis. It is worth noting, however, that the 22 years of the study have witnessed important improvements among the lowest income group in terms of antenatal, delivery, and infant care indicators. With universalization, this group began to have access to interventions previously restricted to the clients of private services, with an effective reduction in the absolute differences between the rich and the poor. Part of this reduction may be due to the fact that wealthy mothers and children showed high levels of coverage already in 1982, rates thus being unlikely to increase any further. In spite of this mathematical hindrance, it is evident that the universalization of healthcare has undeniably led to progress among poor mothers and children, many of which were cared for as indigents by philanthropic services in 1982.

In the present series, we described the temporal evolution of maternal and child health by means of a comparison of three population-based birth cohorts. Even though the results of a single municipality cannot be extrapolated to the rest of the country, the social, demographic, and care-related transformations seen in Pelotas are still a reflection of phenomena taking place in the country as a whole, and thus help to promote a better understanding of the process of the epidemiological and healthcare transition. The 1982 and 1993 cohorts are still being followed prospectively to this date. Future follow-ups of the 2004 cohort will allow us to describe the evolution of several other indicators of the health of children and adolescents.

Resumo

Foram observadas mudanças importantes nas características maternas, de assistência à saúde e de saúde infantil ao longo dos 22 anos cobertos pelas três coortes de base populacional na cidade de Pelotas, Rio Grande do Sul. Melhorou o nível de escolaridade materna, houve uma redução no tabagismo durante a gravidez e aumentou o espaçamento entre filhos. Além disso, havia mais mães solteiras e aumentou a obesidade materna. Melhoraram a cobertura pré-natal e assistência ao parto por profissionais, mas houve um aumento marcante nos partos induzidos e nas cesarianas, que representaram 45% do total de partos em 2004. Com relação à saúde infantil, houve uma redução apenas modesta nas taxas de mortalidade neonatal e infantil, e o aumento significativo nos partos prematuros (14,7% de todos os nascimentos em 2004) parece haver contribuído para essa estagnação. Outros indicadores de saúde infantil, como cobertura de imunização e duração do aleitamento materno, melhoraram durante o período. Em relação à nutrição infantil, a desnutrição aos 12 meses de idade diminuiu, mas a prevalência de sobrepeso foi maior em 2004. A existência de três coortes de nascimento de base populacional utilizando metodologias comparáveis permitiu o estudo de importantes tendências seculares na saúde materno-infantil.

Mortalidade Infantil; Mortalidade Perinatal; Aleitamento Materno; Nutrição; Estudos de Coortes

Contributors

The two authors jointly wrote the final article, analyzing all of the articles in the series and determining which aspects should be highlighted.

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Submitted on 29/Mar/2007

Final version resubmitted on 07/Nov/2007

Approved on 18/Jan/2008