

Trends In Childhood Mortality In Developed Countries: The Role Of Biologic And Socioeconomic Determinants.

*Variazioni Temporalì Della Mortalità Pediatrica Nei Paesi
Sviluppati: Il Ruolo Dei Fattori Biologici e Socio-Economici*

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Riassunto: I tassi di mortalità in età pediatrica sono diminuiti in modo rilevante nei Paesi sviluppati durante ultimi decenni. Nel primo anno di vita le malformazioni congenite, la SIDS e le condizioni perinatali sono le cause più frequenti di morte. Gli incidenti e i tumori sono invece le cause più ricorrenti per i bambini di età 1-14 anno. Campagne mirate alla prevenzione degli incidenti, l'introduzione di antibiotici e di vaccini e lo sviluppo di terapie efficaci contro i tumori hanno contribuito alla riduzione della mortalità. Nei paesi anglosassoni, dove sono disponibili dati disaggregati per classi socio-economiche, la mortalità nei bambini nati nelle famiglie più disagiate è doppia di quella che si osserva nei figli di famiglie abbienti. Una riduzione delle disuguaglianze sociali che si riflettono sulla mortalità resta un obiettivo da raggiungere nella maggior parte dei paesi sviluppati, così come un più equo accesso ai servizi sanitari.

Keywords: Childhood mortality, time trend, determinants.

1. Introduction

Epidemiology is currently defined as the study of the distribution of ill health and its determinants on a population basis. The determinants of health are all the physical, biologic, socioeconomic factors that influence health.

Mortality data are readily available and accurate and can be used to describe disease patterns and trends in a population, to assess the effect of interventions and to support the case for clinical, public health or policy interventions. There are pitfalls to be aware of when using mortality information: the cause of death is only as reliable as the death certificate, mortality does not measure the health status of a population, comparison between countries and over time can be problematic if different disease definitions are used (Sorlie).

Monitoring and improving the health status of children are among the most important goals set forth by health services in developed and developing Countries. Childhood death rates began to decline in the second part of the 19th century and this decline continued through the 20th century: the last three decades have witnessed dramatic

reduction in childhood mortality in most Countries. The decline in mortality has been attributed to improved standards of living and nutrition, public health sanitary reforms, and improved medical care.

2. Infant Mortality

The infant mortality rate (0-11 months of age) is traditionally considered an important indicator of the health of a community. In the early part of 20th century deaths from infectious diseases in the first year of life were so common that it is not surprising to find few physicians devoted to premature birth and few articles concerning the special needs of low birth weight (LBW) infants (under 1500 grams). As many infectious diseases came under control (vaccine, antibiotics), more attention was focused by physicians to the premature infants and to their special requests. As the mortality of the small infants gradually reduced, new problems came into focus (respiratory distress syndrome (RDS), retrolental fibroplasia due to large amounts of oxygen). The introduction of continuous airway pressure for sick newborns with RDS spurred the development of neonatal care units and the impetus to transfer LBW newborns from community hospitals to such centers of neonatal expertise. The advances in survival attributable to neonatal intensive care units made it imperative to make these services available to a wider population.

Today over two third of deaths recorded in children 0-14 year of age occur during the first year of life. Boys have higher mortality rates than girls. Half of all infant deaths are attributable to four leading causes: congenital anomalies, disorders relating to short gestation, sudden infant death syndrome (SIDS) and RDS. SIDS rates fell rapidly since 1992 when the American Academy of Pediatrics issued a recommendation to placing infants on their back to sleep. Mortality rates for RDS declined since 1990 when antenatal corticoids and surfactant became widely available (Modanlou).

Birth weight is one of the most important predictors of infant mortality (Shiono). About 90% of infants with birth weight <500 grams die within the first year of life. The infant's chances of survival increase rapidly with larger birth weight. The decline of infant mortality rate has been attributable to declines in birth weight specific mortality rates and not to the prevention of LBW. This trend has been attributed primarily to improvements in obstetric and neonatal care. The benefits of routine prenatal care are difficult to measure, but timely comprehensive prenatal care can promote healthier pregnancy. The two most frequent maternal risk factors for the newborn are pregnancy-associated hypertension and diabetes (Misra). These findings underscore the compelling need to consider the health of the mother to reduce morbidities and mortality of newborn (Graham).

In the last decades major changes in life-style and family composition affected the number of infants born and their morbidities and causes of death. Marital status is related to unintended pregnancies, these pregnancies are far more likely to end in abortion than the intended ones. Immigration from developing countries is increasing and with it poverty and illness. The effects of different risk factors can be cumulative. Poverty is associated with single-parents household, adolescent pregnancies. Social inequalities in UK are shown by the 2-fold increase between infant of class I family

respect to class V. Almost 1000 infant deaths per year would be prevented if mortality was reduced to that observed for class I and II families.

Birth weight, like growth, is determined by genetic and environmental factors (Paneth). Birth weight is related to socioeconomic status and increasing disadvantages are associated to low birth weight (Spencer). Given the role of birth weight for infant, childhood and adult health, a 150-200 grams social gradient in mean birth weight and 30% of newborns with weight less than 2500 grams at birth are attributable to social inequalities (Barker).

Large use of alcoholic beverages and of illicit drugs is associated to poor mother nutrition during pregnancies, increased risk of pre-term labor, LBW and sexually transmitted diseases. Smoking during pregnancy is related to LBW and it is one of the most preventable determinants of LBW (Kleinman).

3. Childhood mortality

Among children 1-4 years old, accidents (unintentional injuries) are the leading cause of death, accounting for one third of all deaths. Among the unintentional injuries, the motor vehicle accidents account for 10% of deaths. Congenital abnormalities and cancer (including leukemia) are the second and the third leading causes. Other prominent causes of death are homicide and infections. The gender differentials have increased in the last decades, girls having experienced a faster decline of mortality rates. In US children, the top six leading causes in 1-4 year age group ranked in the same order in 1979-81 and in more recent years. However, the mortality dropped by 20%, the largest decline was observed for infections (excluding HIV related mortality), accidents, cancer and congenital abnormalities. Homicide, perinatal conditions and HIV/AIDS showed an upward trend.

Historically, mortality rate for children aged 5-14 years has been the lowest of all age-specific death rates in developed Countries. Accidents are almost half of all deaths and motor vehicle crashes represent more than half of accidents. Cancer and leukemia are the second leading cause, followed by homicide, congenital abnormalities heart disease and suicide.

In 1987, in US a special category was created to classify death due to HIV infection. HIV infection is a leading cause in 1990s: between 1987 and 1994 the age adjusted rate increases of 16% per year among children. Since mid-1990s the mortality due to HIV has fallen or stable in vast majority of developed Countries. The downturn was attributed to improvements in the treatment and prevention of the disease. (Hoekelman).

4. Discussion

In most developed Countries, the decline in childhood mortality tended to be more rapid for children in 1-4 year age group than for older ones. These declines have occurred as a result of impressive drops in mortality due to unintentional accidents, cancer, infections (other than HIV) and congenital abnormalities. Homicide and suicide rates as well as HIV related deaths have shown an upward trend.

Childhood cancer mortality rates have decreased in early 1960s among US children and in 1970s in most European Countries (including Italy (Pastore)) as a result of improvements in diagnosis and treatments (Crist, Pui). The decline in childhood cancer mortality rate has been also attributed to implementation of clinical trials supported by cooperative pediatric oncology groups that have improved and refined treatment strategies for this rare group of diseases in highly specialized centers (Kramer, Stiller). In spite of these remarkable improvements, current treatments are not effective for approximately 25% of cases who died for the cancer or treatment-related sequelae (Stiller).

The decrease in mortality has been observed for all cancer types in both genders and in all age groups. Whereas, the incidence rates for specific cancer types were relatively stable during the period 1970-90 with the exception of upward trends for central nervous system (CNS) tumors and acute lymphoblastic leukemia (ALL). The increase incidence rates for CNS tumors occurred abruptly in 1980s followed by stable rates in 1990s. The incidence rates peaked during the period in which advances of in diagnostic imaging (CAT and MNR) for CNS tumor were becoming widely disseminated. The increase in incidence rates was not paralleled with changes in CNS tumors mortality rates which slowly decreased during the period 1970-90 (Crist). The timing of the increasing incidence rates and the lack of corresponding increase in mortality rates has been suggested, as cause of this observation, the improvements in diagnosis and/or reporting. The increasing rate for ALL, observed in many developed Countries, is probably a real event not due to refinement of diagnostic criteria.

In UK, the direct cost for unintentional injuries (morbidity and death) has been estimated in £200million/year for the NHS. Recent studies reported a drop in death rates from injury and poisoning in both genders, although by a relative much greater extent in younger children than in teenagers. The decline in higher classes is steeper than in lower ones, so the socioeconomic differential is widening (Morrison). The decline of unintentional injuries has been attributed to prevention measures such as smoke alarms and sprinkler system in homes and in schools. Declines in motor vehicle related mortality reflect the increasing attention to vehicle safety and mandatory use of seat belts. Yet a large proportion of childhood deaths continue to occur as a result of preventable injuries.

Pediatricians are familiar with the increased morbidity and mortality risk of LBW newborns. These infants are at higher risk of dying during the first year of life and they are more likely to develop a variety of neurological, respiratory and gastrointestinal diseases. There is an increasing evidence that birth weight is associated to later health status. LBW is reported to be related with coronary heart disease, stroke, hypertension, type II diabetes. Large birth weight is associated with childhood and adult cancer.

Mortality and morbidity from childhood vaccine-preventable diseases are today at the lowest levels in developed Countries. Barriers to routine childhood vaccination have been identified: recent immigration, poverty and education level of the family.

Socioeconomic status is a major underlying determinant of childhood mortality (Mare). In addition, poor socioeconomic level in early life may cause biological vulnerability in adult life (Wadsworth, Davey Smith). In fact a woman whose parents are from low social class, is more likely to have been LBW herself, to have experienced childhood ill health, to have a diet with adverse effect on her growth, to have started smoking early and to be pregnant in adolescence. Both income and

education showed a net impact on death risk in childhood. However, social class is a weak measure of education and tends to underestimate inequalities in mortality. In UK the highest mortality occurs in children living in families classed as unemployed. About 90% of these children are from families headed by an economically inactive single mother (Judge). The effect on child survival of maternal education diminishes with rising national literacy levels and health expenditure (Cochrane). The lower the level of educational attainment and the greater the poverty, the higher the childhood mortality rates. Poverty is one of the many risk factors associated to violence against children. In US differentials for childhood mortality by family income was observed: children with family income of less than \$10,000 had 3 times higher risks of mortality than children of more affluent families did. In addition, racial differential was partly accounted by family income.

Overall improvements in socioeconomic and living conditions, better nutrition, advances in medical knowledge and technology have been suggested as factors contributing to reductions in childhood mortality. There has been considerable debate over the relative contribution of these factors, but it is generally accepted that health care makes a relatively small contribution to the health status of a population. There are some exceptions where advances in medical treatment have reduced mortality, such as immunization campaigns, developments in neonatal intensive care and the treatment of childhood cancers. Difference in childhood mortality may reflect differences in access and use of health care services. Appreciable socioeconomic differentials in childhood and adult mortality persist even in highly developed Countries (Davey Smith, Smith).

References

- Barker DPJ eds (1992) Fetal and infant origins of adult disease. London BMJ publications group.
- Cochrane SH, O'Hara DJ and Leslie J (1980) The effects of education on health. World Bank Staff Working Paper n. 405. Washington D.C.
- Crist WM, Kun LE (1991) Common Solid Tumors. N Engl J Med. 324: 461-471.
- Davey Smith G, Gunnell D and Ben-Shlomo (2000) Life course approaches to socioeconomic differentials in cause-specific adult mortality, in: *Poverty, inequality and health*, Leon D and Walt G (Eds.) OUP Oxford 88-124..
- Graham WJ (2001) Now or never: the case for measuring maternal mortality Lancet 359: 701-703.
- Hoekelman RA, Pless BL (1988) Decline in mortality among young Americans during the 20th century: prospects for reaching national mortality reduction goals for 1990. Pediatrics 82: 582-595.
- Kleinman JC, Madans JH (1985) The effects of maternal smoking, physical stature and educational attainment on the incidence of low birth weight. Am J Epidemiol 121: 843-855.
- Kramer S, Meadows AT, Pastore G, Jarrett BD (1984) Influence Of Place Of Treatment On Diagnosis, Treatment And Survival In Three Pediatric Solid Tumors. J Clin Oncol 2: 917-923.

- Modanlou HD, Beharry K, Padilla G and Iriye B (1996) Combined effects of antenatal corticosteroids and surfactant supplementation on the outcome of very low birth weight infants. *J Perinatol* 16: 421-428.
- Morrison A, Stone DH, Redpath A, Norrie (1999) Trend analysis of socioeconomic differentials in death from injury in childhood in Scotland, 1981-95. *BMJ* 318: 567-568.
- Misra DP (1996) The effects of the pregnancy-induced hypertension on fetal growth: a review of the literature. *Paediatr Perinatol Epidemiol* 10: 244-293.
- Mare RD (1982) Socioeconomic effects on child mortality in the United States. *Am J Public Health* 72: 539-547.
- Paneth NS (1995) The problem of low birth weight. *The Future of Children* 5: 20-32.
- Pastore G, Mosso ML, Dalmaso P, Magnani C. (1999) Il Registro di Tumori Infantili del Piemonte Epidemiologia descrittiva dei tumori maligni in età pediatrica in Piemonte, 1967-94. *Epidemiol Prev* 23: 360-368.
- Pui CH, Evans EV (1998) Acute Lymphocytic Leukemia. *N Engl J Med* 339: 605-615.
- Shiono PH, Behrman RE (1995) Low birth weight. Analysis and recommendations. *Future Child* 5: 4-18.
- Smith GD, Egger M (1993) Socioeconomic differentials in wealth and health. *BMJ* 307: 1085-1086.
- Sorlie PD, Rogot E, Johnson NJ (1992) Validity of demographic characteristics on the death certificate *Epidemiology* 23: 181-184.
- Spencer NJ, Bambang S, Logan S et al (1999) Socioeconomic status and birth weight: comparison of an area-based measure with the Registrar General's social class. *J Epidemiol Community Health* 53: 495-498.
- Stiller CA (1984) Centralization of treatment and survival rates for cancer. *Arch Dis Child* 63: 23-30.
- Stiller CA, Eatock EM (1998) Patterns of care and survival for children with acute lymphoblastic leukemia diagnosed between 1980 and 1994. *Arch Dis Child* 81: 202-208.
- Judge K, Benzeval M (1993) Health inequalities: new concerns about the children of single mothers. *BMJ* 306: 677-680.
- Wadsworth MEJ (1997) Health Inequalities in the life course perspective. *Soc Sci Med* 44: 859-869.