

PREMATURITY

Preterm Delivery and Its Impact on Physical Health and Development in Children

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Introduction

Premature birth has become a global priority in reducing the toll of mortality in children under 5.¹ Prematurity is defined as a birth less than 37 completed weeks of gestation; very preterm infants are those born less than 32 weeks. The rate of preterm births is about 12% in the US and 8% in Canada.² Prevention of prematurity has proven to be difficult, and decreases in mortality require interventions that improve the survival of these infants.³ In wealthier countries, the increase in survival among even the smallest and most immature infants has been remarkable, such that almost three-quarters of infants born between 22 and 26 weeks survive to discharge.^{4,5}

Subject

Nonetheless, it must be recognized that these infants are born with organs not yet mature enough for extra-uterine life. The infant is maturing in a context that is quite different from the uterus, and may also require intensive therapies of a variety of types to assure survival. Thus, preterm infants are at risk for a variety of health problems, and these problems may place stresses on health, educational, and family resources.⁶

Problems

The potential for preventing preterm delivery appears limited in the near term. Meanwhile, the survival of growing numbers of very premature infants has raised two questions:

1. What is the impact of the increased survival of such infants on child health?
2. Is there potential for decreasing this morbidity with current technology?

Recent Research Results

Multiple reviews (summarized in reference 6) have documented the 2- to 4-fold risk of many interrelated outcomes of premature and/or low birthweight infants over time. The risk of morbidity is highest among the most premature infants, but even infants close to term may experience some health problems.⁷

Major complications in the neonatal period include chronic lung disease, following respiratory distress, and sepsis. A minority of infants also experience necrotizing enterocolitis, intracranial hemorrhage and cerebral white matter disorder. It has proven difficult to attain third trimester weight gain in the neonatal intensive care units (NICU) so that very preterm infants weigh less than tenth percentile (normal being 50th percentile) of a term infant discharge from hospital, generally close to when the infant should have been born.

In early childhood, documented morbidity reflects some of these neonatal complications. Rates of cerebral palsy range from 6-28%, but children may also experience less severe motor problems with poorer fine motor and coordination. In addition, of those born before 26 weeks, 10% may be blind, 6% deaf, and 13-20% may have IQs <70.

Other health problems affect the respiratory system, with 7% diagnosed with asthma and poorer growth, although the latter is not seen in all studies.

When these children enter school, new developmental challenges reveal other difficulties. Rates of learning disabilities, singly and multiple are higher, with math reasoning being most affected. School success is further compromised in the presence of attention deficit disorder, which is also higher in preterm infants.

The data are beginning to be obtained on preterm infants born in the era of modern intensive care. The severe neurodevelopmental problems persist (e.g., cerebral palsy and blindness). The risk for emotional disorders like depression is unclear. Preterm adolescents seem to be at lower risk for risky behaviours. Although they have poorer lung function, symptomatic asthma does not seem to be a problem. There are some indications that they do experience some evidence of advanced aging with hypertension, metabolic syndrome and earlier hip disease. Despite this list of difficulties, preterm adolescents and adults, while acknowledging their increased health issues, actually rate their health-related quality of life higher than those born at term.

Influences on Morbidity

In interpreting the data on the health problems in preterm infants, it is important to note that prematurity confers an increased risk not certainty, and many of these health problems are also common in children born at term. Thus, one of the approaches to reducing the risk of morbidity is to identify situations that may increase risk beyond that of being born premature.

Quality of Perinatal and Neonatal Care. It is now very clear that controlling for gestational age and birth weight, outcomes differ among different neonatal intensive care units.⁸⁻¹⁰ Moreover, improvements in neonatal intensive care are associated with decreases in morbidity.^{4,11}

Quality of the Post-Discharge Environment. An important determinant of health in all children is the home and neighborhood environment.¹² The environment includes the resources that the parents have, financial,

educational and emotional, to provide care for a vulnerable infant. It also includes the medical care and other supportive services like early intervention, as well as the school system into which the child will go. Environmental exposures, like lead or pollution, will exacerbate the underlying difficulties that preterm infants experience.

Conclusion

Even with optimal prenatal services, rates in preterm delivery have remained stable or decreased only slightly. Declines in infant mortality reflect the increasing technological sophistication of neonatal intensive care to support these fragile infants. Indeed, the efficacy of neonatal intensive care has permitted reproductive strategies that may result in an indicated preterm delivery to protect the health of the mother and/or infant, and increase the risk of preterm delivery (as may be the case when two or three embryos are implanted in a woman's womb as part of assisted reproductive technology). Thus, it is likely that we will continue to encounter very premature survivors in the foreseeable future. Improving outcomes for these infants should therefore be the focus, where possible.

Implications for Policy and Services

The major public health implication of the higher rates of preterm births is their contribution to infant mortality. Infants born in the extreme stages of prematurity, with the highest morbidity rates, represent a tiny proportion — less than 1% — of births. Therefore, while this high risk of morbidity does not significantly contribute to overall rates of child morbidity, overall rates of cerebral palsy may be more significantly increased.

Clearly, the best way to decrease the incidence of developmental and physical morbidity attributable to prematurity is to reduce the number of such births. However, our current understanding of the factors leading to preterm delivery are apparently of little guidance in developing efficacious interventions. Thus, improvements in childhood outcomes among premature infants will have to be based on the technology that is currently available.

First, such infants should be delivered, whenever possible, in a hospital equipped to deal with both the mother and infant. A substantial body of literature supports the benefits of such a strategy.¹³ In addition, the specialists providing this care must engage in quality improvement activities, comparing institutions and seeking to reduce complication rates to the lowest possible level. Thus, perinatal and neonatal services must be organized in such a way as to identify risk early and provide the care needed through referral and transfer.

Second, continued attention is needed in supporting normal physical and psychological development in the intensive care unit. Great strides have been made in reducing the barrage of sound and light on infants' senses that characterized early NICU care using novel technologies.¹⁴

Finally, after discharge, there should be a robust network of early intervention services to sustain infant and child development, and provide guidance to parents. Substantial evidence has accumulated that such interventions do improve outcomes.^{15,16} However, financial and other restrictions create disparities in access to such services.¹⁷

Finally, we must continue to define the health issues of surviving preterm infants, and understand how they affect these children across the life-span.¹⁸ The interplay of environment and physical vulnerabilities is not well

understood, and preventing further problems will require this information to inform more effective interventions.

References

1. Liu L, Oza S, Chu Y, Perin J, Zhu J, Lawn JE, Cousens S, Mathers C, Black RE. Global, regional, and national causes of under-5 mortality in 2000-15: an updated systematic analysis with implications for the Sustainable Development Goals [published online November 11, 2016]. *Lancet* 2016;388(10063):3027-3035. doi: 10.1016/S0140-6736(16)31593-8
2. Chang HH, Larson J, Blencowe H, Spong CY, Howson CP, Cairns-Smith S, Lackritz EM, Lee SK, Mason E, Serazin AC, Walani S, Simpson JL, Lawn JE; Born Too Soon prematurity prevention analysis group. Preventing preterm births: analysis of trends and potential reductions with interventions in 39 countries with very high human development index. *Lancet* 2013;381(9862):223-234.
3. March of Dimes, PMNCH, Save the Children, WHO. Born Too Soon: The Global Action Report on Preterm Birth. Howson CP, Kinney MV, Lawn JE, eds. Geneva: World Health Organization; 2012.
4. Stoll BJ, Hansen NI, Bell EF, Walsh MC, Carlo WA, Shankaran S, Laptook AR, Sánchez PJ, Van Meurs KP, Wyckoff M, Das A, Hale EC, Ball MB, Newman NS, Schibler K, Poindexter BB, Kennedy KA, Cotten CM, Watterberg KL, D'Angio CT, DeMauro SB, Truog WE, Devaskar U, Higgins RD; Eunice Kennedy Shriver National Institute of Child Health and Human Development Neonatal Research Network. Trends in care practices, morbidity, and mortality of extremely preterm neonates, 1993-2012. *JAMA* 2015;314(10):1039-1051.
5. Horbar JD, Carpenter JH, Badger GJ, Kenny MJ, Soll RF, Morrow KA, Buzas JS. Mortality and neonatal morbidity among infants 501 to 1500 grams from 2000 to 2009. *Pediatrics* 2012; 129(6):1019-1026.
6. McCormick MC, Litt JS, Smith VC, Zupancic JAF. Prematurity: overview and public health implications. *Ann Rev Public Health* 2011;32:367-379.
7. Woythaler M, McCormick MC, Yao W, Smith VC. Late preterms infants and neurodevelopmental outcomes at kindergarten. *Pediatrics* 2015; 136(3):424-431.
8. Horbar JD, Soll RF, Edwards WH. The Vermont Oxford Network: a community of practice. *Clin Perinatol* 2010;37(1):29-47.
9. Vohr BR, Wright LL, Dusick AM, Perritt R, Poole Wk, Tyson JE, Steichen JJ, Bauer CR, Wilson-Costello DE, Mayes LC; Neonatal Research Network. Center differences and outcomes of extremely low birth weight infants. *Pediatrics* 2004;113(4):781-789.
10. Rogowski JA, Staiger DO, Horbar JD. Variations in the quality of care for very-low-birthweight infants: implications for policy. *Health Aff (Millwood)*. 2004;23(5):88-97.
11. Platt MJ, Cans C, Johnson A, Surman G, Topp M, Torrioli MG, Krageloh-Mann I. Trends in cerebral palsy among infants of very low birthweight (<1500 g) or born prematurely (<32 weeks) in 16 European centres: a database study. *Lancet* 2007;369(9555):43-50.
12. Committee on the Evaluation of Children's Health. *Children's Health, the Nation's Wealth*. Washington, DC: National Academies Press; 2004.
13. Lasswell SM, Barfield WD, Rochat RW, Blackmon L. Perinatal regionalization for very low-birth-weight and very preterm infants: a meta-analysis. *JAMA* 2010; 304(9):992-1000.
14. Grey JE, Safran G, Davis RB, Pompilio-Weitzner G, Steward JE, Zaccagnini L, Pursley D. Baby CareLink: Using the internet and telemedicine to improve care for high-risk infants. *Pediatrics* 2000;106(6):1318-1324.
15. McCormick MC, McCarton C, Tonascia J, Brooks-Gunn J. Early educational intervention for very low birth weight infants: Results from the Infant Health and Development Program. *J Pediatr* 1993;123(4):527-533.
16. McCormick MC, McManus B. Cognitive and behavioral interventions. In: Nosarti C, Murray RM, Hack M, eds. *Neurodevelopmental outcomes of preterm birth: from childhood to adult life*. Cambridge, U.K.: Cambridge University Press; 2010: 237-250.
17. McManus B, McCormick MC, Acevedo-Garcia D, Ganz M, Hauser-Cram P. The effect of state early intervention eligibility policy on participation among a cohort of young CSHCN. *Pediatrics* 2009;124 Suppl 4:S368-74.
18. McCormick MC, Litt JS. The Outcomes of Very Preterm Infants: Is It Time to Ask Different Questions? *Pediatrics* 2017;139(1):e20161694.