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Neurodevelopmental Outcomes of Preterm Infants and Importance of Early Developmental Interventions

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Abstract

Advances in obstetric and neonatal care have decreased preterm mortality rates. But neurodevelopmental problems have increased in survivors, especially in extremely preterm infants. Preterm infants have greater risk of neurodevelopmental disabilities compared to full-term infants. Common long-term adverse outcomes after extreme prematurity include intellectual disability and cerebral palsy. Moderately preterm children have more scholastic problems, more cognitive difficulties and increased behavioural problems compared with term-born children. Multi-faceted early developmental interventions are essential to prevent the high rate of neurodevelopmental problems in preterm children. Early parent-training intervention is associated with better outcomes in preterm children, especially for domains related to language and socio-emotional functioning. Early developmental interventions given to preterm infants have long-lasting positive effects on improving physical well-being and quality of life.

Keywords: Early developmental interventions, preterm infants, developmental delay, premature birth; neurodevelopmental outcome.

Introduction

Improvements in technology in the neonatal intensive care unit in recent decades, have led to survival of even extremely preterm infants [1,2]. Rates of survival of preterm children born at 22 to 34 weeks' gestation have increased during the past two decades, but these children remain at high risk of neurodevelopmental problems [3]. Preterm infants have greater risk for neurodevelopmental disabilities compared to full term infants [4]. Although advances in obstetric and neonatal care have decreased preterm mortality rates, neurodevelopmental disabilities have increased in survivors, especially in extremely preterm infants born at ≤25 weeks' gestation. Better understanding of the prevalence and patterns of neurodevelopmental problems in preterm children is important for patient care, family guidance and future research. Instituting early intervention programs, lead to brighter futures and improve neurodevelopmental outcome of preterm infants [5]. Early diagnosis of neurodevelopmental problem is very important in order to provide appropriate early developmental interventions for preterm infants.

Neurodevelopmental Outcomes following Preterm Birth

There is increased risk of adverse neurodevelopmental outcome for preterm very low birth weight

infants [6]. Common long-term adverse outcomes after extreme prematurity include intellectual disability (5% to 36%) and cerebral palsy (9% to 18%). Preterm infants born at 22-24 weeks gestational age and infants with neonatal morbidity, are at highest risk for cerebral palsy [7]. In the study assessing the neurodevelopmental outcome at 2 years for preterm children born at 22 to 34 weeks' gestation, it was found that, the overall rate of cerebral palsy at 24-26 weeks, 27-31 weeks and 32-34 weeks gestation was 6.9%, 4.3%, and 1.0% respectively [3].

Children born preterm are vulnerable for socio-emotional difficulties, which can lead to the development of behavioral and emotional problems in adolescence. Preterm children are less accurate in detecting positive emotional expressions compared to full-term children. The early difficulties in decoding emotional signals from faces may cause emotional regulation problems [8].

Milder degrees of disability involving cognition, behavior, and learning are increasingly seen among older preterm children [5]. Higher prevalence of scholastic problems, more behavior problems and lower cognitive functioning are found in moderate and late preterm born children compared with full term peers [9].

The most frequent adverse neurodevelopmental outcome, for preterm extremely low birth weight infants was cognitive impairment (8.52%) [10]. The intelligence quotient scores of very preterm children are significantly lower than full-term peers. They have problems in non-verbal reasoning and information processing. Very preterm children are also at risk for behavioral, attentional, and social problems. These children also have an increased risk for attention-deficit/ hyperactivity disorder [11]. Parents of very preterm children reported twofold higher prevalence for hyperactivity/inattention, emotional symptoms, and peer problems compared with term children. Behavioral problems were significantly higher among very preterm children. There was associated low cognitive performance and developmental delay [12].

Moderately preterm children have more school problems, more cognitive difficulties, more attention-deficit/hyperactivity disorder characteristics and increased behavioral problems compared with term-born children. Early identification and monitoring of precursors of these problems at young age is essential for prevention [13]. Parents of children who were born preterm reported worse quality of life.

The main risk factors associated with worse quality of life in preterm children included congenital malformations, mechanical ventilation, and cognitive impairments [14]. Health-related quality of life of children born very preterm is impaired by complications of preterm birth [15].

Importance of Early Developmental Interventions

Early developmental interventions after preterm birth have positive influence on child development [16]. Interventions are necessary to enhance early development of infants born very preterm [17,18]. Multi-faceted early developmental interventions are urgently needed to prevent the high rate of neurodevelopmental problems in very preterm children [19].

There are several early developmental intervention programs involving parents of preterm babies. The interventions having home and facility-based components have maximum positive impact [20]. Continuous and global early intervention programs involving parents at home is better than the standard care, for very preterm infants [21].

Early interventions that enhance the parenting capacity have the greatest potential to improve developmental outcomes in children [22]. Parenting is very important to enhance healthy development of at-risk preterm infants. Very early parenting intervention is associated with better psychomotor outcomes in preterm children, especially for domains related to language and socio-emotional functioning [23].

Early developmental intervention programs have positive effect on cognitive and motor outcomes during infancy and the cognitive benefits persist into preschool age [24]. Early developmental interventions given to preterm infants have long-lasting positive effects on improving physical well-being. Early intervention influences positively the quality of life as reported by parents of prematurely born children [25].

Preterm infants who received early developmental interventions had lower levels of negative emotionality at 2, 3, 5, and 7 years [26]. In the randomized controlled trial to examine the effectiveness of an intervention at corrected ages of 3 and 5 years for children with birth weights of <2000 g, improved cognitive outcomes was reported at corrected age of 5 years [27]. At 9 years of age, the early intervention group of preterm born children had less attentional problems, better scholastic performance and better quality of life compared to preterm control group [28].

Conclusions

Preterm infants are at higher risk for adverse neurodevelopmental outcomes. Preterm birth is associated with motor, intellectual, behavioral, and scholastic problems in children. Neonatal care for preterm babies should include the implementation of early interventions with most positive impact. Preterm infants should be monitored for developmental delay. An integrated program of early developmental interventions involving parents of preterm infants should be developed. These early interventions will help preterm infants to achieve their greatest potential. Early parental stimulation will lead to improvement of cognition and motor skills of preterm infants. Parent mediated early interventions to improve the neurodevelopmental outcome, are essential for enhancing the overall functioning and quality of life of preterm children.

References

1. Hee Chung E, Chou J, Brown KA. Neurodevelopmental outcomes of preterm infants: a recent literature review. Transl Pediatr. 2020 Feb;9(Suppl 1):S3-S8. doi: 10.21037/tp.2019.09.10. PMID: 32206579; PMCID: PMC7082240.

2. Arpino C, Compagnone E, Montanaro ML, Cacciatore D, De Luca A, Cerulli A, Di Girolamo S, Curatolo P. Preterm birth and neurodevelopmental outcome: a review. Childs Nerv Syst. 2010 Sep;26(9):1139-49. doi: 10.1007/s00381-010-1125-y. Epub 2010 Mar 27. PMID: 20349187.

3. Pierrat V, Marchand-Martin L, Arnaud C, Kaminski M, Resche-Rigon M, Lebeaux C, Bodeau-Livinec F, Morgan AS, Goffinet F, Marret S, Ancel PY; EPIPAGE-2 writing group. Neurodevelopmental outcome at 2 years for preterm children born at 22 to 34 weeks' gestation in France in 2011: EPIPAGE-2 cohort study. BMJ. 2017 Aug 16;358:j3448. doi: 10.1136/bmj.j3448. PMID: 28814566; PMCID: PMC5558213

4. Benzies KM, Magill-Evans JE, Hayden KA, Ballantyne M. Key components of early intervention programs for preterm infants and their parents: a systematic review and meta-analysis. BMC Pregnancy Childbirth. 2013;13 Suppl 1(Suppl 1):S10. doi: 10.1186/1471-2393-13-S1-S10. Epub 2013 Jan 31. PMID: 23445560; PMCID: PMC3561170

5. Jarjour IT. Neurodevelopmental outcome after extreme prematurity: a review of the literature. Pediatr Neurol. 2015 Feb;52(2):143-52. doi: 10.1016/j.pediatrneurol.2014.10.027. Epub 2014 Nov 4. PMID: 25497122

6. Longo S, Caporali C, Pisoni C, Borghesi A, Perotti G, Tritto G, Olivieri I, La Piana R, Tonduti D, Decio A, Ariaudo G, Spairani S, Naboni C, Gardella B, Spinillo A, Manzoni F, Tinelli C, Stronati

M, Orcesi S. Neurodevelopmental outcome of preterm very low birth weight infants admitted to an Italian tertiary center over an 11-year period. Sci Rep. 2021 Aug 11;11(1):16316. doi: 10.1038/s41598-0

7. Chen R, Sjolander A, Johansson S, Lu D, Razaz N, Tedroff K, Villamor E, Cnattingius S. Impact of gestational age on risk of cerebral palsy: unravelling the role of neonatal morbidity. Int J Epidemiol. 2022 Jan 6;50(6):1852-1863. doi: 10.1093/ije/dyab131. Epub 2021 Jun 28. PMID: 34999876; PMCID: PMC8743109.

8. Della Longa L, Nosarti C, Farroni T. Emotion Recognition in Preterm and Full-Term School-Age Children. Int J Environ Res Public Health. 2022 May 26;19(11):6507. doi: 10.3390/ijerph19116507. PMID: 35682092; PMCID: PMC9180201

9. de Jong M, Verhoeven M, van Baar AL. School outcome, cognitive functioning, and behaviour problems in moderate and late preterm children and adults: a review. Semin Fetal Neonatal Med. 2012 Jun;17(3):163-9. doi: 10.1016/j.siny.2012.02.003. Epub 2012 Feb 23. PMID: 22364677.

10. Caporali C, Longo S, Tritto G, Perotti G, Pisoni C, Naboni C, Gardella B, Spinillo A, Manzoni F, Ghirardello S, Borgatti R, Orcesi S; ELBWI Neurodevelopmental Follow-up Study Group. Neurodevelopmental outcome of Italian preterm ELBW infants: an eleven years single center cohort. Ital J Pediatr. 2022 Jul 19;48(1):117. doi: 10.1186/s13052-022-01303-9. PMID: 35854369; PMCID: PMC9297614.

11. Johnson S. Cognitive and behavioural outcomes following very preterm birth. Semin Fetal Neonatal Med. 2007 Oct;12(5):363-73. doi: 10.1016/j.siny.2007.05.004. Epub 2007 Jul 10. PMID: 17625996.

12. Delobel-Ayoub M, Arnaud C, White-Koning M, Casper C, Pierrat V, Garel M, Burguet A, Roze JC, Matis J, Picaud JC, Kaminski M, Larroque B; EPIPAGE Study Group. Behavioral problems and cognitive performance at 5 years of age after very preterm birth: the EPIPAGE Study. Pediatrics. 2009 Jun;123(6):1485-92. doi: 10.1542/peds.2008-1216. PMID: 19482758

13. van Baar AL, Vermaas J, Knots E, de Kleine MJ, Soons P. Functioning at school age of moderately preterm children born at 32 to 36 weeks' gestational age. Pediatrics. 2009 Jul;124(1):251-7. doi: 10.1542/peds.2008-2315. PMID: 19564307

14. Vieira ME, Linhares MB. Quality of life of individuals born preterm: a systematic review of assessment approaches. Qual Life Res. 2016 Sep;25(9):2123-39. doi: 10.1007/s11136-016-1259-9. Epub 2016 Mar 19. PMID: 26995563

15. Kim SW, Andronis L, Seppanen AV, Aubert AM, Barros H, Draper ES, Sentenac M, Zeitlin J, Petrou S; SHIPS Research Group. Health-related quality of life of children born very preterm: a multinational European cohort study. Qual Life Res. 2022 Aug 17. doi: 10.1007/s11136-022-03217-9. Epub ahead of print. PMID: 35976599

16. Spittle A, Treyvaud K. The role of early developmental intervention to influence neurobehavioral outcomes of children born preterm. Semin Perinatol. 2016 Dec;40(8):542-548. doi: 10.1053/j.semperi.2016.09.006. Epub 2016 Nov 3. PMID: 27817913.

17. Ramachandran S, Dutta S. Early developmental care interventions of preterm very low birth weight infants. Indian Pediatr. 2013 Aug;50(8):765-70. doi: 10.1007/s13312-013-0221-y. PMID: 24036642.

18. Anderson PJ, Treyvaud K, Spittle AJ. Early developmental interventions for infants born very

preterm - what works? Semin Fetal Neonatal Med. 2020 Jun;25(3):101119. doi: 10.1016/j.siny.2020.101119. Epub 2020 May 15. PMID: 32446767.

19. Spittle AJ, Ferretti C, Anderson PJ, Orton J, Eeles A, Bates L, Boyd RN, Inder TE, Doyle LW. Improving the outcome of infants born at <30 weeks' gestation--a randomized controlled trial of preventative care at home. BMC Pediatr. 2009 Dec 3;9:73. doi: 10.1186/1471-2431-9-73. PMID: 19954550; PMCID: PMC2797495.

20. Puthussery S, Chutiyami M, Tseng PC, Kilby L, Kapadia J. Effectiveness of early intervention programs for parents of preterm infants: a meta-review of systematic reviews. BMC Pediatr. 2018 Jul 9;18(1):223. doi: 10.1186/s12887-018-1205-9. PMID: 29986683; PMCID: PMC6038283

21. Silveira RC, Mendes EW, Fuentefria RN, Valentini NC, Procianoy RS. Early intervention program for very low birth weight preterm infants and their parents: a study protocol. BMC Pediatr. 2018 Aug 9;18(1):268. doi: 10.1186/s12887-018-1240-6. PMID: 30092772; PMCID: PMC6085617

22. Colditz P, Sanders MR, Boyd R, Pritchard M, Gray P, O'Callaghan MJ, Slaughter V, Whittingham K, O'Rourke P, Winter L, Evans T, Herd M, Ahern J, Jardine L. Prem Baby Triple P: a randomised controlled trial of enhanced parenting capacity to improve developmental outcomes in preterm infants. BMC Pediatr. 2015 Mar 4;15:15. doi: 10.1186/s12887-015-0331-x. PMID: 25884634; PMCID: PMC4363360.

23. Pisoni C, Provenzi L, Moncecchi M, Caporali C, Naboni C, Stronati M, Montirosso R, Borgatti R, Orcesi S. Early parenting intervention promotes 24-month psychomotor development in preterm children. Acta Paediatr. 2021 Jan;110(1):101-108. doi: 10.1111/apa.15345. Epub 2020 Jun 3. PMID: 32392381.

24. Spittle A, Orton J, Anderson PJ, Boyd R, Doyle LW. Early developmental intervention programmes provided post hospital discharge to prevent motor and cognitive impairment in preterm infants. Cochrane Database Syst Rev. 2015 Nov 24;2015(11):CD005495. doi:10.1002/14651858.CD005495.pub4. PMID: 26597166; PMCID: PMC8612699.

25. Landsem IP, Handegard BH, Ulvund SE, Kaaresen PI, Ronning JA. Early intervention influences positively quality of life as reported by prematurely born children at age nine and their parents; a randomized clinical trial. Health Qual Life Outcomes. 2015 Feb 22;13:25. doi: 10.1186/s12955-015-0221-9. PMID: 25888838; PMCID: PMC4343051

26. Landsem IP, Handegard BH, Ulvund SE. Temperamental Development among Preterm Born Children. An RCT Follow-Up Study. Children (Basel). 2020 Apr 23;7(4):36. doi: 10.3390/children7040036. PMID: 32340334; PMCID: PMC7230507.

27. Nordhov SM, Ronning JA, Dahl LB, Ulvund SE, Tunby J, Kaaresen PI. Early intervention improves cognitive outcomes for preterm infants: randomized controlled trial. Pediatrics. 2010 Nov;126(5):e1088-94. doi: 10.1542/peds.2010-0778. Epub 2010 Oct 11. PMID: 20937650

28. Ulvund SE. Early Intervention in Families with Preterm Infants: A Review of Findings from a Randomized Controlled Trial Following Children Up to 9 Years of Age. Children (Basel). 2022 Mar 30;9(4):474. doi: 10.3390/children9040474. PMID: 35455518; PMCID: PMC9029705