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# Developmental patterns from 1 to 4 years of extremely preterm infants who required home oxygen therapy

Natasha M. Moon<sup>a,\*</sup>, Heather A. Mohay<sup>a</sup>, Peter H. Gray<sup>b</sup>

<sup>a</sup> Queensland University of Technology, School of Psychology and Counselling, Beams Road Carseldine, Qld. 4034, Australia

<sup>b</sup> Growth and Development Research Unit, Mater Health Services, Raymond Terrace, South Brisbane, Qld. 4101, Australia

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## KEYWORDS

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## Abstract

**Background:** Bronchopulmonary dysplasia (BPD) remains a common complication of prematurity, with those being discharged on home oxygen at particularly high risk of adverse developmental outcomes.

**Aims:** To compare the developmental patterns, from 1 to 4 years, of extremely preterm infants with BPD discharged from hospital on home oxygen, extremely preterm infants with BPD discharged breathing room air, and extremely preterm infants without BPD.

**Subjects:** Two hundred and seventy-six infants with a gestational age of <28 weeks or birthweight <1000 g, free from sensory and motor disabilities who were followed up longitudinally to 4 years corrected age.

**Outcome measures:** Children were assessed on the Griffiths Mental Development Scales at 1 and 2 years corrected age, and the McCarthy Scales of Children's Abilities at 4 years corrected age.

**Results:** The developmental trajectories of the three groups did not differ significantly, however at 1 year corrected age the non-BPD group had significantly higher developmental scores than both BPD groups. At 2 years corrected age the non-BPD group had significantly higher developmental scores than the BPD-home oxygen group, and at 4 years corrected age no differences between the groups were evident.

**Conclusions:** Extremely preterm children with BPD exhibited an initial developmental lag compared to preterm peers. Children with BPD discharged breathing room air had developmental scores at 2 years corrected age that were comparable to the non-BPD group, but those

\* Corresponding author. Tel.: +61 7 3864 4625.

E-mail address: [nm.moon@student.qut.edu.au](mailto:nm.moon@student.qut.edu.au) (N.M. Moon).

discharged on home oxygen still had lower developmental scores. At 4 years, no differences between the groups were evident.

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## 1. Introduction

The improved survival of extremely preterm infants is thought to have contributed to an increase in the incidence of bronchopulmonary dysplasia (BPD) [1], and a change in its clinical presentation and pathology [2]. The so-called “new BPD” is consistent with interference to normal lung development, which may prevent later lung growth [3]. Where once BPD was defined as an abnormal chest X-ray and supplemental oxygen dependency at >28 days of life [4], more recently oxygen dependency at 36 weeks premenstrual age has been used as the criterion [5].

Children with BPD are a high risk subgroup of preterm infants. A number of studies have cited BPD as a significant contributor to adverse developmental outcomes including developmental delay and psychoeducational disability [6–16]. As infants with BPD suffer frequent episodes of hypoxaemia and desaturation [17,18], these respiratory insufficiencies could impair the development of cognitive functions [19].

Katz-Salamon et al. [20] found that at 10 months corrected age very low birthweight (VLBW) infants with BPD (defined as supplemental oxygen requirement >28 days of life) had significantly lower overall scores on the Griffiths Mental Development Scale and lower scores on the hand and eye coordination and performance subscales compared to VLBW infants without BPD. Waugh et al. [10] reported that BPD (supplemental oxygen requirement >28 days of life) was significantly associated with intellectual impairment at 2 years corrected age in a cohort of extremely low birthweight children. Similarly, O’Shea et al. [13] found that at 4 to 5 years of age preterm children recovered from BPD (supplemental oxygen requirement >36 weeks postmenstrual age) had lower full scale IQ and performance scores on the Weschler Preschool and Primary Scale of Intelligence-Revised compared to birthweight matched peers.

The severity and chronicity of respiratory illness and the prolonged need for supplemental oxygen have been cited by some researchers as key predictors of future disability [13,21]. In the past, infants with BPD remained in hospital until they no longer required supplementary oxygen. Nowadays, many are discharged home on oxygen programs.

The small amount of evidence available from studies conducted in the 1980s and early 1990s suggests that preterm children with BPD who require home oxygen therapy are at high risk of neurodevelopmental problems, and may have different developmental trajectories from those not requiring home oxygen therapy [12,22]. However, dramatic changes in the care and technology available to preterm infants mean that results gained from studies of children born more than two decades ago are not pertinent to preterm children born today. There is a dearth of recent research investigating the developmental patterns of children with BPD who require home oxygen, and even less comparing their development with that of children with BPD

who do not require home oxygen, or with other preterm infants. It is important to make these comparisons to determine if the need for home oxygen poses additional risks for these infants beyond those of prematurity and BPD per se.

The current study aims to fill a gap in the literature by examining whether the developmental pattern of extremely preterm children with BPD who are discharged on home oxygen differs from that of extremely preterm children with BPD discharged breathing room air, or extremely preterm children without BPD. Developmental trajectories and outcomes for these three groups of infants will be compared at 1, 2 and 4 years corrected age.

It is hypothesised that the developmental trajectories of the three study groups will differ and that children with BPD will initially perform more poorly on developmental measures, with those requiring home oxygen performing at the lowest level. Further, based on clinical observation, it is expected that children with BPD who require home oxygen will show progressive catch-up in their development after they no longer require supplemental oxygen, and that no differences will be found between the three groups on cognitive measures at 4 years corrected age.

## 2. Methods

### 2.1. Participants

The present study used a pre-existing de-identified data set of all children ( $N=393$ ) born between January 1, 1995 and December 31, 2000 at <28 weeks gestation or birthweight <1000 g who were discharged from the Mater Mothers’ Hospital Neonatal Intensive Care Unit (NICU), Brisbane. At discharge, these children were enrolled in the Mater Children’s Hospital Growth and Development Clinic for follow-up at 1, 2 and 4 years corrected age.

For the purpose of the present study, the children were divided into three groups. The *BPD-home oxygen* group comprised 63 children diagnosed with BPD (requiring supplemental oxygen >36 weeks postmenstrual age) and discharged home on supplemental oxygen; the *BPD-room air* group comprised 83 children diagnosed with BPD and discharged home breathing room air; the *non-BPD* group comprised 247 children who were not diagnosed with BPD.

Children were excluded from the study if they had missing developmental assessment data at two or more of the follow-up points. With this amount of missing data, it was impossible to satisfactorily impute scores and to include them in statistical analysis. Children were also excluded from the statistical analysis if they had a sensory or motor disability which precluded accurate assessment. Children with intellectual impairment (scores >2 standard deviations below the test mean) were not excluded if they had a complete developmental assessment, as this was the area of development which was of particular interest in this study.

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