

The outcome at 12 months of very-low-birth-weight infants ventilated at Tygerberg Hospital

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Objective. To determine the outcome at 1 year of age of a group of very-low-birth-weight (VLBW) infants, from urban and rural communities, ventilated at Tygerberg Hospital, W. Cape.

Study design. Prospective descriptive study in which the prevalence of bronchopulmonary dysplasia (BPD), sensori-neural deafness, intraventricular haemorrhage (IVH), retinopathy of prematurity (ROP) and abnormal motor developmental outcomes were determined in 153 ventilated VLBW infants from rural and urban areas. Of these, 69% were from lower socio-economic backgrounds.

Main outcome measures. Attrition rates for rural and urban babies, BPD, ROP, IVH and abnormal motor development.

Study population and setting. All ventilated VLBW infants discharged from the neonatal intensive care unit at Tygerberg Hospital over a 1-year period were followed up at 3-monthly intervals for 12 months.

Results. BPD was diagnosed in 19% of the babies, with significantly more babies with birth weights under 1 000 g and gestational ages under 28 weeks having BPD. Of the babies with BPD, 25% had abnormal motor development at 1 year of age. Seven per cent of the babies had grade 3 or 4 ROP and 2,6% had sensorineural hearing loss. One hundred and seventeen (79%) of the infants attended the follow-up clinic until 12 months of age (corrected for prematurity). There were no significant differences in the number of babies followed up from rural or urban areas. Fourteen (11,9%) of the babies had abnormal motor development. A disturbing finding was that so many babies had spastic quadriplegia (8; 57%) versus diplegia (6; 43%).

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The incidence of abnormal motor development in the babies from the rural areas and in those with birth weights under 1 000 g from rural areas was high — a further cause for concern.

Conclusion. The prevalence of the major complications associated with ventilated VLBW infants correlated well with those reported for similar infants from First-World countries. The poor motor developmental outcome of the babies from rural areas with birth weights under 1 000 g and high attrition rates for infants with serious complications such as BPD, IVH and ROP are distressing.

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The survival rate of ventilated very-low-birth-weight (VLBW) infants from First-World countries is improving steadily.¹ Progress in perinatal medicine over the past 2 decades in so-called developing countries has also resulted in improved survival rates for VLBW infants.^{2,3} Many of these neonatal intensive care unit (NICU) survivors may, however, suffer from the consequences of therapy received during the neonatal period or from perinatally contracted insults.⁴ The discharge from the NICU of a VLBW infant who has been ventilated does not always indicate resolution of the baby's problems.

Complications associated with ventilated VLBW infants include intraventricular haemorrhage (IVH), bronchopulmonary dysplasia (BPD), impairment of hearing and vision (retinopathy of prematurity (ROP)) as well as cerebral palsy (CP).⁴

Many of the complications are diagnosed while the baby is still in the NICU, while others are only detected at follow-up. Most of the reports on the long-term follow-up of VLBW infants deal with infants from middle- and higher socio-economic backgrounds from First-World countries, where follow-up attendance is usually above 90%.⁵ Poor follow-up results have been reported for lower socio-economic infants from First-World countries.⁶ Limited information exists on the follow-up of infants from lower socio-economic conditions receiving sophisticated NICU care in a developing country.³

A study was undertaken to determine the incidence of complications such as BPD, ROP, hearing loss and CP in a group of ventilated VLBW infants from predominantly lower socio-economic backgrounds in a developing country.

Patients and methods

The NICU at Tygerberg Hospital, the teaching hospital of the University of Stellenbosch, mainly serves as a primary care centre for the surrounding lower socio-economic area whose inhabitants are of mixed racial origin (so-called 'coloured' people). It also acts, however, as the tertiary referral centre for patients from the Western Cape and as far afield as the Namibian border and Beaufort West (in the north) and George (in the south). All infants with a birth weight under 1 500 g discharged from the NICU between July 1986 and August 1987 were prospectively studied for a period of 12 months. Tygerberg had 8 000 deliveries during the study

period with a rate of low birth weight (< 2 500 g) of 21% and a rate of very low birth weight (< 1 500 g) of 4%. The infants were classified as 'inborn' when born at Tygerberg, and 'outborn' when referred.

Gestational ages were calculated from the last menstrual date, early booking, early ultrasound (< 24 weeks) or Finnstrom score.⁷ Babies below the 10th centile on Dunn's growth curve⁸ were classified as small for gestational age (SGA).

Because of the limited number of beds available in the NICU, only babies with birth weights more than 800 g who required ventilation were admitted to the NICU. The babies were ventilated if the partial arterial oxygen pressure (PaO₂) was < 8,0 kPa in a fractional inspired oxygen concentration (FiO₂) of > 0,6, if the PaCO₂ was > 8,0 kPa or for recurrent apnoea. Surfactant was not available in South Africa at the time of the study. Non-ventilated VLBW infants were not included in the study. Routine cranial ultrasonography was performed between days 3 and 7. Outborn babies with mild respiratory distress were frequently transferred back to the referring hospital before cranial ultrasound studies could be performed. IVH was classified according to the method of Papile *et al.*⁹

Fundoscopies were performed at 4, 6 and 8 weeks of age by an ophthalmologist experienced in retinal examination. The retinal pathology was classified according to the international classification of ROP.¹⁰

BPD was defined as oxygen dependence after 28 days of life, as well as radiographic findings consistent with BPD in an infant requiring ventilation in the early neonatal period. Babies with BPD were treated in hospital until they were no longer oxygen-dependent.

After discharge, the babies were followed up at 3-monthly intervals at the preterm follow-up clinic until 12 months of age (corrected for prematurity). An intensive effort was made to achieve the best possible attendance at the follow-up clinic. This included letters and telephone calls to parents and the help of the local clinics. Development was assessed according to the method of Tison¹¹ and the Denver scales¹² and the infant's motor function was classified as follows: normal, suspect (when minor motor changes present did not interfere with function), and abnormal (when there were abnormal reflexes, tone or any form of cerebral palsy). A complete audiometric assessment was undertaken at 9 months of age. Babies with major congenital abnormalities were excluded from the final analysis.

All measurements and neurodevelopmental evaluation results were corrected for prematurity. At each visit a complete physical and neurological examination was performed and physical measurements recorded, using the NCHS growth charts.¹³ Lower socio-economic conditions were defined as a monthly income of under R1 000,00 per family. This was decided upon because no available international classification of socio-economic status could be applied to local conditions without serious distortion of the true conditions.

Statistical analysis

Statistical differences between groups were compared using Student's *t*-test and the chi-square test. When small numbers were compared, Fisher's exact test was used.

Results

Two hundred and ten babies with birth weights below 1 500 g were ventilated over the 12-month period. A total of 153 (72%) survived and constituted the study cohort. Of these, 117 (76,5%) were inborn and 36 (23,5%) outborn. Eighty-one (53%) of the babies came from rural areas and 72 (47%) from the urban area. Forty-four per cent of the rural mothers were referred for the management of severe pre-eclampsia. Sixteen of the urban babies (22%) were outborn. Of these, 3 were born at home and 13 referred from urban hospitals for ventilation. Twenty of the rural babies (25%) were also outborn. Two of them were born at home and 18 were referred from rural hospitals for ventilation. The mean birth weight of the babies was 1 184,8 g (SD 176,7) and mean gestational age was 29,9 weeks (SD 2,14); 45,8% were SGA. Twenty-five were white, 8 black and 120 of mixed race; 63 were boys and 90 girls. Sixty-nine per cent of the babies came from low socio-economic conditions. One hundred and seventeen (79%) of the babies were followed up until 12 months corrected age: 72% from the rural and 87% from the urban areas attended the follow-up clinic. Eighty-five per cent of the babies from the rural areas were born to parents living under poor socio-economic conditions. Only 68% of them attended the follow-up clinic.

Seven of the 8 black babies were lost to follow-up and intensive efforts to trace them were unsuccessful. Of the 153 babies who were discharged from hospital, 2 had fetal alcohol syndrome (1 each from the rural and urban areas), and 3 babies from the urban area died after discharge from hospital. They were not included in the final analysis.

Ultrasound examination of the brain was not undertaken in 14 babies because of early transfer back to their referring hospitals. The overall incidence of IVH was 18,9%; grades 3 and 4 were diagnosed in 10 (7%) and periventricular leucomalacia (PVL) in 11 (7%) of the babies. Of the 10 babies with grade 3 or 4 IVH, 4 had major motor abnormalities, 2 were lost to follow-up (1 each from the rural and urban areas), 2 died after discharge from hospital, 1 was normal and 1 infant's motor development was classified as suspect.

Of the 11 babies with PVL, 2 babies from the rural areas were lost to follow-up, 1 died after discharge from hospital, 5 had abnormal motor development, 1 was suspect and 2 normal. The clinical characteristics of the babies are shown in Table I.

Table I. Clinical characteristics of the babies

	Birth weight (g)			
	All infants	< 1 000	1 000-1 250	> 1 250
No.	153	25	70	58
SGA (%)	70 (45,8)	13 (52)	33 (47)	24 (41,4)
Mean gestational age (wks)	29,9	28,3	29,8	30,9
BPD (%)	30 (19,6)	10 (40) ^a	18 (25,7) ^b	2 (3,4) ^{a,b}
PDA (%)	78 (51)	21 (84) ^{c,e}	37 (52,9) ^{c,d}	20 (34,5) ^{e,d}
IVH				
grade 1 and 2 (%)	19 (12,4)	6 (24)	9 (13)	4 (7)
3 and 4 (%)	10 (7)	4 (16)	4 (6)	2 (3,4)
PVL (%)	11 (7)	4 (16)	5 (7)	2 (3,4)

^{a,b,c,d,e} = $P < 0,05$.

BPD = bronchopulmonary dysplasia; IVH = intraventricular haemorrhage; PDA = patent ductus arteriosus; PVL = periventricular leucomalacia; SGA = small for gestational age.

The duration of ventilation, oxygen therapy, stay in the NICU and total hospitalisation for the different weight groups are shown in Table II.

Table II. Duration of ventilation, oxygen therapy and total hospitalisation according to birth weight

	Birth weight (g)				P
	All infants	< 1 000	1 000-1 250	> 1 250	
Mean IPPV (days)	9,41	21,7 ^{a,b}	12,6 ^a	4,4 ^b	< 0,05 ^{a,b}
Mean O ₂ therapy (days)	17,7	41,3 ^a	30,8	10,0 ^a	< 0,05 ^a
Mean total hospital stay (days)	67,54	85,4 ^{a,b}	80,9 ^{a,f}	47,7 ^{b,f}	< 0,05 ^{a,b,f}

IPPV = intermittent positive-pressure ventilation.

^{a,b,f} = $P < 0,05$.

The prevalence of the various grades of ROP is shown in Table III. Twenty-six babies were not examined for ROP. The babies with ROP received oxygen for significantly longer periods of time, namely 48,5 days (SD 65,9) compared with 19,18 days (SD 27,6; $P = 0,013$) for the babies without ROP.

Table III. The prevalence of the various grades of ROP according to birth weight

	Birth weight (g)			
	All infants (N = 127)	< 1 000	1 000-1 250	> 1 250
1 and 2 (%)	31 (24)	10 (40) ^a	13 (22)	8 (18) ^a
3 and 4 (%)	9 (7,1)	2 (8)	6 (10) ^b	1 (2) ^b

^{a,b} = $P < 0,05$.

ROP = retinopathy of prematurity.

Hearing could not be formally assessed in 33 (22%) of the survivors because of non-attendance at the hearing assessment clinic. Three babies died. Seventy-six babies (66%) had normal hearing, 3 (2,6%) babies had sensorineural hearing loss, and 36 (31%) conductive hearing loss caused by serous otitis media.

One hundred and seventeen babies (79%) were followed up until 12 months corrected age. Their motor developmental outcome according to birth weight is shown in Table IV. The 4 babies from the urban area with abnormal motor development comprised 2 with spastic quadriplegia (SQ) and 2 with spastic diplegia (SD). The 2 babies from the urban area with SQ with birth weights greater than 1 250 g were both one of pairs of twins. Of these pregnancies, one was complicated by an abruptio placentae that caused severe intrapartum asphyxia. The other twin pregnancy was complicated by an amorphous acardiac fetus. The other 6 babies with SQ all had a birth weight under 1 250 g and were from rural areas. Two of them had PVL. Four of the 6 babies with SD, 2 each from the rural and urban areas, had associated abnormal brain ultrasounds. Only 1 of the outborn babies from the rural area had abnormal motor-development at the 12-month assessment. The characteristics of the babies with abnormal neurodevelopmental outcome are shown in Table V.

Table IV. Motor developmental outcome of the infants at 12 months corrected age according to birth weight

	Birth weight (g)			
	All infants	< 1 000	1 000-1 250	1 500
Normal (%)	96 (82)	14 (61) ^a	44 (84) ^a	38 (91) ^a
Suspect (%)	7 (6)	2 (9)	4 (8)	1 (2)
Abnormal (%)	14 (12)	7 (30)	4 (8)	3 (7)
Spastic quadriplegia	8	4*	2*	2†
Spastic diplegia	6	3*	1*, 1†	1†

^a = $P < 0.05$.
* rural.
† urban.

Table V. Clinical characteristics of the babies with abnormal neurodevelopmental outcome

Baby No.	BW (g)	GA (wks)	Cranial ultrasound	BPD	Maternal or neonatal complications	Area	CP
1	1 340	30	Grade 4 IVH	Yes	Twin, amorphous	U	SQ
2	1 268	28	PVL	No	Twin, abruptio	U	SQ
3	1 255	28	PVL	No		U	SD
4	1 015	30	PVL	Yes		U	SD
5	995	31	Normal	No	Severe IUGR exchange transfusion for polycythaemia	R	SQ
6	1 040	30	PVL	Yes	SBE, mother died	R	SQ
7	900	29	Grade 2 IVH	No	Severe PE, unbooked	R	SQ
8	980	28	PVL	No	Mi and MS, prolonged ruptured membranes	R	SQ
9	970	27	Normal	No	PE, unbooked	R	SQ
10	1 100	30	Normal	Yes	Traumatic breech delivery	R	SQ
11	920	30	PHH	Yes	Severe PE	R	SD
12	1 105	29	PHH	Yes		R	SD
13	890	28	Grade 1 IVH	No	Antiphospholipid syndrome	R	SD
14	880	29	Normal	No	Abruptio	R	SD

BPD = bronchopulmonary dysplasia; BW = birth weight; CP = cerebral palsy; GA = gestational age; MI = mitral incompetence; MS = mitral stenosis; PE = pre-eclampsia; PHH = post-haemorrhagic hydrocephalus; PVL = periventricular leucomalacia; R = rural; SBE = subacute bacterial endocarditis; SD = spastic diplegia; SQ = spastic quadriplegia; U = urban; IUGR = intra-uterine growth retardation; IVH = intraventricular haemorrhage.

Of the 22 babies from rural areas in the present study who were not brought in for follow-up, 6 had BPD, 2 grade 3 ROP, 1 grade 3 IVH and post-haemorrhagic hydrocephalus and 2 PVL. Nine babies from the urban area did not return for follow-up. Of these, 2 had BPD, 1 grade 3 ROP and 1 grade 3 IVH. A major concern was that none of the black babies returned for follow-up, as many of their homes were in isolated rural areas where medical facilities are very limited.

Thirty (19%) babies developed BPD, with 40% in the under 1 000 g group, 26% in the 1 000 - 1 250 g group and 3% in the 1 250 - 1 500 g group. The clinical characteristics of the babies with and without BPD are shown in Table VI. Compared with the babies without BPD, the babies with BPD were smaller, more often immature and more often had IVH grades 3 - 4, ROP grades 3 - 4, a patent ductus arteriosus (PDA) and abnormal developmental outcome. There were no statistical differences with regard to birth weight, gestational age, or prevalence of BPD, ROP, IVH and hearing loss between the rural and the urban babies.

Discussion

NICUs in developing countries may be faced with major problems when babies from rural areas as well as those from lower socio-economic backgrounds are referred for consultation. Many of the mothers have never attended antenatal clinics, extra-uterine transfers of babies are common, resuscitation and treatment facilities in some rural areas are inadequate and poor attendance of infants from rural areas at follow-up clinics at tertiary centres is common. Facilities in rural areas for screening and treating of complications associated with prematurity and neonatal ventilation are often inadequate. Infants from lower socio-economic backgrounds are also more often born prematurely and the developmental consequences of their prematurity tend to be worse.¹⁴

Sixty-nine per cent of the infants in the present study came from a very poor socio-economic background; this is a very similar figure to the 76% reported by Thompson *et al.*³ for VLBW infants treated at Groote Schuur Hospital. However, of the infants from rural areas in the present study, 85% were from very low socio-economic backgrounds.

Reasons for the poor follow-up attendance in the present study include inadequate communication systems (few of the mothers could be contacted directly by telephone), frequent address changes and inadequate and relatively expensive transportation. Lasky *et al.*⁶ reported an attrition rate of 40 - 50% for lower socio-economic VLBW infants from a First-World country after discharge from hospital. In 75% of their infants unavailable for follow-up, a correct address could not be obtained.⁶ There were no statistical differences regarding the number of babies followed up from urban and rural areas in the present study.

BPD was diagnosed in 19% of the babies. The development of BPD during the neonatal period is a serious complication and is seen in 6 - 24% of preterm infants requiring mechanical ventilation.⁴ These infants remain in hospital longer, are at greater risk of dying and are prone to growth failure and poor neurodevelopmental outcome.¹⁵ The babies with BPD in the present study were ventilated longer and stayed in hospital for a significantly longer time than the babies without BPD (Table VI). The incidence of BPD is directly related to the birth weight and gestational age of the infants,^{15,16} with a dramatic increase in the incidence of BPD in infants under 1 000 g birth weight and under 28 weeks gestational age, a finding confirmed in the present study. The incidence of BPD in the present series would probably have been higher if infants with birth weights below 800 g had also been ventilated. Of the babies with BPD who attended the follow-up clinic in the present study, 25% had an abnormal motor developmental outcome, a finding which is very similar to that reported for VLBW infants with BPD from lower socio-economic conditions.¹⁷ No mention of the prevalence of BPD or the association between BPD and IVH with poor neurodevelopmental outcome was made in the Groote Schuur Hospital study.³ Four of the 5 babies with BPD who also had grade 3 or 4 IVH and/or PVL had a significantly poorer motor developmental outcome than the babies with BPD but no IVH or PVL. This supports previous observations that IVH is a better predictor of poor neurodevelopmental outcome in babies with BPD than the severity of the lung disease.¹⁶

Table VI. The clinical characteristics of the babies with and without BPD

Clinical characteristics	BPD	No BPD	P-value
No. (%)	30 (19)	121*	
Mean birth weight (g)	1 057,5	1 215,8	< 0,001
Mean gestational age (wks)	29,2	30,2	< 0,05
Birth weight < 1 000 g (%)	10 (33,3)	15 (12,4)	< 0,05
Gestational age < 28 wks (%)	7 (23,3)	6 (4,9)	
Mean duration of IPPV (days)	39,8	3,3	< 0,001
Mean duration of O ₂ therapy (days)	90,6	8,3	< 0,001
Mean duration of hospitalisation (days)	114,6	57,8	< 0,001
ROP grade 3 and 4 (%)	5 (16,7)	4 (3,3)	< 0,05
IVH grade 3 - 4 (%)	6 (20)	4 (3,3)	< 0,05
PDA (%)	24 (80)	54 (44)	< 0,0001
Developmental outcome of clinic attenders			
Abnormal (%)	5 (25)	9 (9,2)*	< 0,05
Suspect (%)	2 (10)	5 (5)*	
Normal (%)	13 (65)	83 (75)	
Not followed up	8	23	
Died	2	1	

* Excluding 2 babies with fetal alcohol syndrome.

IPPV = intermittent positive-pressure ventilation; IVH = intraventricular haemorrhage; PDA = patent ductus arteriosus; ROP = retinopathy of prematurity.

An infant with BPD may place considerable stress on the family. Lower respiratory tract infections such as bronchiolitis and pneumonia occur in 30 - 80% of babies with BPD after discharge and are major risk factors for mortality and rehospitalisation.⁴ Two of the babies with BPD from the metropolitan area died after discharge from hospital. It is possible that some of the babies with BPD from the rural areas also died after discharge from hospital as 6 were lost to follow-up. It is of the utmost importance that a multidisciplinary team consisting of a paediatric pulmonologist, paediatrician, social worker, physiotherapist and neurodevelopmentalist follows up infants with BPD closely after discharge from the nursery to monitor growth and development and to treat lung complications aggressively. All 6 babies (20%) with BPD lost to follow-up were from rural areas. Of these, 2 had grade 3 IVH which put them at high risk for abnormal neurodevelopmental outcome.¹⁷

ROP remains a cause of significant morbidity among VLBW infants who survive neonatal intensive care.¹⁸ As more and more infants under 1 000 g (the group at greatest risk of ROP) survive, the number of infants blind because of ROP will also increase.¹⁹ Although ROP may affect up to 50% of VLBW infants, severe disease (grade 3 and 4) is relatively rare (7,5%).²⁰ It remains difficult to compare the incidence of ROP reported in previous reports because of variations in patient selection and methodology of examination.²⁰ ROP developed in 31,5% and grade 3 and 4 ROP in 7% of the babies in the present study, which is very similar to results reported by Prendiville and Schulenberg.²¹ It is important that infants with grade 3 disease plus ROP, where retinal detachment appears imminent, be identified early to determine which babies should receive cryosurgery to induce regression.²² The surveillance for ROP is costly and labour-intensive. Acheson and Schulenberg²⁰ recommended that only babies under 31 weeks of gestational age should be examined for ROP as no infant over 31 weeks in their study was found to have ROP of grade 3 or more. However,

5 of the 9 babies with ROP grade 3 or more in the present study were of more than 31 weeks' gestation.

The incidence of hearing loss among VLBW infant survivors of NICU care reportedly ranges from 1% to 28%.²³ Mild hearing deficits are even more prevalent.²³ Factors that may increase the risk of deafness include asphyxia, hyperbilirubinaemia, congenital infections, meningitis, and certain ototoxic medication.⁴ Sensorineural hearing loss occurs in 1,5 - 9% of infant intensive care survivors.²⁴

Of the infants, 38,5% had some degree of hearing loss at follow-up in the present study. Of these, 3 babies (2,6%) had sensorineural hearing loss. All 3 were seriously handicapped by the hearing impairment and required hearing aids. In 1 baby the hearing loss was associated with a large venous infarction of the brain, another one had positive serology for toxoplasmosis and in the third baby no specific cause could be identified.

A high incidence of serous otitis media has also been noted among infants within the NICU.²⁵ This may be related to endotracheal intubation.²⁵ It is, however, still unclear whether NICU survivors are at higher risk of repeated episodes of otitis media.²⁵ Conductive hearing loss secondary to serous otitis media was diagnosed in 36% of our infants at 9 months of age. Gravel *et al.*²⁶ found that 91% of VLBW infants and term infants from lower socio-economic backgrounds developed serous otitis media during the first year of life and concluded that middle-ear infection is probably a complication of overcrowding and poor social conditions rather than a consequence of neonatal intensive care. The poor attendance at the Audiology Clinic in the present study was discouraging and the actual incidence of hearing impairment is probably much higher. This poor attendance could be related to unmotivated parents (the baby's hearing seemed to be normal) as well as the financial implications of taking the baby to the clinic. Early detection of hearing loss in babies is vital as the success of rehabilitation is directly related to the time at which treatment is initiated.²⁷ This makes hearing evaluation for high-risk infants imperative during the first year of life.²⁸

Major motor deficits were diagnosed in 14 (11,9%) of the babies in the present study, a figure similar to that reported for VLBW infants from First-World countries.²⁹ Of the babies with motor abnormalities, 50% had birth weights below 1 000 g and 70% were from rural areas. All the babies below 1 000 g birth weight from the urban area had normal motor function at 12 months of age compared with only 50% of the same weight group from the rural area. Eighty-seven per cent of the rural babies below 1 000 g were transferred *in utero* to Tygerberg Hospital. Only 1 rural infant referred after birth to our NICU for ventilation had SQ at 12 months, while the other 9 infants with CP were transferred *in utero*. All 4 urban infants with CP were inborn. CP was found to be twice as prevalent in survivors of *in utero* transfer and four times as prevalent in survivors of postnatal transfer than in babies booked and born at a tertiary unit.²⁹ Seventeen per cent of the rural babies and 7% of the urban babies in the present study had abnormal motor development.

A disturbing finding was the high incidence of SQ versus SD in the present study, which is also reflected in Thompson *et al.*'s study.³ Cooke³⁰ reported that SQ is more commonly associated with a postnatal brain insult and SD is largely

determined before birth. This might have been the case in 3 of the 6 rural babies with SQ, as 2 of them required intermittent positive-pressure ventilation for 97 and 194 days respectively because of severe RDS, and the third one was readmitted to the ICU on day 17 with septicaemia and hypovolaemic shock.

A strong association between CP in VLBW infants and ultrasound scan appearance in the neonatal period, suggesting that CP may be related to perinatal events, has been reported.²⁹ Five of the 6 babies with SQ had either PVL or a grade 4 IVH. The 1 baby with SQ and a normal brain ultrasound scan was severely growth retarded and required an exchange transfusion after birth for polycythaemia.

With only 72% of the rural babies attending the follow-up clinic, the number of babies with motor deficits is probably much higher. Bernuth *et al.*³¹ reported a twofold greater incidence of neurological deficits among infants who failed to return for follow-up evaluation, but who were subsequently located and examined, than among those who returned as scheduled. Thompson *et al.*³ noted that 24 infants were lost to follow-up, of whom at least 5 were known to be abnormal.

This study only reports on the motor outcome at 1 year of age as these results should reflect the impact of perinatal and neonatal factors upon the neurological status. The impact of a poor socio-economic environment on later developmental outcome can only be assessed by following up these babies for a much longer period. Socio-economic status exerts an overwhelming influence upon later cognitive development and VLBW infants from lower socio-economic conditions show a cognitive decline during the second year of life when language and early concept formation first emerge.³² With the high attrition rate for follow-up in infants from rural and lower socio-economic conditions, the magnitude of cognitive delay may be underestimated. This study shows that VLBW infants, especially those with birth weights under 1 000 g from rural areas transferred *in utero* to our institution, seem to be at risk for abnormal motor development. With the acute shortage of neonatal beds at tertiary centres, new criteria must be established for the transfer of mothers from rural areas who show fetal distress at less than 28 weeks' gestation or where the fetal weight is assessed to be below 1 000 g. The poor follow-up rate for babies from rural and lower socio-economic conditions may also be improved if the responsibility for the care and tracing of the infant is shared between the referring clinic/doctor and the tertiary centre. Until now, the referring doctor's involvement in the majority of cases often ended with the transfer of the mother or infant.

This study has confirmed the high attrition rate of babies from rural areas in respect of follow-up, and that the infants at highest risk for motor developmental delay are babies with birth weights below 1 000 g, PVL, grade 3 and 4 IVH and BPD. A special effort must be made to follow these babies up after discharge from hospital to detect peri- or postnatally contracted complications early in order that early therapy may be instituted.

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