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Cognitive Development and Behaviour in Very Low Birthweight Twins at Four Years

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Abstract. This study included two groups of 37 children, one of twins and the other singletons at 4 years of age. All subjects had birthweights under 1500 grams and individuals in the groups were matched for birth date, gender and birthweight. Except when parental socio-economic status was taken into account, no significant differences between twins and singletons were observed on any of the results of *The Stanford-Binet Intelligence Scale*, nor were there any when the twins and singletons were divided into groups with birthweights < 1000 grams and 1000 to 1499 grams. When cognitive scores were analysed in relation to socio-economic status, there were significant differences in the whole population between subjects in the high and low socioeconomic status groups, with higher mean scores for the former. Comparison of the twins and singletons with parents in the lower socio-economic status group did not produce any significant differences but in the case of the upper socio-economic status group the singletons scored significantly better that the twins in Quantitative Reasoning and on the Composite Score. No significant differences were demonstrated in the clinical assessment of speech, language or behaviour. So far as general life considerations and health were concerned only one significant difference was found and this was for the number of siblings born subsequently, with more born in the singleton families. This study did not provide support for the view that singletons and twins differ significantly in the areas considered.

Key words: Twins, Very low birthweight (VLBW), Cognitive development, Language, Behaviour, Socio-economic status

INTRODUCTION

A number of studies conclude that cognitive development is slower in twins than singletons [1, 8]. Language, articulation and reading problems also have been noted in young twins [4]. It has been suggested that differences in development may be a result of a higher percentage of premature births among twins [1].

Low socio-economic status (SES) was documented as the most frequently reported predictor of poor outcome in an overview of 25 followup studies reporting on very low birthweight infants to school age [9]. Some investigators have found that socio-economic status or other social risk factors are related to the developmental outcome of multiple gestation children [5, 12].

With the increase in incidence of twins and higher multiple births [2] it is important to study the outcome of these children.

The present study compares very low birthweight (VLBW <1500 grams) twins with VLBW singletons. Influence of parental socio-economic status on the cognitive development of the children is also investigated.

METHOD

Children studied were those who weighed under 1500 grams, born in 1988 and 1989. Thirty-seven were twins (Twin I 16, Twin II 21) and 37 were singletons.

Each twin infant was matched with a singleton comparison for closest birth date, gender and weight category (range 500-999 grams and 1000-1499 grams). There were equal numbers of males (14) and females (23) in the twin and singleton groups.

Exclusions were children with congenital abnormalities, visual loss and cerebral palsy.

Each child was individually assessed as close as possible to his/her fourth birthday (twin mean 4. 0, *SD* 0.3 years; singleton mean 4.0, *SD* 0.3 years). As a measure of cognitive functioning, *The Stanford-Binet Intelligence Scale*, 4th edition, was used in all cases. A clinical assessment of speech, language and behaviour was rated on a 5 point scale by the examiner immediately after the testing session.

Testing was carried out by two experienced registered psychologists in a clinical setting in the hospital where the children received their neonatal care.

At the time of the visit, parents (usually mothers) were asked several questions regarding their child's health, development and behaviour. One component of this information was a description of the child's temperament, modelled on the categories described in a study [6]. The definition of temperament employed was based on a review which described this feature of the child as the property "... that organizes interactions with the environment over a wide range of situations" [10].

Parents were classified for socio-economic status using *The Elley-Irving Socio-Economic Index* [3]. The authors describe this instrument as "an objective index of occupational status ... [and] when scaled according to conventional educational and income criteria, occupational level appears to correlate highly with many other social status variables making it a very useful 'marker' variable in regional surveys". As a result of classification on this Index 44 (59.5%) children were in SES groups 1 to 4, and 30 (40.5%) in SES groups 5 and 6 (1 professorial and managerial; 6 unskilled). This pattern is not significantly different to that of the New Zealand population as set out in the article by the same researchers (χ^2 (1, N = 74) = 3.69).

Analyses techniques for the study included Student's t and chi square tests.

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RESULTS

Twin and singleton control groups were similar with respect to: Gestational age (*M* 28.9, *SD* 3.1, and *M* 28.7, *SD* 2.9 weeks, t (72) = 0.35, NS); birthweight (*M* 1112.6, *SD* 321.8, and *M* 1105.2, *SD* 272.7 grams, t (72) = 0.11, NS); ethnic group (χ^2 (1, N = 74) = 3.80, NS); and socio-economic status (χ^2 (2, N = 74) = 2.84, NS).

Cognitive Development

There were no significant differences between twin and singleton groups for the Composite and four area scores (Verbal Reasoning, Abstract/Visual Reasoning, Quantitative Reasoning and Short-Term Memory) on the *Stanford-Binet Intelligence Scale*. However, the result for Abstract/Visual Reasoning approached significance at .05 level (Table 1).

Table 1 - Children Under 1500 grams Birthweight *Stanford-Binet Intelligence Scale* at Four Years Twins and Singletons N = 74

	Twins		Singletons			
	M	SD	M	SD	t	p
Verbal Reasoning	98.8	16.8	97.4	15.3	0.36	NS
Abstract/Visual Reasoning	89.2	11.0	94.3	11.4	1.97	NS
Quantitative Reasoning	97.0	10.3	102.5	18.5	1.60	NS
Short Term Memory	93.4	11.2	96.2	17.5	0.81	NS
Test Composite	93.7	11.9	97.7	15.3	1.28	NS

Table 2 - Children Under 1500 grams Birthweight *Stanford-Binet Intelligence Scale* at Four Years Birthweight Groups N = 74

	Under 1000g						1000-1499 g					
	Twins		Singletons				Twins		Singletons			
	M	*SD*	*M*	*SD*	df	*t*	*M*	*SD*	*M*	*SD*	df	*t*
Verbal Reasoning	85.8	12.5	95.8	10.9	22	2.02	105.0	21.5	98.2	16.7	48	1.52
Abstract/Visual Reasoning	82.4	11.0	89.2	9.3	22	1.56	92.4	9.2	96.8	11.3	48	1.47
Quantitative Reasoning	94.5	19.1	89.0	9.8	22	0.85	100.8	7.9	106.4	16.4	48	1.51
Short Term Memory	86.8	10.5	88.5	16.4	22	0.30	96.6	9.8	99.9	16.4	48	0.83
Composite	91.3	12.7	83.7	10.9	22	1.52	98.4	8.7	100.8	15.1	48	0.66

Note: None of the above comparisons was significant.

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Table 3 - Children Under 1500 grams Birthweight Socio-Economic Groups *Stanford-Binet Intelligence Scale* at Four Years Twins and Singletons N = 74

		Twins		Singletons				
	SES Group	M	SD	M	SD	df	t	p
Verbal Reasoning	A	104.7	14.5	105.5	12.7	42	0.20	NS
	B	87.8	15.7	87.8	12.4	28	0.01	NS
Abstract/Visual	A	91.4	9.6	97.1	10.2	42	1.89	NS
Reasoning	B	85.1	12.6	91.0	12.1	28	1.32	NS
Quantitative	A	99.3	9.7	109.7	13.5	42	2.98	<.01
Reasoning	B	92.8	10.5	94.1	20.2	28	0.22	NS
Short Term Memory	A	97.7	9.1	103.3	10.7	42	1.88	NS
	B	85.7	10.7	87.8	20.3	28	0.35	NS
Test Composite	A	98.1	9.2	104.8	11.2	42	2.19	<.05
	B	85.4	12.1	89.3	15.4	28	0.75	NS

Category A N = Twins 24, Singletons 20 *Category B* N = Twins 13, Singletons 17

When children who weighed less than 1000 grams in the groups twin and singleton were compared for each of the area scores and Composite score, there were no significant differences between the two groups. Similarly when twin and singleton children in the category 1000-1499 grams were compared, in no instance was the difference significant (Table 2).

Results were analysed for twin and singleton children according to parental socio-economic group (A = SES groups 1 to 4, professional, highly skilled and skilled occupations; B = SES groups 5 and 6, semi-skilled and unskilled occupations).

For the Composite Score, results for the whole population produced a significant result (t (72) = 4.76, p <.001). Children with parents in the upper SES category fared significantly better than those in the lower SES group.

Consideration of the Composite Score and all area scores, produced no significant differences between twin and singleton children in parental SES category B. However, in the case of category A, results were significant for Quantitative Reasoning (p <.01) and Composite Score (p <.05), with singletons obtaining the higher mean score in each instance (Table 3).

Speech and Language

Speech and Language were evaluated by measures of Quality of Language and Intelligibility of Speech.

When all the children were classified for Quality of Language, 58.1% were average or above and 41.9% below average. In the twin group 40.5% were below average compared with 43.2% in the controls (χ^2 (1, N = 74) = 0.06, NS).

For Intelligibility of Speech, of the total group, 51.4% were average or above aver-

age and 48.7% below average. Comparison of the twin and singleton groups did not demonstrate a significant difference (χ^2 (1, N = 74) = 0.22, NS), with 51.4% of the twins and 46.0% of the singleton group below average.

Behaviour

Assessment of Attention Span and Activity Level provided measures of behaviour in the clinic setting.

Classification of all the children for Attention Span placed 70.3% in the average or above average and 29.7% in the below average categories. Differences between the twins and singletons in the numbers below average (32.4% and 27.0% respectively) did not prove to be significant (χ^2 (1, N = 74) = 0.26, NS).

Activity level during the session for 74.3% of all the children was normal, and 25.7% were more active than would be expected at this age. The difference between the twins and singletons in the numbers more active than normal (27.0% and 24.3% respectively) was not significant (χ^2 (1, N = 74) = 0.07, NS).

Parent Interview

In addition to general considerations of development, information was gathered concerning health and temperament.

There had been alterations in life circumstances since the birth of their child, for families of 10 (27.0%) twins and 18 (48.7%) singletons. These included births of siblings, deaths in the family and redundancy of a parent. The only alteration in life's circumstances that was statistically significant was in the number of subsequent siblings born. Fewer siblings were born in the case of twins compared with singletons (χ^2 (1, N = 74) = 8.88, $p < .01$).

Twenty-two (59.5%) twins and 24 (64.9%) singletons had moved from their original home. Families of singletons moved a little more often than those of twins (Mean 1.0 and 0.8 respectively, t (72) = 0.78, NS).

Thirteen (35.1%) twins and 17 (46.0%) singletons were reported to have had illness or a medical problem after discharge from the Newborn Service. These included general infections, respiratory problems, ear infections, fractured bones, heart problems and convulsions. Two areas had suitable numbers for comparison. These were respiratory illness and hearing problems. In both cases where twins were compared with singleton controls the result was non-significant (χ^2 (1, N = 74) = 0.05 and χ^2 (1, N = 74) = 0.09, NS).

Parents reported that 16 (43.2%) twins and 13 (35.1%) singletons had been readmitted to hospital since discharge from the Special Care Units. Reasons included respiratory problems, heart conditions, surgery, seizures and miscellaneous illness. The main reason given for hospitalisation was respiratory conditions, however comparison between numbers in the twin (11) and singleton (9) groups did not reach significance (χ^2 (1, N = 74) = 0.26, NS).

For 30 (81.1%) twins and 28 (75.7%) singletons there were no additional problems to those mentioned above (χ^2 (1, N = 74) = 0.32, NS). Where problems were reported they were commonly associated with feeding, speech, behaviour, motor skills, and physical development.

A number of parents described their children as different to others of the same age (for example: physical development, temperament, general development, social skills, ability to concentrate and activity level), but no differences were observed by parents of 20 (54.1%) twins and 16 (43.2%) singletons (χ^2 (1, N = 74) = 0.87, NS).

Thirty-five (94.6%) twins and 33 (89.2%) singletons participated in some type of organised preschool education programme (Fisher p = 0.34, NS).

At the time of interview 35 (94.6%) twins and the same number of singletons were toilet trained during the day. This had taken piace at a mean age of 28.2 and 30.6 months respectively (t (68) = 1.34, NS). A lesser number of children were toilet trained at night – 26 (70.3%) twins and 28 (75.7%) singletons. For these children training was complete at 29.6 and 32.2 months respectively (t (52) = 1.09, NS).

Parents described their children's temperament in a variety of ways including: quiet, placid, easily frustrated, determined, stubborn, sociable, prone to temper tantrums. When the results were analysed for twins and singletons, for traits viewed as positive or negative, there were no significant differences between the groups (χ^2 (1, N = 74) = 0.99).

A large number of children in both groups were rated by parents as generally positive in temperament, (22 (59.5%) twins and 20 (54.1%) singletons). No singletons and only 3 twins were described as negative in mood (Fisher p = .12, NS). Parents reported 32 (86.5%) twins and 33 (89.2%) singletons as easier than average or about average to manage, while 5 twins and 4 singletons were more difficult than average because of their temperaments (Fisher p = .50, NS).

When parents' perceptions of their children's activity level were divided into high compared with medium and low, 11 (29.7%) twins and 7 (18.9%) singletons were rated as having a high activity level (χ^2 (1, N = 74) = 1.17, NS).

Eleven (29.7%) twins and 6 (16.2%) singletons were rated as easily distractible compared with variable and non-distractible (χ^2 (1, N = 74) = 1.91, NS).

The majority of children were viewed as persistent or variable in maintaining specific activities, with only 5 (13.5%) twins and 3 (8.1%) singletons rated as non-persistent (Fisher p = .38, NS).

DISCUSSION

Several studies have pointed out differences between twins and singletons so far as development and language are concerned, however this research does not support these observations in the case of VLBW children. The most important contribution of the present study was the finding that twins and singletons did not demonstrate significant differences in the areas assessed. Rather, a feature of the comparisons was their similarities rather than their differences.

Birthweight was "controlled" in so far as subjects in both groups were all <1500 grams at birth. As twins are typically low birthweight, differences reported in some studies may be a result of the over representation of immature births in the twin group. Results tended to substantiate the contention that differences between twins and singletons demonstrated in past studies may have been influenced by this imbalance [1].

Cognitive development, as measured by the *Stanford-Binet Intelligence Scale (1986)* did not differ significantly in a comparison of the twins and singletons. Further analyses

comparing similar weight groups (< 1000, 1000-1499 grams) produced no significant differences. These results are in keeping with those of a study [7] which reported no significant differences between preterm twins and singletons in cognitive outcome (*Bayley Scales of Infant Development, 1969*), at 18 months post-term. Further, investigators found that multiple gestation was not related to increased morbidity in a large group of infants with birthweights ≤1250 grams who were followed to school age [5].

However, when the socio-economic status of the subjects was taken into account by dividing each group into high and low SES two significant differences did appear, both were in the high SES comparisons. In each instance high SES singletons did better in the area score Quantitative Reasoning and in the Composite Score than high SES twins. Performance on the first of these measures Quantitative Reasoning, may indicate knowledge of number facts and skill, knowledge of mathematical concepts, and ability to analyse word problems [11]. The Composite Score provides a measure of general cognitive functioning and is based on the assessment of all four area scores.

Explanations for the above differences are not clear. It may be, in the case of Quantitative Reasoning, that benefits are to be obtained from more direct and individual interaction and it is difficult to provide this when two children of the same age are involved.

Other assessment in the Clinic of speech, language and behaviour did not produce any significant differences between the singleton and twin groups. This is noteworthy in the light of the folklore and research which has presented twins as frequently having difficulty with language and presenting with behaviour problems.

Information on general considerations of health was obtained from parents. This not only gathered useful data for comparison purposes but it also provided an opportunity for the views of the parents to be included in the study.

Of all the information relating to life circumstances and health, covering areas such as mobility, illness, hospitalisation, pre-school attendance, toilet training, differences to other children and problems identified by the caregivers, there was only one significant difference between twins and singletons. Not surprisingly, parents of twins were less likely to have another child following the birth of the child included in the study.

In the area of temperament or personality the patterns of descriptions or views expressed by parents did not differ significantly for the two groups. Proportions in the different categories for attention span, positive and negative behaviour, activity, persistence and general temperament were similar for both groups.

From the results obtained it may be concluded that in this <1500 grams birthweight population for the areas assessed there was little evidence that the twins were developing differently from the singletons.

Further, this study illustrates the need to carry out a number of carefully designed comparison investigations directed at clarifying some of the views held concerning the development of twins. Here birthweight was controlled and the results were informative.

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