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LONG-TERM OBSERVATION OF QUADRUPLETS

THE BRISTOL QUADRUPLETS

Twenty-four-Year History

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A 24-year-study has been made of female quadruplets, two homozygous and two heterozygous, delivered by Cesarean section at 36 weeks gestation to a gravida 2 with severe preeclampsia and hydramnios. The babies were small for gestational age.

The development, management, education, and social environment are described. All are above average height, and physical and emotional problems have been few. The intelligence and education attainment of the first (also the smallest) baby are in the superior range, the others were high average. Two girls have married, one of whom has two normal sons.

Quadruplets were born at Southmead Hospital, Bristol on 12th June 1948. The father, aged 27 years, was employed as a farm labourer; his wife was aged 27 years. An elder daughter born in March 1946 was healthy. There were twin pregnancies in both parents' family histories; the father's maternal aunt had a pair of boy/girl twins and the mother's maternal grandmother had twin girls regarded as identical, all of whom survived and were normal.

The mother's last menstrual period was 10th October 1947. Her abdominal girth was considered excessive from the early months of the pregnancy, so that multiple pregnancy was suspected, but an X-ray taken at 5 months did not support this. Three weeks prior to delivery her blood pressure was observed to be rising. On 10th June 1948 she had well-marked evidence of preeclamptic toxemia with blood pressure 170/100, marked edema and albuminuria; she complained of blurred vision and headache. During the next 24 hours the blood pressure rose to 180/105, and the abdominal circumference at the umbilicus measured 120 cm. X-ray on 11th June showed four fetuses.

Owing to the severe preeclampsia, rapid delivery seemed essential. Four female infants were delivered by classical Cesarean section on 12th June using general anesthesia with cyclopropane, nitrous oxide and oxygen. The first three babies cried at once and quickly established regular breathing. There was some difficulty in rupturing the fourth amniotic sac so that the fourth child remained limp and cyanosed and did not gasp for 4 minutes. Aspiration, laryngoscopy and oxygen by catheter effected regular respiration by 7 minutes. The infants were transferred to the premature-baby unit where they were nursed in cots heated to 90° F fitted with oxygen tents.

The second and third children (Frances and Elizabeth) appeared to be identical twins. The first (Bridget) and fourth (Jennifer) were clearly dissimilar. The measurements at birth are shown in Table 1.

The placenta measured 36×23 cm. There was a roughly circular central portion, diameter 23 cm with a chorion and 2 amniotic sacs and 2 umbilical cords attached at some distance apart. Attached at one side of this central placenta was a second, 15×13 cm, quadrilateral in shape, separated by a well-marked groove on both surfaces, with a separate chorion and amnion and one cord. It seemed likely that, owing to the difficulty in rupturing this sac, this placenta belonged to the 4th fetus. About one third of the large central area was marked off by a slight straight ridge arranged cord-wise, the fourth cord arose from this and there was a separate amnion; the chorion of this section was fused with the large central chorion where these were in contact. It was therefore assumed that 3 ova were fertilised resulting in one pair of uniovular twins and 2 heterozygous children¹. The blood groups of the parents and quadruplets were as follows (National Blood Transfusion Service Report, 27.4.57):

Father: A_1 Rh genotype: cde/cde, Ns — p+
 Mother: A_1 Rh genotype: CDe/CDe, MS+ P+
 All Quadruplets: A_1 Rh genotype: CDe/cde, MNS+ P—

Feeding was begun at 12 hours, some esophageal tube feeding being necessary during the first 4 days. Expressed human milk was used for the first 3 weeks, then gradual weaning to modified dried cow's milk. Additional vitamins A, D and C were started at 7 days, an iron supplement at 4 weeks, and mixed feeding with baby cereals and vegetable broth and purées by spoon were added from 3 months.

The home environment before the birth of the quadruplets comprised a small country cottage with two rooms, no electricity, gas or indoor piped water supply and no water-borne sanitation, and the family income was very low. After the birth of the quadruplets, the local authority provided a new council house with electricity, and all modern facilities at a reduced rent. The babies remained in hospital for the first three months to await completion of this home.

The children made uninterrupted physical progress and their development proceeded normally in locomotion, speech-hearing, adaptive and personal-social behaviour. At 8 months they were sitting unsupported, manual manipulation was normal and the children were alert and responsive to their environment.

At 1 year they pulled themselves up to stand and were walking unsupported at 13-14 months. The twins remained considerably heavier (Table 2) and were more advanced in locomotor development but there was no obvious difference at 2 years in fine manual skills or speech.

X-rays of the wrists were carried out at 3 months and 1 year and showed normal ossification.

At 2 years all could run, climb on to a chair and a wooden climbing frame. They were starting to throw a ball, scribbling with the right hand holding the pencil correctly for age, turned pages of a book and looked at the pictures. They had very good spatial recognition and were able to fit 6×3 -dimensional shapes in to appropriate slots in the "posting box toy". Speech had a good variety of single words and 3-word phrases.

At 3-5 years the usual skills were acquired and all achieved right-hand dominance by 3 years.

¹Watson-Williams E.J. 1949. The Good quadruplets. III - Notes. Bristol Med. Chir. J., 66: 17-19.

Table. *The Bristol Quadruplets: Physical Measurements*1. *At birth*

	Weight (kg)	Length (cm)	Head (cm)	Hb % (7 days)
1. Bridget	1.750	40.5	30.5	140
2. Frances	1.820	40.5	30.5	140
3. Elizabeth	2.000	44.5	32.0	152
4. Jennifer	1.780	39.0	30.5	136

2. *At 1 year*

	Weight (kg)	Length (cm)	Head (cm)
1. Bridget	8.9	70	46.5
2. Frances	11.0	74	46.5
3. Elizabeth	11.2	75	48.0
4. Jennifer	8.4	70	46.5

3. *At 21 years*

	Weight (kg)	Height (cm)
1. Bridget	55.0	166.0
2. Frances	54.0	170.7
3. Elizabeth	53.0	170.2
4. Jennifer	53.5	177.8

Regular oral inspection by a dental consultant showed that up to 5 years they all remained free from caries and occlusion was relatively normal, except in Bridget, who had a degree of mandibular recession similar to her mother. The dentition and occlusion in the twins was identical.

HEALTH AND PHYSICAL DEVELOPMENT

Throughout the first year the children had no illness. Immunisation for diphtheria and pertussis was given at 5-8 months. Smallpox and B.C.G. vaccination at 4 months. The birth-weight differences were maintained (see Table 2: measurements at 1 year) till adolescence, but there was little height difference after 3 years.

At 2 years all had measles, Jennifer had a convulsion at the onset of the fever. All had infective hepatitis in the 4th year and, during later school years, chicken pox and mumps. Frances and Elizabeth had tonsillectomy at 9 years for recurrent tonsillitis. They were found to be myopic and wore glasses from 9 years and were fitted with contact lenses at 16 years. Bridget resembled her mother in facial appearance and in general somatic type, and started orthodontic treatment for recession of mandible and protruding premaxilla at 11 years; she had a tendency to catarrhal otitis media with colds, and tonsillitis. Tonsillectomy was performed at 15 years.

At 10 years, Bridget was physically more advanced and about 1.5 cm taller than the others, and menarche occurred at 10 years 6 months. She appeared to be educationally, emotionally and socially about 1 year ahead of her sisters and from then onwards she separated herself from them both at school and for leisure activities. Within the next year Jennifer became the tallest. Menarche was reached by the others as follows: Elizabeth and Frances, 11 years 4 months and 11 years 5 months. Jennifer, 11 years 8 months.

The ultimate growth by age 21 years is shown in Table 3. It will be noted that Jennifer, who was the smallest child at birth, became very tall and in somatic type resembled her father. The twins resembled each other very closely in size and facial appearance. Elizabeth was always the ring-leader in infancy. She attempted new physical skills first. In adult life she again tended to resume authority on the death of the mother.

EDUCATION

At 5 years primary-school education began and progressed well so that all could read before 7 years. IQ scores (Terman-Merrill form L) at 7 years and on two subsequent occasions were: (1) Bridget 119, (2) Frances and (3) Elizabeth (identical twins) 112, (4) Jennifer 119. The elder sister scored 104 at about the same age.

During the ninth year, the parents moved to a small dairy farm in a more rural area which necessitated changing the primary school. Although no serious learning problems were encountered, the children were probably understimulated, became bored with school and their education attainments fell considerably below their potential. Although apparently well adjusted, they acted as a group in school, which often caused distraction in the class and the playground.

Until they left school, the family, the local community and the general public treated the children as a group and invariably included the older sister in all their private and public activities, but their parents had considerable insight into their individual aptitudes and interests. They were dressed alike, and were always given similar treats and toys. For their first thirteen years this was a very poor family financially, as the father was a low-paid farm worker until he was able to develop his own small farm during their adolescence. However, they gained experience of farm life and became competent pony riders.

Secondary education began at 11 years 3 months, in a large school where each child was placed in a different class. In the class of most able children, Bridget developed independently and achieved higher academic attainment than her sisters. She remained at school till 17 years, taking a secretarial course during her last year.

The homozygous pair were separated and became extremely disturbed. Frances had recurrent abdominal pain, capricious appetite, insomnia and no weight gain for 6 months for

which no organic cause was found; she was unhappy and depressed in a class with children of poor ability. Child guidance treatment relieved her anxiety and when reunited with her twin sister in another class she resumed good health quickly. Jennifer, Frances, and Elizabeth remained at school till 16 years, making average progress. They all learnt to play the piano and Jennifer the violin.

ADULT LIFE

The family travelled widely in Britain and abroad on sponsored holidays and the girls also showed enterprise with independent travel. On leaving school they established their individuality as shown by different hair styles, clothes and leisure activities, and their childhood rôle as quadruplets was resented. Although there were strong emotional ties with their fairly large extended family in the neighbourhood, the girls trained for careers away from home.

Bridget became secretary to a lawyer, married at 20 years a training college lecturer and lives in a country town near the farm.

Frances trained as a groom for horses and married a local farmer during her twentieth year. Two pregnancies resulted in normal sons, birth weights 6 lb 12 oz, and 5 lb 12 oz. Elizabeth went as a nursery nurse to California, U.S.A., and Boston, Mass., and also attended technical college part-time for further studies. After returning home in 1969 for the 21st birthday celebration she continued as a nursery nurse with a British family in West Germany and became engaged to be married to a soldier in Autumn 1972.

Jennifer trained in kennel management and is employed in a large dog breeding establishment.

The mother of the quadruplets was intelligent, active and had many interests outside the home. Unfortunately she was unable to control excessive obesity and heavy smoking and in October 1971 she died from a sudden subarachnoid hemorrhage. The father is still alive and healthy. The elder sister is married and has two healthy children.