LOW INTELLIGENCE AND OBSTETRIC COMPLICATIONS*

BY

D. J. P. BARKER

Department of Social Medicine, University of Birmingham

Investigations into the association between low intelligence and obstetric complications have been inconclusive. Dayton (1930) wrote that "the literature on mental deficiency is replete in its references to difficult labour as an aetiological factor in the production of intelligence defects". But in a retrospective inquiry he found no evidence that abnormal deliveries were associated more frequently with the births of subnormal children. Pasamanick and Lilienfeld (1955) looked at the birth records of subnormal children in Baltimore and concluded that "the pre-natal and paranatal records of mentally defective children born in Baltimore between 1935 and 1952 showed significantly more complications of pregnancy and delivery, prematurity, and abnormal neonatal conditions than a similar number of matched controls. The non-mechanical abnormalities such as bleeding during pregnancy and toxæmia appear to be important factors in this association rather than the mechanical factors of delivery previously described". Stott (1957) claimed that "pregnancy troubles might be responsible for a large, and probably the greater part of the retardation" of the subnormal children whom he was studying. Rauramo, Grönross, and Kivikoski (1961) obtained the delivery reports of pupils in a school for backward children, and concluded that there was a raised incidence of forceps delivery, breech birth, toxæmia of pregnancy, and prolonged labour.

It is difficult to assess the results of these studies because they are based on comparisons between unrepresentative samples of subnormal children and control groups which do not seem adequate. These methodological difficulties were largely overcome by

Fairweather and Illsley (1960). They identified the majority of subnormal children born in Aberdeen during a single year and compared their birth histories with those of the entire population born in the city in the same year. They concluded that "the direct contribution of recognized obstetric complications to the total volume of mental handicap is small". But, although they showed that the importance of obstetric complications had been exaggerated, they studied only 66 subnormal children and were unable to identify particular complications associated with subnormality.

The findings described below are based on a study of 607 subnormal children for whose low intelligence there is no known cause. These children were drawn from a population of 73,687 single births for whom obstetric data were recorded at the time of birth.

METHODS

POPULATION OF CHILDREN

The population comprised all children born in Birmingham during the years 1950-4 (multiple births excluded) who lived in the City until the age of 5 years. Obstetric data have been recorded for all births in Birmingham since 1950 and health visitors have recorded the subsequent medical histories of the children (Charles, 1951).

There were 94,476 total births during the 5-year period, from which the following were excluded:

- (1) Stillbirths;
- (2) Deaths under 5 years of age;
- (3) Children untraced by health visitors one year after birth;
- (4) Children known to have left the City between the age of 1 and 5 years;
- (5) Twins and triplets.

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There remained a population of 73,687 children who were still in Birmingham when they reached school age (5 years).

ASCERTAINMENT OF CHILDREN OF LOW INTELLIGENCE

The following procedure was used to identify children whose performance on intelligence tests was subnormal.

"Intellectual subnormality" was defined as an Intelligence Quotient (IQ) of less than 75 (using the Terman-Merrill revision of the Stanford-Binet Intelligence Scale Forms L and L-M). At the time of the survey the children studied were aged from 9 to 14 years and the intellectually subnormal were therefore in one of three educational categories:

(1) Those unsuitable for education (in the care of the Public Health Department with the majority living at home).

(2) The educationally subnormal (ESN) (usually attending special schools for the educationally subnormal but occasionally in special schools for children with physical handicaps such as cerebral palsy or epilepsy).

(3) Those on the borderline of subnormality (the least accomplished children in primary or secondary schools).

It was not possible to identify children in the last category and the sources of ascertainment were therefore restricted to the Public Health Department and the Special Schools Section of the Education Department.

The records in these departments permitted identification of 753 intellectually subnormal children from the population. 237 of these children had been classed as unsuitable for education, and 516 were attending special schools. Together they represented 1.0 per cent. of the population, a lower incidence than would be expected from the results of some other surveys (Penrose, 1963).

There seem to be three ways in which ascertainment of subnormal children may have been incomplete. First, it was not possible to identify borderline subnormal children and this has undoubtedly resulted in a deficiency at the higher levels of subnormal intelligence. But inquiries have shown that it is exceptional for a Birmingham child with an IQ of less than 65 to go through primary school unascertained, and the deficiency is probably confined to the IQ range 65 to 74. At this level children who are ascertained probably differ from those who are not. For example, teachers may refer unintelligent boys for special schooling more readily than they refer unintelligent girls, and dull children with

physical deformities or disorders of temperament will be singled out sooner than others.

A second cause of incomplete ascertainment results from the lapse of time between the entry of a subnormal child into a primary school and the referral of the child to an ascertaining clinic. Since the survey's population is composed of children who entered schools in Birmingham at the age of 5 years, but are not known to have remained there subsequently, it is probable that some subnormal children left the city after reaching school age and before ascertainment as ESN or unsuitable for education. It is difficult to obtain precise information about the number of such children, but it is probably small. Although ascertainment of subnormal children was spread over the entire primary school period, it was maximal between 5 and 8 years and declined sharply thereafter, so that the average age of ascertainment of ESN children was $7\frac{1}{2}$ years and that of children unsuitable for education was 6 years. Over 75 per cent. of all subnormal children were ascertained before the age of 9 years. There are no data to show the rate at which Birmingham-born children move from the city while they are attending primary schools, but information about the emigration rate of pre-school children shows that there is a decline with increasing age, and less than 2 per cent. of those born in 1950-4 left the city when they were 4 years old. It seems reasonable to assume that, with the entry of children into primary schools, families become less mobile; and it is unlikely that there are more than 35 subnormal children who should have been included in the study but left the city before ascertainment.

A third possible cause of defective ascertainment is the care of subnormal children in private institutions without the knowledge of the local authority. There are three reasons for thinking that the number of children cared for in this way is very small:

(1) The City's School Attendance and Bye-Laws Department makes an unusually thorough annual census of all children in the city, and since the population which is being studied comprises children who were born in the city and spent their pre-school years there it is improbable that many were untraced.

(2) Birmingham contains no private institutions for the intellectually subnormal.

(3) Goodman and Tizard (1962), studying the prevalence of imbecility and idiocy in London and Middlesex, found that few children attending private institutions were unknown to the Health Department. This finding was made in an area where local authority ascertainment of subnormal children

seems to present more difficulties than in Birmingham, since 16 per cent. of mongols were not notified until after the age of 10 years.

MEDICAL HISTORIES

Medical histories of the subnormal children were obtained from two sources: records made by medical officers working for the Education and Public Health Departments, and hospital records.

Since the children had lived in Birmingham from the time of birth until ascertainment, it seemed probable that when they had visited hospitals, either as in-patients or as out-patients, they would usually have gone to hospitals within the city. A search was made for the name of each child in the index register of every Birmingham hospital that admits or has clinics for children, and details of each admission or visit were inspected. 87 per cent. of children who had been found unsuitable for education, and 52 per cent. of ESN children, had been examined by a paediatrician on one or more occasions. A further 6 and 19 per cent. respectively had been seen by consultants in other specialties.

The information obtained from these sources enabled identification of 146 children who either had conditions known to be associated with subnormality, or had had diseases such as meningitis to which subnormality can confidently be attributed. These 146 children (Table I) were removed from the subnormal group whose records were analysed. The 607 subnormal children who remained were regarded as having "non-specific" subnormality.

NORMAL SIBS

Names, dates of birth, and school histories of all sibs in the families of subnormal children were obtained, but attention was restricted to sibs who belong to the population being studied (*i.e.* children born in Birmingham between 1950 and 1954 (excluding multiple births) who remained in the city until the age of 5 years). At the time of this inquiry all these children, excepting those born during the last quarter of 1954, had become eligible to take the "11+" examination. The results of this examination were made available and the scores of sibs were obtained.

Candidates have to take two verbal reasoning tests. These are a form of group intelligence test and the actual scores obtained are adjusted so that the average score is 100 and the standard deviation is 15. For the purposes of this study "normal intelligence" was defined as a mean score of 75 or more on the two tests. Such a score corresponds to one of about 80 or more obtained on an individual intelligence test.

TABLE I
PATHOLOGICAL CONDITIONS TO WHICH LOW INTELLIGENCE IS ATTRIBUTED IN 146 OUT OF A GROUP OF 753 SUBNORMAL CHILDREN

Pathological Condition	Subnormal Children		
	Unsuitable for Education	Educationally Subnormal	Total
Mongolism	57	4	61
Microcephaly* .. .	20	4	24
Tuberculous .. .	1	3	14
Meningococcal .. .	1	4	
Influenzal .. .	0	1	
Lymphocytic .. .	0	1	
Pyogenic, organism unidentified .. .	1	0	
Unknown .. .	2	0	12
Hydrocephalus .. .	7	5	
Acute encephalopathies .. .	7	4	11
Degenerative encephalopathies .. .	1	0	1
Cretinism .. .	1	3	4
Maternal rubella in first trimester of pregnancy .. .	3	0	3
Oxycephaly .. .	1	2	3
Encephalocele .. .	2	0	2
Head injury (followed by neurological signs of cerebral damage) .. .	1	2	3
Psychosis .. .	2	0	2
Laurence-Moon-Biedl-Bardet syndrome .. .	1	0	1
Turner's syndrome .. .	1	1	2
Gargoylism .. .	1	0	1
Phenylketonuria .. .	1	0	1
Cerebral calcification of unknown cause .. .	0	1	1
Total .. .	111	35	146

* Microcephaly was defined as a head circumference of 3 or more standard deviations below the average for the age and sex of the child. The figures of Westropp and Barber (1956) were used.

By this means 180 subnormal/normal sib pairs were identified for special study. Subnormal children who have normal sibs are not typical of subnormal children as a whole (they differ for example in parental fertility), and conclusions made from comparison of normal and subnormal sibs must take account of this.

RESULTS

The 607 subnormal children have been divided into three groups, according to their IQ: below 50; 50 to 64; 65 to 74. A division has been made at 65 because ascertainment of children above this level is known to be incomplete. The division at 50 corresponds with the traditional demarcation between imbecility and feeble-mindedness, and it has been shown to separate, approximately, two groups of subnormal children who have important differences.

The incidence of obstetric complications in the three groups has been compared with that in the whole population and in normal sibs.

ANTENATAL DISEASES

Table II (overleaf) shows the incidence of toxæmia, non-toxic ante-partum haemorrhage (APH),

TABLE II
INCIDENCE OF ANTENATAL DISEASE, BY IQ GROUP

IQ Group	No. of Children	No. with Details of Pregnancy Known	Percentage with			
			Tox-aemia	Non-Toxic APH	Anaemia	Pyelitis
Below 50	123	116	11.2	3.4	4.3	1.7
50 to 64	198	186	8.1	1.6	7.0	2.2
65 to 74	286	272	6.6	1.5	6.2	1.1
Whole Population of Single Births	73,687	68,846	9.0	1.9	4.8	1.7

anaemia, and pyelitis in pregnancies which preceded the births of the subnormal children; Table III shows the incidence of the same diseases in pregnancies preceding the births of the sib pairs (composed of one normal and one subnormal child).

TABLE III
INCIDENCE OF ANTENATAL DISEASES IN SIB PAIRS, BY IQ GROUP

IQ of Sub-normal Sibs	No. of Sib Pairs	Sibs	No. with			
			Tox-aemia	Non-Toxic APH	Anaemia	Pyelitis
Below 50	32	Sub-normal	5	1	0	0
		Normal	5	1	1	0
50 to 64	54	Sub-normal	3	1	3	2
		Normal	5	0	2	0
65 to 74	94	Sub-normal	2	2	9	0
		Normal	4	6	5	3

In the compilation of the birth records, the coding "toxaemia" was applied to all cases of hypertension or albuminuria during pregnancy. There is no apparent increase in the frequency of toxaemia in association with subnormality. But the incidence of toxaemia in the population falls from 13.4 per cent. during first pregnancies to 7.2 per cent. during second pregnancies, and the proportion of first-born children in the subnormal group is smaller than in the population. In Table IV the observed number of pregnancies complicated by toxaemia and resulting in a subnormal child is compared with the number which would be expected if the birth rank distribution of the subnormal children was the same as that of the population. There is no evidence that toxaemia and subnormality are associated.

Tables II and III show that there is no association between non-toxic ante-partum haemorrhage and

TABLE IV

OBSERVED INCIDENCE OF TOXAEMIA AND EXPECTED INCIDENCE AFTER CORRECTION FOR BIRTH RANK, BY IQ GROUP

IQ Group	No. with Details of Pregnancy Known	No. with Toxaemia	
		Observed	Expected
Below 50	116	13	11
50 to 64	186	15	16
65 to 74	272	18	23

subnormality. "Non-toxic antepartum haemorrhage" is a description that was applied to antepartum bleeding which resulted from many causes but was not associated with toxaemia, and even some cases of threatened abortion were classified in this way. One can draw only the general conclusion that disturbance of the placenta which results in bleeding during pregnancy, and which is not associated with toxaemia, does not lead to subnormality in the foetus.

This conclusion can be made more specific in so far as the inspection of delivery records enabled a distinction to be made between placenta praevia and bleeding from other causes. Four pregnancies which resulted in subnormal children were complicated by placenta praevia (one child had an IQ below 50, two had IQ's from 50 to 64, and one had an IQ between 65 and 74). This corresponds to an incidence of 6.6 per 1,000 children and may be compared with the incidence of 3.9 per 1,000 confinements which Record (1956) estimated for the population born in Birmingham between 1942 and 1952. The excess of two subnormal children with placenta praevia seems too small to justify a conclusion that the conditions are associated.

All types of anaemia were grouped together as "anaemia" and measurements of the haemoglobin level and other blood indices were not recorded. In the IQ groups 50 to 64 and 65 to 74, there is a small increase in the number of children whose mothers had anaemia during pregnancy. In the population the frequency of anaemia during pregnancy rises from 3.8 per cent. in mothers of Social Classes I and II to 6.0 per cent. in mothers of Social Classes IV and V. Allowing for the excess of the latter, the expected incidence of anaemia in both subnormal groups is 5.2 per cent., compared with the incidences of 7.0 and 6.2 per cent. that have been observed. There is also a slight excess of subnormal sibs who resulted from pregnancies complicated by anaemia.

In Tables II and III there is no evidence of a relationship between "pyelitis" (a category that

includes all non-tuberculous urinary tract infections) and intellectual subnormality.

PRESENTATION AT THE ONSET OF LABOUR

Table V shows the type of presentation at the onset of labour. In each IQ group there is a small excess of breech presentations. This is partly a result of the increased number of subnormal children who were born before term, since in the population there were 4.5 per cent. of breech presentations among children who were born before the 38th week of gestation and only 2.1 per cent. among those born after this time. But when an allowance has been made for the length of gestation, there remains an excess of one breech presentation in each of the two lower IQ groups and an excess of four in the upper IQ group. The number of such presentations in subnormal sibs does not exceed that in normal ones (Table VI).

TABLE V

TYPE OF PRESENTATION AT ONSET OF LABOUR, BY IQ GROUP
Percentage distribution

IQ Group	No. with Type of Presentation Recorded	Type of Presentation					
		Normal Vertex	Occipito-posterior	Brow	Face	Breech	Caused by Transverse Lie
Below 50	115	87.8	7.8	0.0	0.0	3.5	0.9
50 to 64	181	92.3	3.3	0.0	0.6	3.3	0.6
65 to 74	267	94.0	1.5	0.0	0.4	4.1	0.0
Whole Population of Single Births	68,185	92.5	4.8	0.1	0.2	2.2	0.2

TABLE VI

OCCIPITO-POSTERIOR AND BREECH PRESENTATIONS IN SIB PAIRS, BY IQ GROUP

IQ of Subnormal Sibs	No. of Sib Pairs	Sibs	No. of Presentations	
			Occipito-posterior	Breech
Below 50	32	Subnormal	1	1
		Normal	2	1
50 to 64	54	Subnormal	0	1
		Normal	1	0
65 to 74	94	Subnormal	1	2
		Normal	3	4

Occipito-posterior presentation does not seem to be associated with subnormality. Although there is a small increase in the frequency of this presentation

in the lowest IQ group, the frequency in the other two groups is below that in the population. Among sibs there are in every group fewer subnormal than normal children who presented in this way (Table VI).

Neither face nor brow presentations, nor presentations caused by a transverse lie, are more frequent among subnormal children.

TYPE OF LABOUR

This was classified to show whether the onset was spontaneous or induced, and whether delivery was spontaneous, instrumental, or by Caesarean section.

The results (Table VII) suggest that instrumental delivery is not related to subnormality; but no allowance has been made for the association between this method of delivery and primiparity. In the population the percentage of instrumental deliveries falls from 8.8 in first births to 1.5 in second ones. After correction for the birth rank distribution in each IQ group, there is no excess of these deliveries among subnormal children.

TABLE VII

METHOD OF DELIVERY, BY IQ GROUP
Percentage distribution

IQ Group	No. with Method of Delivery Recorded	Method of Delivery			
		Spontaneous	Instrumental	Caesarean Section	"Other"
Below 50	117	92.3	4.3	2.6	0.9
50 to 64	189	93.1	2.1	3.2	1.6
65 to 74	277	96.0	1.1	1.8	1.1
Whole Population of Single Births	69,693	93.7	3.8	2.2	0.2

Similarly, although the results in Table VII suggest that Caesarean section is not related to subnormality, a correction has to be made for the increase in frequency of Caesarean section from 1.3 per cent. in mothers under 20 to 6.1 per cent. in mothers over 40. After this correction there remains no evidence of association between this method of delivery and subnormality.

In the classification of type of labour a category "other" denoted labours and deliveries which were considered unusual. This category was not strictly defined but its most frequent use was for labours which ended in breech extractions. Of the 163 children in the population who were born after "other" types of labour seven are subnormal. It seems unlikely that abnormal labour caused subnormality in two of these seven children. One has five

educationally subnormal sibs; the other has anal atresia and was therefore damaged during early intra-uterine life. But none of the other five has either a family history of subnormality or a congenital defect, and it seems probable that their low intelligence is at least in part a consequence of obstetric complications. Their birth histories are summarized in Table VIII.

TABLE VIII
CHILDREN DELIVERED BY "OTHER" METHODS
(TABLE VII, COL. 6), BY IQ GROUP

IQ Group of Child	Description of Antenatal History and Labour	Birth Weight of Child (lb. oz.)	Condition of Child after Birth
Below 50	Mother had rachitic flat pelvis. Threatened abortion. Spontaneous onset of labour at 29 weeks. Cord prolapsed; internal version and breech extraction performed	2 12	Retrolental fibroplasia Spastic diplegia
50 to 64	Mother had flat pelvis and history of three previous miscarriages and one stillbirth; labour precipitate at 38 weeks	3 1	Normal
65 to 74	Precipitate labour; child delivered into a bucket	8 0	Bruised on head Vomited blood for 4 days after birth
	Maternal and foetal distress during second stage; breech extraction performed	7 12	Described as showing signs of cerebral irritation
	Toxaemia followed by eclamptic fit during second stage of labour; breech extraction performed	6 1	Normal

ABSENCE OF A QUALIFIED BIRTH ATTENDANT

The observations on the type of attendant present at the birth (for example hospital midwife or general practitioner) showed cases where birth had occurred before the arrival of a qualified attendant. This happened in 2.1 per cent. of births in the population but during the births of subnormal children it was more frequent (Table IX).

TABLE IX
CHILDREN BORN IN THE ABSENCE OF A QUALIFIED ATTENDANT, BY IQ GROUP

IQ Group	No. with Circumstances of Birth Recorded	Per cent. Born in Absence of a Qualified Attendant
Below 50	122	2.5
50 to 64	196	5.1
65 to 74	285	6.7
Whole Population of Single Births ..	73,062	2.1

Among the subnormal/normal sib pairs delivery in the absence of a qualified attendant occurred more often during the birth of the subnormal than of the normal children (Table X).

TABLE X
ABSENCE OF QUALIFIED BIRTH ATTENDANT AND CONDITION AFTER BIRTH IN SIB PAIRS, BY IQ GROUP

IQ of Subnormal Sibs	No. of Sib Pairs	Sibs	No. Born in Absence of Qualified Birth Attendant	No. with Birth Injury and/or Asphyxia
Below 50	32	Subnormal Normal	0 1	2 0
50 to 64	54	Subnormal Normal	5 3	3 0
65 to 74	94	Subnormal Normal	7 4	1 1

BIRTH INJURY AND ASPHYXIA

A single coding was used to denote children who showed signs of trauma or asphyxia at birth. Therefore children who for example had cephal-haematoma or were unusually cyanosed after birth were coded in the same way. It is possible to make only general conclusions from such data. Nevertheless the excess of subnormal children with "birth injury and/or asphyxia" is striking. It is present in all IQ groups (Table XI), and it also shows in the comparison between normal and subnormal sibs (Table X). Table XII gives details of the condition at birth of subnormal children with birth injury and/or asphyxia.

TABLE XI
INCIDENCE OF "BIRTH INJURY AND/OR ASPHYXIA", BY IQ GROUP

IQ Group	No. whose Condition at Birth was Recorded	Per cent. with Birth Injury and/or Asphyxia
Below 50	117	6.8
50 to 64	191	5.2
65 to 74	282	3.5
Whole Population of Single Births	69,841	2.2

TABLE XII
ANALYSIS OF SUBNORMAL CHILDREN WITH "BIRTH INJURY AND/OR ASPHYXIA", BY IQ GROUP

Description of Child's Condition	IQ Group			
	Below 50	50 to 64	65 to 74	Total
Cephalhaematoma ..	1	2	1	4
White asphyxia ..	0	1	1	2
Cerebral irritation ..	0	1	2	3
Cyanosis (with or without convulsions) ..	6	3	4	13
Unspecified	1	3	2	6
Total	8	10	10	28

DISCUSSION

These results suggest that recognized complications of pregnancy and labour play little part in the aetiology of low intelligence. They confirm the findings of Fairweather and Illsley (1960), but they do not support the conclusion of Pasamanick and Lilienfeld (1955) that toxæmia and bleeding during pregnancy cause low intelligence.

There was a small increase in the incidence of anaemia during pregnancies which preceded the births of children with IQ's above 50. This increase persisted after adjustment to allow for the association of anaemia with Social Class. But correction for Social Class probably does not make adequate allowance for the unusual social circumstances of many of the families of mildly subnormal children; and the data do not justify conclusions about the association between anaemia and subnormality.

A small excess of breech presentations was found in each IQ group; but among sibs breech presentations were not more frequent for subnormal than for normal children. Breech delivery may be a rare cause of subnormality. Among subnormal children with IQs above 50, the excess of unsupervised births was quite marked, and subnormal sibs were more often affected than normal ones. However, many of the parents of these children are themselves of low intelligence, and they may delay before they call a midwife. Therefore, while an unsupervised delivery could lead to cerebral damage and consequent subnormality, it may be that the absence of a qualified assistant at the birth of a subnormal child only reflects the low intelligence of the family into which the child is born.

There is evidence that recognized obstetric complications have contributed to the low intelligence of the five children described in Table VIII and perhaps of a small number of children who were delivered as breeches or in the absence of a qualified attendant. These do not account for the excess of subnormal children recorded as showing signs of birth injury or asphyxia: there remains a small group whose birth was uncomplicated, who did not show frank signs of trauma such as cephalhaematoma, but who showed signs which might have reflected either the effects of asphyxia during birth or the consequences of damage to the brain sustained at some stage before the onset of labour.

SUMMARY

607 children with subnormal intelligence of unknown cause were identified in a population of 73,687 single births for whom obstetric data had been recorded.

Recognized abnormalities of pregnancy and delivery seemed to play little part in determining subnormality. The births of five children were associated with unusual obstetric complications and three other children had cephalhaematoma—direct evidence of birth injury.

There was a small excess of breech presentations among subnormal children, and subnormality above an IQ of 50 was associated with a slightly increased incidence of anaemia of pregnancy and delivery in the absence of a qualified attendant. The aetiological significance of these factors was not established.

Contrary to findings in other enquiries there was no evidence that toxæmia or ante-partum haemorrhage caused subnormality.

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