A Review of the Histories of Children with Minimal Cerebral Dysfunction

Although many factors have been thought to contribute to the development of minimal cerebral dysfunction (MCD), the aetiology of the condition has not been clearly specified. The existence of MCD can be associated with behavioural, emotional or educational problems, so that control of contributing factors can have important implications for the child. As part of a broad study of MCD carried out in the Department of Physiotherapy, University of Queensland, historical data were collected for 1,020 children who attended the MCD clinic. A comparison of the incidence of each of these factors with that in the normal population, highlighted a number of features which could bear further study.

Minimal cerebral dysfunction (MCD), known also as Minimal brain dysfunction (MBD) or minimal neurological dysfunction (MND), has been acknowledged to exist since the 1800's (Kussmaul 1877 in Schain 1972, Morgan 1896 in Schain 1972). In children so diagnosed, the performance of physical activity is affected by minor sensory and motor problems. In addition, behavioural and emotional difficulties often develop (Meier 1976, Ackerman, Roscoe, Dykman and Peters 1977, Langhorne and Loney 1979) and in some cases, learning difficulties occur (Bish and Waugh 1976, Meier 1976).

Many factors have been thought to predispose to MCD. For example, stressful perinatal events including anoxia and prematurity have been linked with MCD by a number of authors (Fidone 1975, Cantwell 1976, Tudehope and Thearle 1984). Genetic predisposition seems to be involved in certain families, while other factors such as heavy metal poisoning (Crawford 1966, Meier 1976), infection and parental age (Ackerman et al 1977) have been proposed as having a contributing effect on the development of MCD in some groups of children.

In order to identify the aetiological factors which may predispose to MCD and the development of its associated problems, a retrospective study was undertaken in the Department of Physiotherapy, University of Queensland. It was thought that analyses of certain historical factors might help not only to clarify the background against which MCD develops, but also to highlight areas where further research might be beneficial.

Data Collection

The data for this study were collected from the files of 1,020 children who had been assessed as having minimal cerebral dysfunction at the MCD research clinic in the Department of Physiotherapy. As part of the assessment of these children, a questionnaire had been used to record certain historical and aetiological factors. This provided the vehicle from which data could be collated. Twice during the span of time over which the 1,020 children were admitted to the clinic, the questionnaire had been expanded. For this reason, the total number of subjects providing data for each question varies between 400 and 1,020. Parents completed the questionnaire with help from the physiotherapist if necessary.

Children assessed were aged between 9 months and 16.6 years at initial assessment, the mean age being 7.2 years. Two-thirds of the total group of children were in the first three grades of Primary School when first assessed.

Information was collected in several major areas, including demographic, prenatal, perinatal, medical, developmental, educationally-related and type of intervention, for each of which a number of different questions were asked.

To provide a basis for determining whether any particular factor might have a significant bearing on the development or presentation of MCD, similar data for the general Queensland or Australian population were collected wherever possible. In many instances, however, no such data appear to exist.

Results

The relevant details for each child were entered into the computer in prescribed format and analyses undertaken to determine the relative incidence of the various factors.
Tabulation of the percentage incidence within the group of children for whom the data were available, in each case, provided a means of overviewing the historical factors. These can be considered under each of the major areas reviewed.

Demographic Factors

Eight demographic factors were considered. These included the ages of the mother and father at the child's birth, the occupational status of the main provider, place in family, the number of siblings, whether the child was an adopted or natural child and the age and sex of the child.

Both the mothers' and the fathers' ages at the time of the child's birth fell within a wide range, the means being 26.6 years for mothers and 29.0 years for fathers. These are very close to the ages of parents at childbirth in the general population. For example, the mean maternal age in Queensland in 1984 was 26.6 years (Births, Queensland 1984) and the mean paternal age in Australia in 1984 was 30.2 years (Births, Australia 1984).

The occupational status of the main provider was examined according to Congalton's (1969) classification. The distribution was fairly even across all occupations, indicating both that children from all socio-economic groups presented with MCD problems and that they had equal access to assessment and treatment services.

In this study, 51.7 per cent were first born, 28.6 per cent were second and 12.2 per cent were third born children. These figures differ from those recorded for Queensland births in 1984, where 40 per cent were first children, 34.7 per cent were second, and 16.4 per cent were third (Births, Queensland 1984). This supports the suggestion that first born children may be more susceptible to developing problems associated with minimal cerebral dysfunction.

Children who were one of twins comprised 4.07 per cent of the study group. It is interesting to note that while 64 per cent of the other twins were normal, 32 per cent had minimal handicaps and 4 per cent died. A comparison with the incidence of twins in the general population reveals that the incidence in the MCD group is unusually high. For example, in Queensland in 1984, twin births occurred in only 0.96 per cent of nuptial confinements, and the expected incidence of twin births is 1 in 90 births (Tudhope and Thearle 1984). Twins are frequently delivered prematurely and the outcomes of prematurity include the development of MCD (Tudhope and Thearle 1984). Hence with twinning being a feature in MCD children with a frequency of almost four times the normal figure, this particular factor is also one which might be considered further.

Eight per cent of the MCD children were adopted, and this is a much higher proportion than that found in the general population. For example, in Queensland in 1984, 174 children under the age of 12 months were adopted, while 40,446 children were born, so that the adopted children comprised only 0.43 per cent of those born (Births, Queensland 1984). The fact that the percentage of adopted children in the MCD group was 19 times that in the general population is worthy of note. Very little perinatal information was available for adopted children, and this might be a fruitful avenue for research.

It is acknowledged that there are limitations in questioning parents about certain perinatal factors was also noted. Factors recorded associated with increased risk to the child at birth included prematurity, dysmaturity, caesarion section, forceps delivery, cord around neck, abnormal presentation, twin birth, respiratory problems, humudicrib nursing, jaundice, transfusion, low birth weight, too rapid or protracted delivery. It was found that of the 670 children who were acknowledged as being exposed to a perinatal risk factor (e.g. just over 50 per cent), quite large proportions of children were exposed to up to five perinatal factors (43.2, 24.6, 17.3, 7.0, 5.8 per cent for 1, 2, 3, 4 or 5 factors respectively). A few children were involved in even more risk factors than this. This high incidence of single and multiple risk factors in the perinatal history of MCD children indicates that there may be a need for further investigation in this area.

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Histories of Children with MCD

prenatal and perinatal events. Illingworth (1963) suggested that posing the questions can give an exaggerated idea of the importance of perinatal factors to parents and warned that the memory of events suffers with time. On the other hand, Bale (1981) considered memory to be no problem in gathering data, as he found that parents' recollections of details coincided well with medical records.

Medical Conditions

The existence of any of a number of medical problems was recorded for the children. The collated data as tabulated in Table 1, revealed that over one-third of the children had had recurrent middle ear infections in childhood. Statistics for the normal population show that although about 80 per cent of children have one episode of middle ear infection by school age, at most 16 per cent are likely to have recurrent infections (Ballantyne and Groves 1971, Jolly 1976). It appears therefore that the incidence of middle ear infections is twice that in the normal population. It should be noted that the presence of middle ear infections is often connected with poor concentration and attention and with learning difficulties (Herscher 1978). Surprisingly, it was found in this study that despite recurrent ear infections, many children had not had their hearing tested. Seven per cent had a hearing loss, and this is apparently greater than normal. Specific information and medical confirmation of the type and extent of the reported losses were not available, and highlights the problem of parents' understanding of medical terms in such questionnaires.

Noting the 4.2 per cent with such infections as encephalitis and the 18.1 per cent reporting serious events such as traumatic head injury (usually at a young age), drowning or severe convulsions (not epilepsy), it can be appreciated that 22 per cent of the children had experienced major events after birth which could predispose to the development of later dysfunction. Despite the absence of comparative normal data, this figure seems very high, and it is worth considering whether inherent clumsiness may have contributed to the accident rate in early childhood.

It is interesting to observe that over one third of the children for whom responses were available about general anaesthetic, had required this procedure. Normative data for such events is difficult to find. However it appears that the figures for general anaesthetic and major events after birth could be high, and further exploration of these factors could provide valuable insights.

Developmental Factors

Parents were questioned about behaviour and development patterns of their child. Only 51 per cent of babies and 60 per cent of toddlers were felt to be normally active. Thus almost half of the children were perceived as being abnormally under or over-active as babies or toddlers. It is interesting to note however that, as babies, 26 per cent were considered to be under active, as compared with 6 per cent when toddlers. On the other hand, as babies, 20 per cent were perceived as being over-active, this number increasing to 34 per cent when applied to the toddler age group. While the behaviour of babies was reported by parents as being a problem in 36 per cent of cases, the incidence of behaviour problems in toddlers was seen as being considerably greater than this (48 per cent). Since toddlers are by nature more active and hence, often more difficult to manage than babies, it is difficult to know whether the behaviour problems increased with time or whether parents become more aware of their existence during the toddler age period. However, it is significant that such a large proportion of the children were regarded by parents as exhibiting behaviour problems at these early stages. Bale (1981) reviewed the literature regarding the accuracy of information provided by parents about aspects of their children's development. In his own study he noted that independent records confirmed the information provided by parents.

During babyhood, over half of the infants (38 per cent) showed normal motor development, 39 per cent exhibiting a delay. However, in the toddler age group, more delay in attaining motor milestones had become apparent, with 59 per cent of toddlers showing some problem. This trend towards more delay with age was further demonstrated in the fact that by pre-School age, 68 per cent of the children showed both fine and gross motor problems. It must be remembered that this was a retrospective study and thus 32 per cent of children were considered to be normal in their fine and gross motor skills at this stage, although at a later stage, they presented with motor problems associated with MCD.

From these figures, it is apparent that patterns of dysfunction may be present far earlier than the first School years, suggesting that referral for management could be made as soon as abnormal patterns are noted consistently, particularly when motor delays are involved.

Educationally Related Factors

A number of factors related to education were recorded for the MCD children. These included the type of School attended and whether the child received remedial teaching. The existence of similar education problems in other members of the family was noted. In addition, details of ability to concentrate, hand dominance and hyperactivity and the degree of parents' success in reducing hyperactivity were recorded.

Ninety-three per cent of the MCD children attended a normal School, with a further 1.2 per cent attending special classes while enrolled in a normal School. The proportion of 5.3 per cent attending a special School is greater than that for the general population. The group of children at special School included some who failed to succeed in normal School despite apparently adequate intelligence, as well
as some children whose poor performance scores (associated with their MCD) caused on overall lowering of scores on intelligence tests despite stronger verbal skills. The relationship between learning disability (LD) and MCD has been well documented despite its being a confusing issue (Peters, Dykman and Ackerman 1973, Denkla and Rudel 1976, Silver 1976). Some predisposing factors are common to both MCD and LD, including prenatal and perinatal problems, prematurity, genetic and biochemical factors and infection. The large percentage (44.1) of children receiving remedial teaching in this study is indicative of the overlap which can exist between MCD and LD, and in line with established patterns well documented in the literature (Coleman 1968, Kappelman, Kaplan and Ganter 1969, Silver 1976). This incidence is much higher than normal as only 10-11 per cent of children are usually involved in remedial teaching in the Primary School system, a figure which matches the 10-11 per cent incidence of Learning Difficulties (LD) noted in the normal population by various authors (Denhoff 1968, Myklebust and Boshes 1969, Tarnopol 1969).

For 73 per cent of the group, parents reported that their child had concentration problems. While 32 per cent were assessed as being hyperactive, it was noted that in only 7.8 per cent of these could the hyperactivity be reduced by parents. The establishment of hand dominance had not been achieved in 26 per cent of the children, a very large incidence in view of the mean age of the group, and the fact that 66 per cent of the children were in grades 1-3 inclusive.

**Styles of Management or Intervention**

It was felt that examination of the styles of management or intervention to which the children had been exposed at initial physiotherapy assessment could reveal some interesting patterns. Forty-three per cent of the children had been reviewed by either a paediatrician or a neurologist, although these were not the sources of referral to the MCD clinic in many instances. Orthopaedic review had been sought for 9.6 per cent of the children, and this seemed to be due largely to the parent's perception of an awkward gait or running style. Over 20 per cent of children had undergone behavioural assessment by a psychologist or psychiatrist. This is an understandable figure when the number of children with minimal neurological problems who also develop social and behavioural problems is considered (Meier 1976, Ackerman et al 1977, Langhorne and Loney 1979).

The fact that 25 per cent of children had received E.N.T. assessment reflects the large number of children with recurrent ear infections noted previously, as well as the number of children who had hearing problems or had demonstrated a lack of auditory attention. Some form of visual assessment (e.g. by an Ophthalmologist, Optometrist or an Orthoptist) had been carried out for 26 per cent of the group. Evidently many parents perceive a problem with visual attention or strain, or consider that a fine reading or writing problem may be related to eye problems.

General practitioners had ideal opportunities to identify children with minimal neurological problems, since 78 per cent of the children had regularly attended one practitioner or one medical group. Once again, however, a corresponding proportion of referrals to the MCD clinic did not come from this source. Almost one third of the children had some previous contact with speech therapy, occupational therapy or physiotherapy, by far the largest group (21 per cent) having received speech assessment. Very few children (1.9 per cent) had attended another motor-based program (such as ANSUA). While almost 9.0 per cent had been trialled on drug therapy, fourteen per cent had used dietary management, usually in the form of the Feingold diet.

Educational assessment by a psychologist or a guidance officer had been carried out for 44 per cent of children. This suggests that educational problems and school failure were major problems for this large group of children. The proportion of children receiving such assessment coincides with the percentage of children who were receiving remedial education, as discussed earlier.

**Conclusions**

It is obvious from these analyses that there are a number of historical features which appear with a different frequency in MCD children to that in the general population. Particular features which could be worthy of further investigation include the developmental outcome of twins, the early background of children who are adopted, the influence of certain prenatal and perinatal factors on development, the effects of middle ear infections and the need for their early treatment. The possibility of earlier referral of children showing delay in motor milestones, hyperactivity or behaviour problems for developmental assessment and management might also be considered. Further, the frequency with which children with MCD are found in remedial education classes suggests the need to look closely at those referred to guidance officers for educational or behavioural problems, with a view to identifying neurological deficits which may be contributing to or associated with these other difficulties.

Much more research needs to be undertaken in this field. It is hoped that the facts revealed by this analysis will help to point the way to other studies which could help in the understanding and management of children with minimal cerebral dysfunctions.

**References**

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Bale P (1981), Pre-natal factors and backwardness in reading, Educational Research, 23(2), 134.
Fidone O (1973), Recognizing the precursors of failure in Schools, Clinical pediatrics, 14(8), 768.
Herscher R (1978), Minimal brain damage and otitis media, Perceptual and Motor Skills, 47(3), 723-726.
Peters SE, Dykman MA and Ackerman T (1973), The special neurological examination in research on minimal brain dysfunction, Exerpta Medica, Princeton, New Jersey.
Schein RJ (1972), Neurology of Childhood Learning Disorders, Williams and Wilkins Co., Baltimore.
Tavassoli L (1969), Learning Disabilities, Charles C. Thomas, Springfield Ill., USA.
Tudehope D and Thearle MJ (1984), Primer of Neonatal Medicine, William Brooks, QLD.