Studies on Physical and Mental Growth of Prematurely Born Children

Series II. Mental Development, Part 6
Results of Intelligence Testing for Nine Consecutive Years from the First Grade of Primary School to the Third Year of Junior High School*

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The present paper described the results of over-all evaluation on the follow-up study for nine consecutive years from the 1st grade of primary school to the 3rd year of junior high school. The prematurely born children were consistently more inferior in intellectual development when compared with matched control group of maturely born children. Especially, the retardation in intellectual development was most marked in the prematurely born children from lower social grade homes.

Since 1955, the department of public health to which the authors belong has conducted a nine-year follow-up study on the physical and mental development of 150 prematurely born children, and of 302 maturely born children as a matched control group. Thorough investigations were performed each year starting from the 1st grade of primary school until they reached the 3rd year of junior high school (at ages from 6 to 14 years). The intelligence tests (TANAKA B or New

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MENTAL GROWTH OF PREMATURE CHILDREN

TANAKA B Tests) were given for nine consecutive years on 91 premature and 171 mature children.

ETO\textsuperscript{5} has already published the detailed results of the intelligence tests for these 262 children in the Psychiatria et Neurologia Japonica (Vol. 68, No. 5, pp. 609–628, 1966, in Japanese) as the original paper. Then again, the present paper will attempt to describe the salient points of these results, reported by ETO\textsuperscript{5}.

MATERIALS and METHODS

In the present paper, the results of the intelligence tests given for nine consecutive years on 91 premature and 171 mature children were synthetically discussed from both standpoints of birth weight and social grade.

There are no significant differences in the distribution of social grades by birth weight for these 262 children shown in Table 1.

Table 1 Distribution of social grades by birth weight (%)

<table>
<thead>
<tr>
<th>Social Grade</th>
<th>Upper</th>
<th>Middle</th>
<th>Lower</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2199 and under</td>
<td>6(21.4)</td>
<td>19(67.9)</td>
<td>3(10.7)</td>
<td>28(100.0)</td>
</tr>
<tr>
<td>2200–2499</td>
<td>14(22.2)</td>
<td>35(55.6)</td>
<td>14(22.2)</td>
<td>63(100.0)</td>
</tr>
<tr>
<td>2500–3099</td>
<td>24(23.8)</td>
<td>66(65.3)</td>
<td>11(10.9)</td>
<td>101(100.0)</td>
</tr>
<tr>
<td>3100 and over</td>
<td>19(27.2)</td>
<td>39(55.7)</td>
<td>12(17.1)</td>
<td>70(100.0)</td>
</tr>
<tr>
<td>Total</td>
<td>63</td>
<td>159</td>
<td>40</td>
<td>262</td>
</tr>
</tbody>
</table>

Notes: (1) This follow-up study has started in 1955. In Japan, the international definition of a premature infant (live-born infant with birth-weight of 2500g. or less) has been adopted since 1958.

(2) $x^2 = 0.602$, df = 3, $0.08 < p < 0.90$

Intelligence Standard Scores (I.S.S.) for these 262 children at each school age were divided into the following three Intelligence Levels:

(1) superior level : $> (M + \frac{1}{2} \sigma)$

(2) average level : from $(M + \frac{1}{2} \sigma)$ to $(M - \frac{1}{2} \sigma)$

(3) inferior level : $< (M - \frac{1}{2} \sigma)$.

And then, finally over-all evaluation on the Intelligence Levels for 9 consecutive years was conducted by the following methods:
1. Superior Level: the children who were on the average level for 5 years and over.
2. Higher Average Level: the children who were on the average level for 5 years, and on the superior level for 3 years and over.
3. Average Level: the children who were on the average level for 5 years and over.
4. Lower Average Level: the children who were on the average level for 5 years, and on the inferior level for 3 years and over.
5. Inferior Level: the children who were on the inferior level for 5 years and over.

RESULTS and DISCUSSION

All children were divided into four groups according to their birth weight. The mean I.S.S. of these four groups fell steadily with decreasing birth weight at 9 consecutive school years studied (Fig. 1). And then, distribution of the Intelligence Levels for these four birth weight groups.

Note: Differences of mean I.S.S. among four birth weight groups are statistically highly significant by the analysis of variance.
was indicated in Figure 2. Percentage of the children with Superior Level increased markedly with increasing birth weight. In other words, percentage of the children with Inferior Level increased markedly with decreasing birth weight.

In both premature and mature groups, the intellectual development fell steadily with decreasing social grade. In each social grade, the prematurely born children were consistently more inferior in the mean I.S.S. and in the distribution of Intelligence Levels when compared with the maturely born children.

The mean I.S.S. of the mature children from upper social grade homes was consistently on the superior level, and that of the premature children from lower social grade homes was consistently on the inferior level throughout 9 years from the 1st grade of primary school to the 3rd year of junior high school.

The mean I.S.S. of other four groups, namely — mature children from middle social grade homes, premature children from upper social grade homes, mature children from lower social grade homes and premature children from middle social grade homes — lay between the above-mentioned two groups (Fig. 3 - 4).
Fig. 3 Mean I.S.S. at each school year for premature and mature children by social grades

![Graph showing mean I.S.S. at each school year for premature and mature children by social grades.]

Primary School    Junior High School

Note: Differences of mean I.S.S. between premature and mature children in the same social grade, and differences among three social grade are statistically highly significant by the analysis of variance.

Fig. 4 Percentage distribution of Intelligence Levels for premature and mature children by social grade

![Graph showing percentage distribution of Intelligence Levels for premature and mature children by social grade.]

From the findings obtained it seems likely that the handicaps on intellectual development due to premature birth are lessened to some extent if there are favourable factors in living condition.

A considerable amount of research has been conducted regarding the intellectual development of prematurely born children. Wiener noted in his review of the literature that recent studies find low birth weight children impaired as regards measures of intelligence (I.Q.). From Baltimore, Knobloch et al. (1956) and Harper et al. (1959) reported the findings that low birth weight children as a group, are psychologically impaired at 40 weeks of age and at
3–5 years of age. Furthermore, Wiener et al.\textsuperscript{10} (1965) confirmed this at 6–7 years of age.

In the Edinburgh Study, Drillien\textsuperscript{4} reported her following findings on intelligence testing in school: results were very similar to those found in the preschool period, with a marked excess of dull, retarded and defective children in those who were 4 ½ lb. or less at birth, more particularly if there were additional adverse factors in living condition. Prematurely born children were more likely to be working below their intellectual capacity in school than maturely born children of like intelligence from similar homes.

Blegen,\textsuperscript{23} Alm\textsuperscript{13}, Dann et al.\textsuperscript{3}, and McDonald\textsuperscript{8} have shown that I.Q. is highest among premature babies coming from the higher social classes.

The findings in our follow-up study are consistent with those in other investigators discussed here.

**SUMMARY**

From the findings reported so far it seems likely that intellectual development during the ages from the 1st grade of primary school to the 3rd year of junior high school depends on biological factors such as birth weight on the one hand, and also on social factors such as social grade and social environment on the other hand. It was concluded that the improvement of maternal health service and social environment, including living condition is necessary for the better mental development of children.

**REFERENCES**

1) Alm, I. : *Acta Paediat.*, 42 : No. 94 (1953)
2) Blegen, S. D. : *Acta Paediat.*, 41 : 1 (1952)