

Child Developmental Delay and Socio-Economic Disadvantage in Australia: A Longitudinal Study

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Abstract

Socio-economic inequalities in adult and child health in Australia have been an issue of national concern. While a large body of data has discussed adult health, there have been relatively few Australian reports of socio-economic inequalities in child health. This occurs in a context where there have been increases in the proportion of Australian children living in poverty and where there has been an increased interest in child developmental delay as an indicator of child health status. This paper reports the result of a longitudinal study of pregnancy outcomes and one indicator of child health, namely child developmental delay. Three indicators of socio-economic status (chronic socio-economic disadvantage, mother's education, family income) were used to predict child developmental delays observed some 52 years after the study commenced. Mothers who had the lowest socio-economic status (using any of the indicators) had substantially higher rates of children manifesting developmental delays.

Keywords: socio-economic; developmental delay; child health; longitudinal study

Introduction

There has been much recent concern with the possibility that socio-economic inequalities in adult health are paralleled by similar inequalities in child health. The existing body of data describing socio-economic inequalities in child health are equivocal, with some papers noting significant class effects [1, 2] while others have not observed such associations [3, 4]. This paper takes data from a large scale longitudinal study of child health, development and behaviour to determine whether different indicators of social class are related to one measure of child health, namely the child's intellectual development.

Background

An extensive body of literature has shown that child mortality and some measures of child morbidity are inversely associated with a variety of indicators of socio-economic inequality [1, 5-14]. While the overall impact of socio-economic inequality on child health has been documented, there is a strong case for additional research in Australia based upon a number of factors:

- (i) There have been major changes in the pattern of child morbidity with a decline in the importance of infectious diseases and- an increased concern with the proportion of paediatric problems which involve "developmental delays, learning difficulties and emotional and behavioural problems" [15]. These latter paediatric problems have been described as the 'new' morbidity of children, partly because such concerns now comprise a significant proportion of paediatric clinical contacts.
- (ii) Some recent studies have questioned whether children living in socioeconomically disadvantaged circumstances have worse health [4, 8, 16]. It is not clear whether this

lack of an association is real or attributable to the selection of particular indicators of social class or child morbidity.

- (iii) If indeed children living in socio-economic disadvantage have higher levels of morbidity, then there is a need for research which provides details of the magnitude of these morbidity differentials.
- (iv) Despite the availability of numerous overseas studies associating child health and socio-economic disadvantage, there have been relatively few such Australian studies and fewer still which address the 'new' morbidity of child development and behaviour.
- (v) There have been important socio-demographic changes in Australia which point to an increase and change in composition of the group living in socio-economic disadvantage. Not only does recent data suggest a substantial overall increase in the numbers living in socio-economic disadvantage, but Australia now has the second highest rate of child poverty of all OECD countries [17]. This increase is largely attributed to a growth in proportion of families receiving social service benefits as their main source of income (e.g. single mothers, the unemployed).

This paper reports the results of a longitudinal study of the Mater-University of Queensland Study of Pregnancy and its Outcomes (MUSP) [18]. It describes the association between various indicators of a mother's socio-economic status and the developmental level of her 5-year-old child.

Socio-Economic Status and Child Development

The term development embraces the concept of the unfolding of normal language, cognitive, motor and social skills—all of which are relevant to the child's educational and social progress in contemporary society. Of course, normal language, cognitive, motor and social skills are arguably culture specific and, within the context of this study, may be measuring middle class conceptions of ability and development. Yet it is this inability of their child to succeed or progress in terms defined by the existing value system, that is of concern to parents. Abnormal development has both clinical and theoretical significance and is the subject of this research. It is also recognised that there is a major genetic component to development which sets limits on what can be achieved, but it is also clear that, within these genetic constraints environmental factors have been found to play a substantial part.

Although previous studies differ in their sampling, research designs and approaches to measurement, they consistently confirm the existence of an association between socio-economic status and child development [7, 8, 10-12, 19]. Thus twins or closely related children, raised in socially advantaged circumstances, have been found to have increased IQ scores and decreased scholastic failure compared to siblings raised in more adverse economic circumstances [20, 21]. The classic study of black children born to socio-economically disadvantaged parents, but raised in white middle-class homes suggested IQ scores increased with the length of time the child was resident in the middle class white home and indicated that the increase in intelligence scores could be as great as one standard deviation (16 points) equivalent [22]. White [23] has reviewed some 200 studies which report positive and statistically significant associations between socio-economic status and children's school achievement.

Although there have been few Australian studies those by Johnston [16], Share *et al.* [24] and Amato [25] have all confirmed the existence of an association between parental SES and child development and/or ability. The relationship between developmental delay and social adversity has been confirmed, both internationally and locally [14, 16, 26, 27]. Longitudinal studies have further added to our understanding of the association between SES, child development and ability. The Newcastle-Upon-Tyne study [12] found that the older the child, the more likely the child's general intelligence and growth (development) were likely to respond to the type of environment in which it is reared. Data from the British Child Health and Education Study [6] of 13,135 children pointed to the importance of parental

social background influencing, in a complex manner, the intellectual development of the child. Groups in socio-economic disadvantage experienced over-crowding, poorer household amenities and shorter tenure of residence. It was the combination of effects which was perceived to influence negatively subsequent child development.

Consistent with the above pattern of results, mild mental retardation has also been found to be associated with lower socio-economic status [12, 28]. Cross sectional studies overseas and in Australia have shown that socio-economic status and child development are positively associated and various longitudinal studies have suggested that the association is probably causal. This paper aims to develop our understanding of the aetiology of child developmental disabilities by considering data from an Australian longitudinal study using various measures of socio-economic status and inequality to describe more clearly the associations previously documented by others.

The Measurement Of Socio-Economic Status

Three (at least) approaches to socio-economic stratification can be identified and considered in the context of understanding variations in child development. Firstly, it has been suggested that chronic socio-economic status disadvantage is likely to be of primary importance in influencing subsequent health and development. The British Child Health and Education Study [6] and the Kauai Study [8] used socio-economic indices which aggregated various types of socio-economic disadvantage. Such an approach aims to distinguish what might be described fairly as a social underclass, a group of families outside the mainstream of society. The implication of this approach is that it is neither money alone, nor educational background, nor residential circumstances that are important in the genesis of child developmental delay, but a history of chronic disadvantage. This measure seeks to detect a social underclass whose health and development may have been compromised over an extended period of time.

A second approach focuses on income inequalities and child development. Lower income groups are simply compared to middle and upper income groups to assess whether there are developmental differences. The implication of this approach is that income socio-economic status, an important indicator of a family's ability to organise and manipulate its environment, directly or indirectly influences a child's intellectual development. Those with the lowest incomes will presumably buy less adequate food supplies, poorer accommodation, etc. If income inequalities were a prime determinant of child developmental delays, then social policies which reduce these inequalities would be advocated. Income in this study is assessed at the first clinic visit, some 51 years before the developmental assessment of the child.

A third approach would identify the nature of the relationship between parent and child and suggests that the education level of the main child carer is critical in influencing the child's health and development. More educated parents would be expected to provide greater intellectual stimulation and to create a home environment which encourages and facilitates the child's development. As the mother remains the child's primary care giver in most families, it is likely that her education level will have the strongest impact on the child's development. It could follow that policies to improve parents' education levels are likely to have the most substantial impact on child health and development. It could be argued that income and other inequalities will be reduced only after education inequalities have been addressed. The education of the mother is assessed at the first clinic visit, some 52 years before the developmental assessment of the child.

Data and Methods

Sampling and research design

Data analysed in this paper were gathered as part of a longitudinal study of 8556 pregnancies at one of the two major obstetric hospitals in Brisbane, Australia. Details of sampling, data collection and response rates are reported elsewhere [18]. Table 1 provides details of the loss of follow-up of women who gave birth to a live child at the study hospital. Some 69% of the women were successfully inter-viewed at the 5 year follow-up. Not surprisingly, less educated women, lower income women, not previously married women, those of nil parity or still teenagers at the first clinic visit were more likely to be lost to follow-up. All the differences in Table 1 are statistically significant ($P < 0.05$). Despite these consistent differences, many are of relatively modest magnitude. Data were obtained in four phases. Women were initially enrolled in the study at their first antenatal clinic visit. They completed a second questionnaire three to five days after the birth of their baby, a third questionnaire when the baby was six months old and a fourth when the child was five years old. Data analysis was undertaken with the SAS package [29] and Tables 3 and 4 involve the use of the program CATMOD which provides odds ratios of selected outcomes.

The measurement of developmental delays

Two commonly used tests of child development were administered to the children at their 5 years-of-age follow-up; the Denver Developmental Screening Test (DDST) and the Peabody Picture Vocabulary Test (PPVT). In most instances (except where circumstances demanded otherwise, i.e. a home visit) these were administered in controlled conditions by a paediatrically trained researcher. While both these tests are widely used, some questions of their validity have been raised.

Table 1. Sample attrition for 5-years-of-age follow-up (% lost as a proportion of those giving birth)

	At Enrolment	At Birth	At 5 yr
Education (TOT)	(8369)	(7614)	(69%)
Up to Grade 10	1572	1434	64%
Finish High School	4519	4128	70%
Some Tertiary Education	2278	2052	71%
Family Income (TOT)	(7855)	(7149)	(70%)
\$0-199 p/w	2805	2512	61%
\$200-399 p/w	4210	3873	74%
\$400+ p/w	840	764	75%
Marital Status (TOT)	(8368)	(7610)	(69%)
Single, live together	1940	1736	55%
Married	6183	5661	74%
Previously married	245	213	50%
Parity-at first visit (TOT)	(8556)	(7775)	(68%)
NIL	2789	2562	63%
1 and 2	4130	3765	69%
3 Plus	1637	1448	66%
Mother's Age (TOT)	(8458)	(7689)	(69%)
13-19 yr	1130	1031	56%
20-34 yr	6880	6256	71%
35yr+	448	402	63%

A thorough review by Miesels [30] of the validity of the DDST reports an excellent test

specificity, but a poor test sensitivity. In other words, the DDST identifies a very high proportion of normal subjects who are correctly excluded from further assessment or evaluation, but selects only a small proportion of individuals who are truly at risk.

Miesels criticisms of the DDST include a comment that the DDST may be attempting too much in trying to summarise the first 6 years of human development in a 105 item test, which is weighted towards younger children, i.e. 2-3 years. Despite these concerns the DDST remains the most used measure of developmental delay and for this reason was one of the measures used in this study.

Table 2. Association between socio-economic status and development of the child in a sample of Brisbane mothers (Kendall's Tau-B)

	Socio-economic disadvantage	Mother's education	Family income
Peabody Picture Vocab. Test	-0.15*	-0.17*	-0.13*
Denver Test	-0.08+	-0.06†	-0.09†

* $P < 0.0003$; † $0.01 < P < 0.07$.

The Peabody Picture Vocabulary Test was revised in 1981 (PPVT-R [31]) and is often used to measure a subject's vocabulary, revealing the extent of English vocabulary acquisition. The PPVT-R has been found to be useful in school, clinical, vocational and for research contexts. In schools, it is used as a screening test for bright, low ability and language impaired children.

In the PPVT-R, subjects look at a series of cards each with 4 pictures on them and are asked to identify which of the pictures depicts a word spoken by the administrator. The raw score on the PPVT-R is converted to a standard score and then compared with others in a similar age group (refer [31]).

The PPVT-R correlates significantly with other scores of child intelligence such as WISC-R, WAIS-R, SPPSI and Stanford Binet [32]. Naglieri and Yazzie add, however, that verbal IQ should not be used to identify verbal intelligence. Caution has been advocated in the use of the PPVT-R as a general intellectual screening instrument (see [33-37]). Despite its deficiencies, the PPVT remains an appropriate screening instrument to determine levels of child vocabulary development.

The measurement of chronic socio-economic disadvantage

We have indicated that various approaches to the measurement of socio-economic disadvantage are possible, and we have chosen to use three such measures. The first was chosen to identify those families which had experienced economic difficulties over an extended period (at least 5 years). To create this measure data were gathered from the four phases of the study. The first three phases take place within a year of the study commencing (Phases 1, 2 and 3). The fourth phase involved the collection of data from the 5 year old child follow-up, approximately 5; years after the study commenced. A list of the variables selected for this index of chronic disadvantage appears in the Appendix. Briefly, this index concentrated upon identifying those who had experienced low income over an extended period of time.

Response categories for each variable were dichotomised to score 1 for disadvantage or 2 for no disadvantage. The extent to which a person experienced disadvantage was obtained by summing the number of instances of disadvantage over all ten variables. Data for individuals was then examined to ensure that those with the greatest disadvantage scores were experiencing continued disadvantage over time rather than experiencing 'incidental disadvantage' during certain phases of their lives. The resulting composite variable (DISI) had

four levels of disadvantage, ranging from No Disadvantage (29.4%), Mild (48.8%) to Moderate (15.8%) to Extreme Disadvantage (6.0%, $n = 218$). A second measure was based upon the highest level of education the mother had received and distinctions are made between mothers who left school prior to completing Grade 10 and those who completed high school. The education variable was taken from the first clinic visit. The final measure of disadvantage is based upon the mother's report of the whole family income, again taken at the time of the first clinic visit.

Results

Some 78 children had abnormal Denver scores (2.2%); a further 253 (7.0%) had scores which were questionable. For the Peabody PPVT, some 153 children (4.2%) scored below 75 equivalent verbal IQ points. These figures imply that development delays are likely to be found in between 2% and 4% of the 5-year-old population depending upon the sample selected and the screening test used. The three indicators of socio-economic status are associated with the two measures of development of the child in Table 2.

The table shows significant but modest SES correlations with the Peabody Picture Vocabulary Test and weak correlations for the Denver Test (untestable group excluded).

Table 3. Socio-economic status by low Peabody score (<75.0)

	Rate per 100 women	Odds Ratio (95% CL)
Chronic disadvantage		
No disadvantage	2.4 (1065)	1.00
Mild disadvantage	3.8 (1769)	1.66 (1.04 2.65)
Moderate disadvantage	7.5 (573)	3.38 (2.04 5.59)
Extreme disadvantage	7.8(218)	3.52 (1.87 6.63)
Total	(3625)	$\chi^2 = 29.85$ $P^3 < 0.0001$
Mother's education		
Completed year 12 or more	2.8 (1005)	1.0
Completed year 10	4.0 (2004)	1.45 (0.94 2.25)
Incomplete year 10	7.3 (590)	2.74 (1.68 4.47)
Total	(3599)	$\chi^2 = 18.32$ $P^2 < 0.0001$
Family income		
\$26,000 plus	1.8 (973)	1.00
\$15,000 to \$25,999	4.4 (1721)	2.56 (1.50 4.36)
\$10,400 to \$14,999	6.5 (557)	3.89 (2.16 6.99)
\$0 to \$10,399	6.5 (276)	3.92 (1.99 7.72)
Total	(3527)	$\chi^2 = 23.46$ $P^3 < 0.0001$

Table 3 shows that there is a consistent association between a child's low scores on the Peabody Picture Vocabulary Test and the mother's three socio-economic ratings. Disadvantaged mothers have between about 3 and 4 times the rate of developmentally delayed children compared to their more middle and upper socio-economic counterparts. Women who reported the lowest family income while pregnant went on to have children with the highest risk of scoring low on the PPVT-R. It is interesting to note that mothers who report chronic economic disadvantage more often have children who score poorly on the PPVT-R. The impact of socio-economic disadvantage on the child's development is similar regardless of which measure of socio-economic status is used.

Table 4 examines the association between an abnormal score on the Denver Test and the mother's socio-economic circumstances. There are significant associations between chronic

disadvantage, family income and an abnormal score on the Denver Test. The association between mother's education and scores on the Denver approaches significance.

Denver score differences appear to be less than those revealed by the PPVT-R with the most disadvantaged groups manifesting rates of abnormal Denver scores between about 1.5 and 2.5 times those of children who are not classified as disadvantaged.

Discussion

A major reservation is that the sample is taken from a large public hospital and is thus under represented in the upper socio-economic group.

A strength however is that assessments of the child's development were undertaken blind to the mother's economic circumstances, using standard measures of development.

The results suggest that, in this Australian sample, low socio-economic status, as measured by the mother's education level, family income and measure of composite chronic socio-economic disadvantage, is associated with the development of the child. Interestingly children born to mothers who are financially poor or with little education (as measured only at first clinic visit) are as likely to manifest developmental delays as children born to parents who have been chronically disadvantaged over a long period of time.

Table 4. Socio-economic status by abnormal Denver scores (1)

	Rate per 100 women	Odds Ratio (95% CL)
Chronic disadvantage		
No disadvantage	1.2 (1057)	1.00
Mild disadvantage	2.0 (1757)	1.50 (0.85 2.65)
Moderate disadvantage	3.7 (568)	2.46 (1.30 4.67)
Extreme disadvantage	3.7 (216)	2.35 (1.00 5.51)
Total	(3598)	$\chi^2 = 9.00$ $P^3 = 0.0294$
Mother's education		
Completed year 12 or more	1.9 (996)	1.00
Completed year 10	1.9 (1990)	0.84 (0.51 1.39)
Incomplete year 10	3.6 (586)	1.52 (0.85 2.72)
Total	(3572)	$\chi^2 = 4.93$ $P^2 = 0.0849$
Family income		
\$26,000 plus	1.7 (962)	1.00
\$15,000 to \$25,999	1.9 (1715)	0.87 (0.51 1.50)
\$10,400 to \$14,999	3.5 (549)	1.86 (1.03 3.37)
\$0 to \$10,399	2.6 (275)	1.12 (0.47 2.69)
Total	(3501)	$\chi^2 = 8.16$ $P^3 = 0.0428$

These results are consistent with those of a number of previous studies [7, 8, 10-12, 19] but extend them in two ways. Firstly, they suggest that the specific indicator of SES used is relatively unimportant and that mothers manifesting socio-economic disadvantage either at birth, or throughout the first five years of the child's life, have children who are more likely to be developmentally delayed. Secondly, the results suggest that disadvantaged mothers have children who are 1.5 to 4 times more likely to- manifest developmental delays.

A substantial component of these observed differences is attributable to biological factors. This study has not distinguished, nor can it distinguish, biological from social factors. Nevertheless, previous re-search has indicated the social environment in which a child is reared can produce substantial increments (and decrements) in intellectual development. The observation that children reared in socio-economic disadvantage experience developmental delays and intellectual deficits raises basic questions to do with appropriate social and welfare policies.

These policies can be identified, in part, from a consideration of the key indicators of disadvantage, as these relate to the prevalence of child developmental delay. Thus, it is interesting that our measure of chronic socio-economic disadvantage, based upon approximately 5 years of data reflecting the long term experience of socio-economic disadvantage was no better at predicting low PPVT-R scores, than was income disadvantage. Similarly mother's education predicted PPVT-R scores, though no better than did the other SES indicators. This suggests that efforts to reduce any dimension of socio-economic inequality are likely to translate into reductions in the magnitude of inequalities in child development. The same data could be used to argue that programs directed towards disadvantaged children, which leave the magnitude of inequality unaltered-are unlikely to produce a lasting benefit. In circumstances where the proportion of children living in socio-economic disadvantage has increased substantially in recent times, there is good reason to be concerned about the impact of such a change on the nation's children.

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APPENDIX*Inter-item Associations (Cramer's V) of Variables in the Chronic Socio-economic Disadvantage Scale*

	A80	A90	A102b	B89	B96b	E95	E96b	H101b	H104	H114
A80	1.000	0.10	0.072	0.064	0.084	0.094	0.078	0.116	0.067	0.103
A90		1.00	0.148	0.130	0.187	0.262	0.164	0.138	0.144	0.179
A102b			1.000	0.101	0.368	0.142	0.327	0.084	0.134	0.116
B89				1.000	0.458	0.127	0.119	0.066	0.108	0.090
B96b					1.000	0.195	0.415	0.111	0.146	0.117
E95						1.000	0.232	0.150	0.172	0.216
E96b							1.000	0.134	0.152	0.147
H101b								1.000	0.139	0.273
H104									1.000	0.216
H114										1.000

Phase 1 (A):

- A80 Level of education of mother.
- A90 Gross family income.
- A102b Welfare benefits recipient in 6 months prior to pregnancy.

Phase 2 (B):

- B89 Serious financial problems in last 6 months.
- B96b Welfare benefits recipient in last 6 months.

Phase 3 (E):

- E95 Gross family income.
- E96b Welfare benefits recipient in last 6 months.

Phase 4 (C and D):

This was the obstetric data sheet containing details of the pregnancy record.

Phase 5 (H):

- H 101b Partners' occupational status.
- H104 Partner unemployed at all in last 5 years.
- H114 Gross family income.