RESEARCH REPORT

Socioeconomic differences in childhood hospital inpatient service utilisation and costs: prospective cohort study

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Study objective: To examine the association between socioeconomic position at the time of birth and the use and cost of hospital inpatient services during the first 10 years of life.
Design: Analysis of a database of linked birth registrations, hospital records, and death certificates. Associations between the social class of the head of household and hospital inpatient service utilisation and costs during the first 10 years of life were analysed using multilevel multiple regression modelling.
Participants and setting: All 117 212 children born to women who both lived and delivered in hospital in Oxfordshire or West Berkshire, southern England, during the period 1 January 1979 to 31 December 1988.
Main results: The study showed that children born into social classes II, III-NM, III-M, IV, and V were more likely to be admitted to hospital, spend longer in hospital overall, and generate greater hospital costs than children born into social class I. The adjusted effect regarding hospital inpatient admissions, days, and costs was 1.27 (95% CI: 1.26, 1.27), 1.20 (1.19, 1.21), and 1.50 (1.49, 1.53), respectively, for children born into social class V when compared with children born into social class I. The impact of social class on hospital inpatient admissions, days, and costs was most acutely felt during years 3–10 of life as compared with the first two years of life.
Conclusions: Health service decision makers need to be alert to the adverse sequelae that might result from socioeconomic disadvantage when planning health services for children. Particular attention should be paid to targeting deprived populations with prevention interventions that are known to be effective.

Recent government reports in the United Kingdom have called for detailed research that assesses the impact of socioeconomic inequalities on children's health.[1 2] Previous research has shown an inverse association between socioeconomic status and adverse child health outcomes. For example, routinely collected data from England show an inverse association between familial social class and childhood mortality,[3] but do not adequately account for the complex interaction of perinatal variables, such as gestational age at birth, birth weight, and maternal complications during pregnancy and delivery, which might explain mortality during the perinatal and later childhood periods. In addition, a number of observational studies conducted in developed countries have shown an inverse association between socioeconomic status and indicators of childhood morbidity, including low birth weight[4] and increased risk of congenital anomalies of non-chromosomal origin,[5] respiratory and gastrointestinal infection,[6 7] middle ear disease,[7] and dental caries.[8]

A number of studies have assessed the relation between socioeconomic status and indicators of health service use during childhood. Three studies reported no significant social class differences in the use of general practitioner, outpatient, and inpatient services by children and young people.[9–11] However, these studies were based on cross sectional surveys, which relied on parents or guardians to retrospectively recall health service use over a limited period. One study, which analysed prospectively collected data from a national cohort study, reported higher general practitioner consultation rates among children from the lowest social classes.[12] However, no study, to our knowledge, has analysed prospectively collected data with the view to establishing whether the use of hospital services by children varies by their socioeconomic circumstances. Furthermore, we are not aware of any studies that have explicitly examined whether the cost of hospital services provided to children varies by their socioeconomic circumstances. The study reported in this paper examines the association between socioeconomic position at the time of birth and the use and cost of hospital inpatient services throughout the first 10 years of life in a large, geographically defined cohort of children. By so doing, we aim to provide health service decision makers with key information that will assist them in estimating the potential economic impact of initiatives aimed at ameliorating socioeconomic influences on adverse child health outcomes.

METHODS

Oxford record linkage study

Data from the Oxford record linkage study (ORLS) formed the basis of the investigation. The ORLS is a collection of linked, anonymised birth registrations, death certificates, and statistical abstracts of NHS hospital inpatient and day case admissions for part of southern England.[13] The dataset is derived from linked hospital activity analysis and hospital episodes statistics records.[14] Data collection in the ORLS covered part of Oxfordshire from 1963 to 1965, and increased its population coverage to include all of Oxfordshire and West Berkshire from 1966, six of the eight districts of the former Oxford Region from 1975 and the whole of the former Oxford Region from 1984.[13] The ORLS perinatal, sociodemographic, and socioeconomic data were collected contemporaneously, in Oxfordshire and West Berkshire only, through the ORLS's own data collection systems.

Study population

The study population comprised all children born to women who both lived and delivered in hospital in Oxfordshire or West Berkshire during the period 1 January 1979 to 31 December 1988. The time limits arose because before 1979 much of the relevant socioeconomic information was not

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Table 1 Mean (SD) hospital inpatient admissions, after initial birth admission, by social class and period of life (n = 93657)*

	I		II		III-NM		III-M		IV		V	
Period of life	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1st year	0.17	0.52	0.20	0.62	0.29	0.73	0.25	0.65	0.26	0.66	0.31	0.80
2nd year	0.08	0.37	0.10	0.42	0.14	0.51	0.12	0.48	0.12	0.51	0.14	0.46
3rd year	0.07	0.33	0.07	0.36	0.11	0.42	0.10	0.39	0.09	0.36	0.10	0.40
4th year	0.06	0.30	0.07	0.36	0.11	0.46	0.09	0.41	0.09	0.39	0.09	0.37
5th year	0.07	0.30	0.07	0.34	0.11	0.49	0.09	0.36	0.08	0.36	0.08	0.35
6th year	0.06	0.35	0.06	0.33	0.10	0.44	0.08	0.33	0.07	0.32	0.07	0.31
7th year	0.05	0.30	0.06	0.36	0.09	0.41	0.07	0.33	0.06	0.39	0.07	0.32
8th year	0.04	0.37	0.05	0.27	0.08	0.40	0.06	0.35	0.05	0.40	0.05	0.25
9th year	0.03	0.33	0.04	0.29	0.06	0.36	0.05	0.37	0.05	0.36	0.06	0.62
10th year	0.03	0.36	0.04	0.35	0.06	0.52	0.04	0.29	0.04	0.32	0.05	0.72

*Only children alive at the start of the specified period were included within inpatient admission estimates.

routinely incorporated into the ORLS's data collection systems across Oxfordshire and West Berkshire, while a delivery cut off point of 31 December 1988 was required for follow up to cover the first 10 years of life. Over the study period, about 6% of births to residents of Oxfordshire and West Berkshire took place outside of these two areas.[15] These were not included in the analyses. The study population also excluded children who were delivered at home, because home births were not captured by the ORLS data collection systems. However, routinely collected data suggest that only 1% of all births in Oxfordshire and West Berkshire were delivered at home during the study period.[16]

Socioeconomic status

As a measure of socioeconomic status of each child, we used social class of the head of household at the time of birth, based on the registrar general's socioeconomic groups.[17] In the ORLS data collection systems, married mothers living with a husband are coded according to the husband's occupation; otherwise, the mother of the child is defined as the head of household. The registrar general's socioeconomic groups are categorised as social classes I (professional), II (managerial/technical), III-NM (skilled non-manual), III-M (skilled manual), IV (partly skilled), and V (unskilled). The ORLS data collection systems also include an ''other'' social class group, which covers armed forces, students, and entries with an inadequate description. However, comparatively few children (0.1%) fell into this category and, given that the primary objective of the study was to determine differences in hospital inpatient service utilisation and costs between children with distinct socioeconomic identities, they were excluded from the analyses.

Hospital inpatient service utilisation

A record of hospital inpatient service utilisation between birth and 10 years of age was compiled for all study children. The data extracted from the ORLS included the date of each hospital admission, including the initial birth admission, the duration of hospital stay, specialty on admission, operative procedures performed, and diagnoses recorded on discharge from hospital, based on codes from the eighth and ninth revisions of the *International Classification of Diseases (ICD)*.[18 19] Each day case admission was counted as a full 24 hour period for the purposes of this study. We calculated the total time spent in hospital by each child by summing the lengths of stay of each child's successive admissions. The estimates of hospital inpatient service utilisation did not incorporate the admissions of the study population to hospitals outside the areas covered at the relevant times by the ORLS. Previous research had indicated that 8.8% of paediatric admissions made in the former Oxford Region during the period 1979–1986 occurred outside of the child's district of residence.[20]

Hospital inpatient service costs

Hospital inpatient service costs were calculated for each hospital admission, regardless of the diagnoses recorded on discharge. The cost of each hospital admission was estimated by multiplying the length of stay by the daily cost of the respective specialty. The specialty based daily costs were based on the English Department of Health's NHS Trust financial returns (TFR2) for 1997–98 and 1998–99, which had been averaged over these two financial years to eliminate any random fluctuation in the data. For the hospital records with an unknown or incorrect specialty code, the daily medical or surgical cost was applied, depending on the approximate ORLS code range. All costs are expressed in constant £ 1998–99 sterling using the NHS Hospital and Community Health Services pay and price deflators provided by the English Department of Health.

Statistical analysis

Analyses were performed on cases for whom we had complete information on the social class of the head of household, date of death, where applicable, and indicators of service utilisation for each hospital admission. Associations between the social class of the head of household and yearly aggregates for hospital inpatient admissions, days and costs during the child's first 10 years of life were analysed using multilevel multiple regression models for each of the dependent variables separately. As Box-Cox transformations indicated a logarithmic function for the utilisation and cost dependent variables, natural logarithms were taken and a value of 0.001 added to the zero values in order to allow for these transformations. The multilevel multiple regressions were applied with repeated measures of the same person—that is, the yearly aggregates for each successive year of the child's life during the period analysed, taken as the first level, and variation between people as the second level. The multilevel analysis was chosen for its capacity to model changes over time for service use and costs by taking into account variations at intraindividual and interindividual levels through a variety of covariance structures (intraclass correlations) unavailable for simpler types of analysis. No service use in a particular year was counted as zero if the child was alive in that year and missing otherwise. Restricted maximum likelihood was implemented using the MIXED procedure in SAS software to estimate the model parameters and their standard errors on the logarithmic scale. The parameters and their 95% confidence intervals were then exponentiated to obtain adjusted effects on the linear scale. In the multilevel analysis, the second (individual) level independent variables included parity (nulliparous, multiparous), maternal weight at first antenatal visit (<45, 45–89, >89 kg), the number of cigarettes smoked by the mother during pregnancy (0, 1–9, 10–19, ⩾20), maternal hospitalised days during pregnancy (0, 1–10, 11–20, >20), complications

Table 2 Mean (SD) hospital inpatient days, by social class and period of life (n = 93657)*

Period of life	I Mean	I SD	II Mean	II SD	III-NM Mean	III-NM SD	III-M Mean	III-M SD	IV Mean	IV SD	V Mean	V SD
1st year:												
Initial birth admission	3.79	3.66	3.71	3.84	3.86	5.37	3.75	5.42	3.91	4.79	3.85	4.68
Subsequent admissions	1.15	6.29	1.34	7.70	2.07	9.77	1.74	8.07	1.85	8.43	2.42	10.86
2nd year	0.16	1.39	0.24	2.26	0.37	2.72	0.31	3.39	0.32	3.70	0.48	2.98
3rd year	0.15	2.60	0.16	1.78	0.22	1.72	0.24	2.56	0.18	1.54	0.39	6.48
4th year	0.10	0.90	0.13	1.29	0.20	1.75	0.14	1.25	0.19	2.42	0.18	1.33
5th year	0.12	1.27	0.13	1.21	0.22	2.11	0.16	1.25	0.15	1.43	0.14	1.05
6th year	0.15	7.60	0.10	1.12	0.21	3.02	0.14	1.08	0.14	1.79	0.14	1.25
7th year	0.08	0.98	0.10	1.56	0.17	3.02	0.12	0.92	0.16	3.71	0.14	1.44
8th year	0.10	2.74	0.08	1.10	0.13	1.50	0.10	1.06	0.12	3.13	0.17	2.54
9th year	0.06	1.24	0.08	1.86	0.13	2.09	0.07	0.66	0.11	2.20	0.20	8.95
10th year	0.06	1.30	0.06	1.03	0.11	1.90	0.12	4.10	0.08	1.36	0.11	2.67

*Only children alive at the start of the specified period were included within inpatient days estimates.

of delivery (no, yes), maternal operations during delivery (no, yes), mode of delivery (spontaneous, instrumental, caesarean), multiplicity of birth (no, yes), order of birth (continuous variable), gestational age at birth (<28, 28–31, 32–36, ⩾37 weeks), whether the child was small for gestational age (no, yes),[21] maternal age at the time of delivery (<20, 20–35, >35 years), whether the child was adopted or fostered around the time of birth (no, yes), and birth cohort (1979–1982, 1983–1985, 1986–1988), while the child's age—that is, the duration of survival during the first 10 years of life (continuous variable, years)—was the only independent variable at the first (measurement) level of the model. All independent variables were kept in the multilevel multiple regression models to evaluate adjusted effects for each of them, and are presented in the tables, with the exception of order of birth, which was clearly statistically insignificant in all analyses. As the focus of the paper is the association between social class and hospital inpatient service utilisation and costs, separate slopes were fitted for variations of social classes as a function of the duration of the child's survival, thus permitting estimation of the differential in the rate of change over time among social classes. The autoregressive component was tested as a fixed effect consisting of previous yearly aggregates for all models. The multilevel multiple regressions were also performed on two age stratified subgroups (0 to 2 years, 2 years plus 1 day to 10 years), after preliminary analyses that showed two years as the flexion point in hospital inpatient service utilisation and costs. We chose a significance level of 0.05 (two tailed) for all analyses.

RESULTS

Study population

A total of 117 212 children were born in hospital to women who both lived and delivered in Oxfordshire or West Berkshire during the study period. Information on social class of the head of household, date of death where appropriate, and indicators of service utilisation for each hospital admission, was available for 93 657 (79.9%) children. Of the 23 555 children excluded from the analyses, 15 416 (65.4%) were born into a social class III household, but the III-NM or III-M sub-categorisation was not recorded, while information on the social class of the head of household was unavailable for 7947 (33.7%) children and a complete record of hospital inpatient service utilisation was unavailable for 192 (0.8%) children. Of the 93 657 children included in the analyses, a total of 15 672 (16.7% of analysed sample) children were born into a social class I household, while 30 305 (32.4%) children were born into a social class II household, 23 716 (25.3%) into a social class III-NM household, 8271 (8.8%) into a social class III-M household, 12 021 (12.8%) into a social class IV household, and 3672 (3.9%) into a social class V household.

Descriptive statistics

The mean number (SD) of admissions to hospital during the first 10 years of life, after the initial birth admission, was 0.66 (1.64) for children born into a social class I household, 0.75 (1.80) for children born into a social class II household, 1.15 (2.32) for children born into a social class III-NM household, 0.95 (1.91) for children born into a social class III-M

Table 3 Mean (SD) hospital inpatient costs (£1998–99), by social class and period of life (n = 93657)*

Period of life	I Mean	I SD	II Mean	II SD	III-NM Mean	III-NM SD	III-M Mean	III-M SD	IV Mean	IV SD	V Mean	V SD
1st year:												
Initial birth admission	921.53	1085.42	906.52	1131.36	963.83	1597.97	938.73	1516.57	958.86	1294.62	924.63	1379.03
Subsequent admissions	411.39	2126.75	475.90	2765.15	698.94	3103.31	586.62	2543.69	614.76	2638.59	790.56	3402.49
2nd year	73.04	497.31	97.32	738.95	144.88	886.83	128.66	1099.87	123.77	1139.04	174.37	964.48
3rd year	69.44	1045.39	72.10	665.86	99.87	734.04	101.39	917.46	82.41	598.99	148.66	2034.23
4th year	53.55	352.07	62.53	471.63	99.22	684.36	70.27	463.22	86.29	940.45	79.69	481.46
5th year	57.68	393.61	64.80	564.93	108.13	887.36	75.29	413.38	68.87	532.55	65.54	392.04
6th year	53.09	1036.49	53.96	434.53	95.25	1077.00	69.70	405.24	64.67	627.57	65.63	465.93
7th year	41.09	445.80	50.60	586.13	81.52	1002.81	59.85	392.90	70.09	1221.87	75.38	842.45
8th year	43.23	925.32	41.28	544.64	70.32	845.68	56.42	601.16	55.61	1064.41	66.33	855.14
9th year	29.91	485.64	38.00	626.19	61.62	781.57	42.63	436.68	51.94	791.00	87.68	2991.18
10th year	29.68	486.21	31.43	498.71	59.00	862.17	50.42	1349.47	36.82	521.30	43.52	884.69

*Only children alive at the start of the specified period were included within inpatient cost estimates.

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Table 4 Perinatal, sociodemographic, and socioeconomic factors predicting hospital inpatient admissions, days, and costs (£1998–99) by age 10, determined by multiple regression (n = 93657)

		Hospital admissions		Hospital days		Hospital costs	
Independent variable	Category	Adjusted effect (95% CI)	p Value	Adjusted effect (95% CI)	p Value	Adjusted effect (95% CI)	p Value
Social class	I	1.00*		1.00*		1.00*	
	II	1.04 (1.04, 1.05)	<0.01	1.03 (1.02, 1.03)	<0.01	1.07 (1.06, 1.07)	<0.01
	III-NM	1.32 (1.31, 1.32)	<0.01	1.21 (1.18, 1.24)	<0.01	1.60 (1.59, 1.61)	<0.01
	III-M	1.19 (1.18, 1.19)	<0.01	1.12 (1.08, 1.16)	<0.01	1.34 (1.32, 1.35)	<0.01
	IV	1.17 (1.17, 1.17)	<0.01	1.15 (1.14, 1.15)	<0.01	1.32 (1.31, 1.33)	<0.01
	V	1.27 (1.26, 1.27)	<0.01	1.20 (1.19, 1.21)	<0.01	1.50 (1.49, 1.53)	<0.01
Parity	Nulliparous	1.00*		1.00*		1.00*	
	Multiparous	1.05 (1.04, 1.06)	<0.01	1.01 (1.00, 1.02)	0.07	1.05 (1.03, 1.06)	<0.01
	Missing	0.93 (0.87, 0.99)	0.02	0.90 (0.90, 1.02)	0.16	0.87 (0.79, 0.96)	0.01
Mother's weight at first antenatal visit	45–89 kg	1.00*		1.00*		1.00*	
	<45 kg	0.99 (0.95, 1.04)	0.68	1.00 (0.95, 1.05)	0.98	1.00 (0.93, 1.07)	0.95
	>89 kg	1.07 (1.03, 1.11)	<0.01	1.04 (1.00, 1.08)	0.02	1.11 (1.05, 1.18)	<0.01
	Missing	0.97 (0.96, 0.98)	<0.01	0.98 (0.97, 1.00)	0.04	0.96 (0.94, 0.98)	<0.01
Cigarettes smoked per day by mother during pregnancy	None	1.00*		1.00*		1.00*	
	1–9	1.09 (1.07, 1.12)	<0.01	1.05 (1.03, 1.07)	<0.01	1.14 (1.11, 1.18)	<0.01
	10–19	1.13 (1.11, 1.14)	<0.01	1.07 (1.06, 1.09)	<0.01	1.20 (1.17, 1.23)	<0.01
	20+	1.16 (1.14, 1.19)	<0.01	1.09 (1.07, 1.11)	<0.01	1.26 (1.22, 1.30)	<0.01
	Missing	1.02 (1.01, 1.04)	<0.01	1.02 (1.00, 1.04)	0.02	1.06 (1.03, 1.08)	<0.01
Mother hospital days during pregnancy	None	1.00*		1.00*		1.00*	
	1–10	1.03 (1.02, 1.04)	<0.01	1.01 (1.00, 1.02)	0.01	1.06 (1.04, 1.07)	<0.01
	11–20	1.14 (1.09, 1.19)	<0.01	1.09 (1.04, 1.13)	<0.01	1.26 (1.18, 1.35)	<0.01
	>20	1.16 (1.10, 1.23)	<0.01	1.08 (1.02, 1.14)	0.01	1.32 (1.21, 1.43)	<0.01
	Missing	1.01 (0.98, 1.05)	0.52	0.98 (0.94, 1.01)	0.18	1.01 (0.95, 1.07)	0.71
Complications during delivery	No	1.00*		1.00*		1.00*	
	Yes	1.01 (1.00, 1.03)	0.01	1.01 (1.00, 1.02)	0.03	1.04 (1.02, 1.06)	<0.01
Mother operated upon during delivery	No	1.00*		1.00*		1.00*	
	Yes	1.02 (1.00, 1.04)	0.04	1.02 (1.00, 1.03)	0.07	1.04 (1.01, 1.07)	0.01
Mode of delivery	Spontaneous	1.00*		1.00*		1.00*	
	Instrumental	1.03 (1.01, 1.04)	<0.01	1.02 (1.00, 1.03)	0.02	1.05 (1.03, 1.08)	<0.01
	Caesarean	1.10 (1.08, 1.12)	<0.01	1.10 (1.08, 1.12)	<0.01	1.23 (1.20, 1.27)	<0.01
	Missing	0.99 (0.94, 1.04)	0.74	1.00 (0.95, 1.05)	0.95	0.99 (0.92, 1.07)	0.87
Multiple delivery	No	1.00*		1.00*		1.00*	
	Yes	1.01 (0.97, 1.04)	0.67	1.01 (0.98, 1.04)	0.41	1.07 (1.02, 1.13)	<0.01
Gestational age at birth	⩾37 weeks	1.00*		1.00*		1.00*	
	32–36 weeks	1.40 (1.36, 1.43)	<0.01	1.41 (1.38, 1.44)	<0.01	1.81 (1.74, 1.87)	<0.01
	28–31 weeks	2.06 (1.92, 2.20)	<0.01	1.34 (1.25, 1.43)	<0.01	3.50 (3.15, 3.89)	<0.01
	<28 weeks	2.70 (2.39, 3.04)	<0.01	1.76 (1.55, 1.99)	<0.01	4.60 (3.80, 5.59)	<0.01
	Missing	0.77 (0.69, 0.87)	<0.01	0.93 (0.83, 1.04)	0.19	0.70 (0.59, 0.84)	<0.01
Small for gestational age	No	1.00*		1.00*		1.00*	
	Yes	1.15 (1.13, 1.17)	<0.01	1.07 (1.05, 1.09)	<0.01	1.27 (1.23, 1.31)	<0.01
	Missing	1.40 (1.25, 1.56)	<0.01	1.13 (1.01, 1.27)	0.03	1.63 (1.37, 1.94)	<0.01
Maternal age at time of delivery	20–35 years	1.00*		1.00*		1.00*	
	<20 years	1.07 (1.05, 1.10)	<0.01	1.06 (1.03, 1.08)	<0.01	1.12 (1.09, 1.16)	<0.01
	>35 years	0.95 (0.93, 0.97)	<0.01	0.98 (0.96, 1.00)	0.04	0.93 (0.90, 0.96)	<0.01
	Missing	0.98 (0.91, 1.05)	0.60	1.02 (0.95, 1.10)	0.56	0.98 (0.88, 1.10)	0.73
Child adopted or fostered	No	1.00*		1.00*		1.00*	
	Yes	0.72 (0.64, 0.81)	<0.01	0.77 (0.69, 0.87)	<0.01	0.63 (0.52, 0.76)	<0.01
Birth cohort (period)	Unit change	0.98 (0.97, 0.98)	<0.01	0.96 (0.96, 0.97)	<0.01	0.95 (0.94, 0.96)	<0.01
Child's survival period (age)	Unit change per year	0.95 (0.95, 0.96)	<0.01	0.80 (0.80, 0.81)	<0.01	0.58 (0.58, 0.59)	<0.01
Interaction of social class and child's survival	I*survival	1.00*		1.00*		1.00*	
	II*survival	1.00 (1.00, 1.00)	0.94	1.00 (0.99, 1.00)	0.75	1.00 (0.99, 1.01)	0.99
	IIINM*survival	0.99 (0.99, 1.00)	<0.01	0.99 (0.98, 0.99)	<0.01	0.98 (0.97, 0.99)	<0.01
	IIIM*survival	0.99 (0.99, 1.00)	<0.01	0.99 (0.99, 1.00)	0.01	0.99 (0.98, 1.00)	0.02
	IV*survival	0.99 (0.98, 0.99)	<0.01	0.99 (0.98, 0.99)	<0.01	0.97 (0.97, 0.98)	<0.01
	V*survival	0.98 (0.97, 0.98)	<0.01	0.98 (0.97, 0.99)	<0.01	0.96 (0.95, 0.97)	<0.01
Value in previous year	Unit change per year	0.95 (0.95, 0.95)	<0.01	1.31 (1.30, 1.31)	<0.01	1.17 (1.17, 1.17)	<0.01

*Reference category.

household, 0.89 (2.13) for children born into a social class IV household, and 1.00 (2.36) for children born into a social class V household (table 1). The number of inpatient days spent in hospital during the first 10 years of life, including the initial birth admission, averaged (SD) 5.12 (6.60) for children born into a social class I household, 5.32 (8.55) for children born into a social class II household, 6.46 (13.09) for children born into a social class III-NM household, 5.83 (10.71) for children born into a social class III-M household, 6.08 (10.22) for children born into a social class IV household, and 6.73 (13.66) for children born into a social class V household (table 2). The cost of hospital inpatient admissions incurred during the first 10 years of life, including the initial birth admission, averaged (SD) £1779.36 (£3871.02), £1890.22 (£4269.50), £2471.92 (£5874.81), £2171.80 (£4413.76), £2205.42 (£5703.97), and £2510.15 (£6894.20) for children born into the respective social classes (table 3).

Predictors of hospital inpatient admissions, days, and costs

Table 4 summarises the results of the multilevel multiple regression models. The adjusted effect regarding hospital inpatient admissions, days, and costs was significantly higher for social classes II, III-NM, III-M, IV, and V when compared with the social class I reference group ($p<0.01$). The adjusted effect regarding hospital inpatient admissions, days, and costs was 1.27 (95% CI: 1.26, 1.27), 1.20 (1.19, 1.21), and 1.50 (1.49, 1.53), respectively, for children born into social class V when compared with the social class I reference group. The model parameters allowed us to relate the adjusted effects of

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Key points

- Children born into social classes II, III-NM, III-M, IV, and V are more likely to be admitted to hospital, spend longer in hospital overall, and generate greater hospital costs than children born into social class I.
- The impact of social class on hospital inpatient admissions, days, and costs is most acutely felt during years 3–10 of life as compared with the first two years of life.

hospital inpatient admissions, days, and costs of the individual social classes to each other. For example, the adjusted effect of hospital inpatient admissions, days, and costs was 27%, 17%, and 50% higher, respectively, for children born into social class III-NM than for children born into social class II. Surprisingly, social class III-NM exhibited significantly higher rates of hospital inpatient admissions, days, and costs than social class III-M. When the social classes were grouped, social classes III-NM, III-M, IV and V combined exhibited significantly higher rates of hospital inpatient admissions, days, and costs than social classes I and II combined.

When the effects of other independent variables were examined, the following characteristics showed a statistically significant association with higher hospital inpatient admissions, days, and costs: a maternal weight at first antenatal visit of greater than 89 kg, maternal smoking during pregnancy, maternal hospitalisation during pregnancy, complications during delivery, instrumental or caesarean delivery, preterm birth (<37 weeks),[22] whether the child was small for gestational age, maternal age at the time of delivery of less than 20 years, whether the child was not adopted or fostered around the time of birth, whether the child was born during 1979–82 as compared with later periods, and younger age of the child. Interaction of social class and the duration of the child's survival showed steeper rates of decline in hospital inpatient admissions, days, and costs over the 10 year period analysed for social classes III, IV and V compared with social classes I and II.

Application of the regression models to the two age stratified subgroups showed that the impact of social class on hospital inpatient admissions, days, and costs was most acutely felt during years 3–10 of life as compared with the first two years of life. For example, during the first two years of life, the adjusted effect regarding hospital inpatient costs was 0.96 (0.89, 1.03), 1.04 (0.97, 1.13), 1.01 (0.91, 1.11), 1.00 (0.91, 1.09), and 0.95 (0.83, 1.09) for children born into social classes II, III-NM, III-M, IV, and V, respectively, when compared with the social class I reference group. In contrast, during years 3–10 of life, the adjusted effect regarding hospital inpatient costs was 1.04 (0.98, 1.11), 1.61 (1.51, 1.71), 1.31 (1.20, 1.43), 1.13 (1.05, 1.23), and 1.16 (1.03, 1.30) for children born into social classes II, III-NM, III-M, IV, and V, respectively, when compared with the social class I reference group. A detailed breakdown of the results of the multilevel multiple regression modelling by period of life is available from the authors upon request.

DISCUSSION

In this cohort analysis of children born in two counties in southern England, we found a clear association between adverse socioeconomic position at the time of birth and increased hospital inpatient admissions, days, and costs during the first 10 years of life. The findings reported in our paper contradict those reported by three recently published

Policy implications

Health service decision makers need to be alert to the adverse sequelae that might result from socioeconomic disadvantage when planning health services for children. Particular attention should be paid to targeting deprived populations with prevention interventions that are known to be clinically and cost effective.

studies,[9–11] which found no significant social class differences in the use of general practitioner, outpatient, and inpatient services by children and young people. However, the data sources for those three studies were cross sectional surveys. The only previous study to use prospectively collected and validated data to examine the association between social class and health service use by children found that general practitioner consultation rates increased linearly from classes I–II to classes IV–V.[12]

This study is the first, to our knowledge, to explicitly examine the association between socioeconomic position at the time of birth and the use and cost of hospital inpatient services during childhood. It was based on a large cohort of children in a geographically defined area, and included a comprehensive and validated record of clinical, socioeconomic, and service utilisation data.[23 24] The incorporation of the confounding effects of perinatal and maternal characteristics in the regression models controlled for potential predictors of adverse child health outcomes: the study thus shows effects of socioeconomic status that are independent of, and exert effects beyond, those of these other predictors.[25] Furthermore, the study was not subject to concerns about generalisability that often arise with small area studies,[26] nor to concerns about differential access to services by socioeconomic groups that characterise some community services.[27]

There are a number of study limitations, which should be borne in mind by readers. Firstly, the social class of the head of household was measured at the time of birth and, consequently, we have not considered changes to the child's socioeconomic circumstances during the first 10 years of life. Had socioeconomic status been measured prospectively, different estimates of additional hospital admissions, days, and costs attributable to low social class might have emerged. A second limitation is that the socioeconomic profile of the study population might not have been nationally representative. Indeed, the social class breakdown reflected a more affluent population than children born throughout England and Wales in 1998 (34.6%, 9.7%, 30.0%, 20.6%, and 5.0% born into social classes I-II, III-NM, III-M, IV-V, and Other, respectively).[15] A third limitation is that the dataset did not include admissions of the study children to hospitals outside the areas covered at the relevant times by the ORLS. These hospital admissions may have arisen for a variety of reasons related to accessibility, availability, and choice.[20] Alternatively, the study children may have migrated out of the areas covered by the ORLS during the study period. National statistics show that 4.7% of children aged less than 15 years migrated out of the local authorities covered by the former Oxford Region during 2000–2001.[28] National census data suggest that about three quarters of this migration would have been to other local authorities within the former Oxford Region.[29] Nevertheless, observational evidence from Oxfordshire shows that migration of children is strongly related to high social class,[30] suggesting that we might have underestimated the absolute levels of hospital admissions by children from the highest social classes and, consequently, overestimated the utilisation and cost differentials between

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the social classes. A fourth limitation of the study is that the specialty based daily costs applied to each hospital admission may not have captured subtle differences in the care provided to infants with varying diagnoses. The English Department of Health has compiled an alternative dataset of NHS reference costs,[31] which is based on categories of acute care interventions that are clinically distinct and have similar implications for resources. However, these costs have been criticised for having improbably wide ranges of values for the same healthcare resource groups,[32] and it was therefore decided that the NHS trust financial returns provided the most rigorous values for our calculations. A final limitation is that we had very little information on factors relating to the parents, such as their lifestyles, behaviours, and attitudes, which might also confound or mediate the relation between social class and the use and cost of hospital inpatient services during childhood. Incorporating such factors into multilevel multiple regression models may prove important in explaining utilisation and cost outcomes during childhood.

The socioeconomic differentials in hospital inpatient admissions, days, and costs during childhood are likely to reflect differences in adverse health outcomes experienced by the social classes. Indeed, separate analyses of the ORLS dataset conducted by the authors suggest that children of low social class are more likely to be admitted to hospital during the first 10 years of life for a wide range of conditions (data available upon request). Interestingly, these analyses also show that children born into III-NM households are more likely to experience a range of adverse child health outcomes than children born into III-M households, which is consistent with the findings reported in this paper. We believe that this rather surprising finding can only be elucidated through further research.

The mechanisms by which socioeconomic disadvantage causes ill health during childhood are unclear, but may be mediated through poor diet and consequent likelihood of poor infant growth and development, as well as through raised risk of infection, raised risk of smoking in mothers, and reduced parental self esteem.[33] Other evidence points to a strong link between socioeconomic disadvantage and non-fatal injuries caused by self harm, assaults, falls, road traffic accidents, poisoning, and burns, reflecting differences in the social environment and access to safety devices in homes and vehicles between the social classes.[34] There is also some evidence to suggest that less affluent children may be more readily admitted to hospital in the UK by health professionals.[34]

Experimental studies aimed at ameliorating socioeconomic influences on adverse child health outcomes have been carried out with mixed results. Short term interventions, such as parenting interventions and home visiting programmes, aimed at improving parent-child relationships among the socially vulnerable have shown some benefits.[35 36] Other early childhood intervention programmes have also been shown to be effective at fostering the cognitive and social-emotional functioning and physical health of preschool children, as well as improving their emerging competencies.[37] In addition, a systematic review of the randomised controlled trials of out of home day care services for preschool children suggests that preschool day care may have beneficial effects on children's development.[38] Future research that we are planning will synthesise effectiveness evidence from experimental studies with baseline service utilisation and cost data from our dataset with the view to estimating the potential economic impact of initiatives aimed at ameliorating socioeconomic influences on adverse child health outcomes.

In conclusion, this study has highlighted the importance of the socioeconomic background of children when the use and cost of hospital inpatient services is examined. Health service decision makers need to be alert to the adverse sequelae that might result from socioeconomic disadvantage when planning health services for children. Particular attention should be paid to targeting deprived populations with prevention interventions that are known to be effective, such as parenting interventions, home visiting programmes, and other early childhood intervention programmes. Further research is required that establishes whether initiatives targeted at deprived populations are effective at preventing hospital service utilisation and costs during childhood.

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APHORISM OF THE MONTH

The person who defines the problem controls the range of solutions

Lowell Levin

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