

Health Service Costs in Adulthood Associated with Adolescent Mental Health Problems in Three British Cohorts

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Abstract

Background: Mental health problems are common among young people and they can have long lasting effects into adulthood. These effects can have economic consequences, both in the short term and into adulthood and across the life course.

Aims of the Study: To present a methodology to estimate harmonised costs across three large-scale British birth cohorts (1946 Medical Research Council National Survey of Health and Development (NSHD); 1958 National Child Development Study (NCDS); and 1970 British Cohort Study (BCS70) for key health service use measures: restrictive and/or urgent care (including inpatient, day surgery and accident and emergency services), outpatient services (including mental health specialist), and general practitioners (GP). We use this to describe relationships between adolescent mental health (assessed at ages 13/15 for NSHD, and age 16 for NCDS and BCS70) and the economic impacts associated with health service use in early- and mid-adulthood. This methodology can be used to explore long-term economic outcomes associated with emotional and behavioural problems experienced by adolescents in other longitudinal cohort studies.

Methods: For each cohort, we analysed data on participant reports of health service use. We categorised services into broad domains

and estimated frequency of service use at comparable timepoints around ages 20, 30 and 40 (NSHD ages 26, 31/36, 43; NCDS ages 23, 33, 42; BCS70 ages 26, 30, 42), by adolescent mental health status (mild and severe emotional problems; mild and severe conduct problems; absence of problems) and sex. Data collection methods varied between cohorts and across time-points, and data on health service use frequency were not always comprehensively collected at each wave. Where frequencies were unavailable, for each cohort we estimated frequency of use from contemporaneous resources and applied conservative assumptions so economic impacts would not be overestimated. We then estimated service use costs for each participant in the different cohorts based on their estimated frequency of health service contact multiplied by relevant unit costs.

Results: Our findings illustrate the capacity to conduct coordinated analyses across three different British birth cohorts and identify patterns of service utilisation for respondents around the ages of 20, 30 and 40 years of age. Our analyses identified similar patterns of utilisation for respondents at around age 20, 30 and 40. For instance, those with conduct problems, on average, had about 1.5 times higher costs associated with GP service use at age 43 compared to those with emotional or no mental health problems.

Discussion: This study demonstrates the potential for comparing service use and associated costs by age, type of health service contact and adolescent mental health problem across different birth cohorts. Our methodology provides a resource that enables examinations of associations between adolescent mental health problems and health service use in adult life, as well as the associated costs, across three British birth cohort datasets.

Implications for Health Policies: Insights from this research could provide methodological and empirical bases to support further work on adolescent mental health, for example to examine the case for shifting resources to early intervention and prevention.

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Implications for Further Research: Future research could investigate in more detail changes in economic impacts over the life course among other population subgroups. Moreover, when combined with information on costs and outcomes of interventions, estimates could be used to help identify interventions with the potential to provide good value for money.

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Background

Mental health problems affect large numbers of children and adolescents. The most recent national survey in England found that one in eight children and young people between the ages of 5 and 19 is experiencing poor mental health.¹ Mental health problems in childhood and adolescence, especially if serious, can be very distressing for individuals and families, sometimes life-threatening, and can cast long shadows over future health and life chances.²

The long-term impacts of emotional problems (such as depression and anxiety) and behavioural problems (such as conduct disorder, hyperactivity and oppositional defiant behaviour) in childhood and adolescence can be wide-ranging and include adverse experiences in adulthood.³⁻¹⁰ For example, analysis of the Medical Research Council (MRC) National Survey of Health and Development (NSHD; 1946 British birth cohort) found that adolescents with conduct problems had poorer mental health and poorer social and economic outcomes at age 53 than adolescents without conduct disorder.⁴ Further analysis across the 1946, 1958 and 1970 cohorts found that childhood conduct problems were associated with lower educational qualifications, teenage parenthood, persistent economic inactivity, lower earnings, divorce, and increased criminal convictions and arrests.⁵ Individuals who experienced emotional problems during childhood or adolescence were more likely to have adult psychopathology, while showing evidence suggestive of risk avoidance.⁵

Some studies, in both the UK and elsewhere, have estimated the economic consequences of mental health problems in childhood or adolescence, both short-term (e.g., costs of health care and educational support)¹¹⁻¹³ and longer-term into adulthood (e.g., service use due to continued poor health, unemployment, reduced earnings, contacts with the criminal justice system).^{14,15} These studies have mostly explored relatively short-term perspectives, missing the potential longer-term economic consequences which may particularly matter, for example, for individuals with mild conduct problems, since some benefit from 'turning points' in adulthood, such as stability if a secure partnership is achieved, but others will not.⁵ Studies have also often focused on specific communities or single mental health conditions. There is little evidence on how longer-term economic costs of mental health problems among young people vary in magnitude, persistence and composition over the life course.¹⁶

Aims of the Study

We sought to estimate long-term economic outcomes associated with emotional and behavioural problems experienced by adolescents in three British birth cohorts (1946, 1958 and 1970). Our study builds on previous work investigating long-term impacts of adolescent mental health problems on later life chances across these three birth cohorts⁵ by estimating the economic cost of health service use associated with these problems. In this paper, we present a methodology to estimate harmonised costs across the cohorts for key health service use measures, and then describe relationships between adolescent mental health and these later economic impacts. As an illustration of the capacity to conduct coordinated analyses across different birth cohorts, we look at the availability of health service utilisation data and describe patterns of utilisation across the cohorts around the ages of 20, 30 and 40 years of age. We describe a methodology for pooling data across three major datasets collected at different points in history, and the considerations needed to make inferences when estimating economic impacts in such cohort data.

Methods

Cohorts

Data from three British birth cohorts were used, providing detailed information on people born in one week of 1946, 1958 and 1970. Data have been collected from these groups of people from birth and throughout their lives, including information on their mental health, use of health services, employment and income. We look at outcomes up to age 42 or 43 years: it is not possible to compare across all cohorts beyond that age (see **Table 1**).

MRC National Survey of Health and Development (NSHD): 1946 British Birth Cohort

NSHD is the oldest of the British birth cohort studies.¹⁷⁻¹⁹ At recruitment, it was a nationally representative, socially stratified sample, initially of 5362 births during one week in 1946 in England, Scotland and Wales. Participants have been followed up in multiple sweeps of data collection. At age 43, 3263 people took part.

National Child Development Study (NCDS): 1958 British Birth Cohort

NCDS follows the lives of 17,415 people born in England, Scotland and Wales during one week in 1958.²⁰ The sample was augmented to include immigrants born in the same week during subsequent sweeps of data collection at ages 7, 11 and 16 years. At age 42, 11,419 individuals took part.

British Cohort Study (BCS70): 1970 British Birth Cohort

BCS70 follows the lives of 17,198 people born in England, Scotland and Wales during a single week in 1970.²¹ This sample was also expanded to include immigrants during childhood sweeps of data collection, at ages 5, 10 and 16

Table 1. Available Data on Mental Health in Adolescence and Health Service Use in Adulthood.

	NSHD	NCDS	BCS70
Adolescent mental health (ages at which problems were assessed)			
Conduct and emotional problems*	<u>13, 15</u>	<u>16</u>	<u>16</u>
Health service use (ages at which health service use in each domain was assessed)			
Restrictive and/or urgent care**	<u>26, 31, 36, 43, 53, 60-64, 69</u>	16, <u>23, 33, 42, 46, 50, 55</u>	16, <u>26, 30, 34, 38, 42</u>
Outpatient***	<u>26, 31, 36, 43, 53, 60-64, 69</u>	16, <u>23, 33, 42, 50</u>	16, <u>30, 34, 42</u>
GP****	<u>26, 31, 36, 43, 53, 60-64, 69</u>	16, <u>23, 33, 42, 50</u>	16, <u>26, 30, 34, 38</u>

NSHD = MRC National Survey of Health and Development; NCDS = National Child Development Study; BCS70 = British Cohort Study

* NSHD teacher report; NCDS & BCS70 parent report.

** Includes service contact described as: Inpatient, inpatient following accident, inpatient residential, inpatient/day surgery, mental health inpatient, A&E, A&E following accident.

*** Includes service contact described as: outpatient, outpatient following accident, mental health specialist/outpatient.

**** Includes service contact described as: GP, GP following accident.

Underlined numbers indicate ages considered in analyses for this study.

years. At the age 42 data collection point, there were 9841 participants.

Our main interest here is data capturing adolescent mental health and health service use up to mid-adulthood in a consistent and comparable way across cohorts. **Table 1** provides a brief overview of the data available and the assessment points we selected for comparison in each cohort. To enable harmonised comparisons between cohorts, we focused on three adult follow-up data points for each cohort, capturing data collected around the ages of 20, 30 and 40 years (NSHD ages 26 (collected in 1972), 31 and 36 (1977 and 1982), 43 (1989); NCDS ages 23 (1981), 33 (1991) and 42 (2000); BCS70 ages 26 (1996), 30 (2000) and 42 (2012)).

Assessment of Adolescent Mental Health

Adolescent mental health was represented as conduct and emotional problems,^{5,22} captured in a broadly harmonised manner across the cohorts. The NCDS and BCS70 used the Rutter A scale^{10,23} to assess emotional and conduct problems, whereas the NSHD used a forerunner of this scale.⁵

In this study, for adolescent mental health ratings in the NSHD, we considered combined teacher reports of participants at ages 13 and 15 years. Conduct problems were summarised by items assessing unpunctuality, restlessness, truancy, daydreaming, indiscipline, disobedience and lying; and emotional problems by items on anxiety, timidity, fearfulness, diffidence and avoidance of attention.

For the NCDS and BCS70, we considered parent report data at age 16. Conduct problems were assessed by questions asking about destroying belongings, fighting with other children, disobedience, lying, bullying, and stealing (BCS70 only). Emotional problems were assessed by questions on worrying, misery, fearfulness, fussiness, and solitariness.

For all cohorts, continuous scores for conduct and emotional problems were generated by summing the items

capturing each domain into a total score. These scores were then categorised into ‘absent’, ‘mild’ and ‘severe’ problem categories in each domain based on established percentile cuts.⁵ For conduct problems these were 0-75%, 75-93% and 94% or higher, respectively; and for emotional problems, these were 0-50%, 50-87% and 88% or higher, respectively.^{4,24-26}

Categorisation of Health Services

Health service use was assessed by cohort participant reports of contacts with various health professionals and services at each relevant data collection sweep for each cohort (see **Table 1**). In NSHD these data were collected primarily by an interviewer and occasionally via self-report, and in NCDS and BCS70 these data were generally assessed through self-report.

Question wording varied between cohorts and between data sweeps. To provide a harmonised point of comparison, and consistent and comparable cost estimates, we categorised questions representing health service contacts into three broad domains: (i) restrictive and/or urgent care, including inpatient service use/overnight hospital stays, day surgery and accident and emergency services (A&E) which resulted in inpatient stays; (ii) outpatient service use, including mental health specialist contact; and (iii) general practitioner (GP) contact.

Questions asking about ‘seeing a doctor’ were considered reflective of general practitioner (GP) contact, and ‘going to hospital’ and ‘hospital clinics’ reflective of outpatient contact. To be conservative, a response of ‘don’t know’ was coded as no service contact. Inpatient contact reflected questions on general inpatient service use, inpatient contacts following accidents, and reporting hospital as the respondent’s primary residence. Questions asking about service use in a way that did not specify the exact service

Table 2. Data Source and Associated Frequencies Used for Estimating GP and Outpatient Contact Frequencies Where Cohort-Based Data Were Not Available.

Resource*	GP visit mean frequency**	Outpatient visit mean frequency***	Study cohort and data collection timepoint to which frequencies were applied
GHS 1982	Males 1.20 Females 1.30	Males 2.07 Females 2.25	NCDS age 23 (data collected in 1981)
GHS 1991	Males 1.28 Females 1.26	Males 2.12 Females 2.05	NCDS age 33 (data collected in 1991)
GHS 1996	Males 1.26 Females 1.31	–	BCS70 age 26 (data collected in 1996)
APMS 2000	Males 1.26 Females 1.31	Males 1.38 Females 1.45	for BCS70 age 30 and NCDS age 42 (data collected in 2000)

NCDS = National Child Development Study; BCS70 = British Cohort Study.

* GHS = General Household Survey; APMS = Adult Psychiatric Morbidity Survey; ** number of visits in past 2 weeks GHS/APMS; *** number of visits in past 3 months GHS/past year APMS.

type used were not included (e.g., ‘medical supervision by hospital, clinic or GP’). Summary variables were computed reflecting any reported service use within each of these domains.

For NSHD at age 26, data on health service use were only collected for GP, outpatient and inpatient service contact due to accidents. Also, in NSHD, for the data collection around age 30, restrictive and/or urgent care was considered using data from age 36 and outpatient and GP data service use data were considered from age 31, as these data collection points provided the most comprehensive information on these service contacts.

Frequency of Health Service Contacts

Cohort-based data on service use frequency were used wherever available. Most such data considered service use within the past year. Where frequencies were reported for a different time period, these data were standardised to one-year equivalents. For example, for BCS70 sweep age 34, number of hospital outpatient visits was reported for the previous 4 years and divided by 4 to estimate an average annual frequency.

If no cohort-based data on contact frequency for a given health service domain were provided, we used other data to estimate these where possible. This was done through identifying non-overlapping questions of contact with a given service domain, where available (e.g., separate questions asking about outpatient service use following accidents, and outpatient service use for mental health services). These reports of multiple separate points of contact with the same service category (e.g. outpatient services) were summed to give a conservative estimate of contact frequency. Participants in NCDS and BCS70 reported their current residence as ‘hospital’ if this had been their address for at least 6 months in the previous year. In these cases, we assumed length of this inpatient stay to be 182.5 days (365 days divided by 2).

Where cohort participants reported on service use but not its frequency, frequency was estimated based on the data

available from other relevant UK general population studies from contemporaneous years: the General Household Survey (GHS) in 1982, 1991 and 1996²⁷ and the Adult Psychiatric Morbidity Survey (APMS) in 2000.²⁸ Both the GHS and APMS asked about number of GP visits in the previous 2 weeks. Regarding outpatient contacts, the GHS asked about number of visits in the previous 3 months, whereas the APMS asked about visits in the past year. The frequencies reported in these datasets were estimated without adjustment as annual frequencies. All estimates were stratified by sex.

Table 2 provides an overview of the service use frequency estimates taken from these alternative sources, specifying the cohort dataset and data collection timepoints to which these frequencies were applied. For NSHD data referring to GP and outpatient service use at age 31 (1977), we used reporting of any use of this service in the past 5 years (as this was the time frame specified in the interview question). However, given that frequency data were not available for this item, service use frequencies were estimated based on the nearest completed data collection sweep that included a frequency variable. The 1989 sweep of data collection was the closest wave which included relevant questions on health service use frequency. If frequency values were missing or were zero in 1989 and a given participant used any of these services in 1977, we assumed that the participant had used the service at least once in the last 5 years as a conservative estimate. These data were standardised to one-year equivalents, as described above.

Health Service Use Costs

To estimate costs associated with health service use, frequency of contact within a given health service domain was combined with the unit cost for that service. Unit costs were sourced primarily from the PSSRU volume.²⁹ If a unit cost figure was not available from that source, we used NHS Reference Costs 2016-2017³⁰ and WHO-CHOICE estimates;³¹ see **Table 3** for cost sources. Unit costs were adjusted to a common 2020 price base using an NHS pay and price cost inflation index.³² For inpatient contacts, even if no

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Table 3. Sources Used to Estimate Health Service Use Costs.

Source	Service type	Unit cost
Restrictive and/or urgent care (incl. inpatient, day surgery and A&E)		
PSSRU Unit Costs	Emergency/non-elective inpatient; episode	£ 2900
PSSRU Unit Costs	Elective inpatient stay; episode	£ 3653
NSH Reference Costs	Day case/day surgery; service provision	£ 738
NSH Reference Costs	A&E Attendance; service provision	£ 148
WHO-CHOICE	Bed day at primary-level hospital	£ 298.5
Outpatient (incl. MH specialist)		
PSSRU Unit Costs	Outpatient attendance; patient appointment	£ 135
PSSRU Unit Costs	Mental health specialist team service; care contact	£ 121
GP		
PSSRU Unit Costs	GP visit; surgery consultation/patient contact	£ 36

data on duration of stay were reported in a cohort dataset a cost could still be estimated for that episode using PSSRU unit cost figures²⁹ as, by default, these are estimated per inpatient stay episode, rather than per day. Costs represented median costs per capita.

Data Analytic Procedures

Frequencies of participant reports of emotional or conduct problems (at absent, mild or severe levels) were computed for each cohort across the total sample, and separately for males and females.

For each cohort, we had data on whether each participant reported health service use within the three key domains (restrictive and/or urgent care, including inpatient service use, day surgery and A&E services; outpatient service use, including mental health specialist contact; and GP contact). Frequency of health service use was then estimated at comparable timepoints around ages 20, 30 and 40 (NSHD ages 26, 31/36, 43; NCDS ages 23, 33, 42; BCS70 ages 26, 30, 42) for each of these domains according to adolescent mental health status (mild and severe emotional problems; mild and severe conduct problems; absence of problems), for each cohort.

Based on the costing procedure previously described, health service use costs were then estimated for each participant based on their frequency of reported health service contacts. We then estimated median total cost and inter-quartile range (IQR) costs for each of the three health service domains at key ages in adulthood, according to adolescent mental health status for each of the cohorts.

Data were analysed using Stata 16.³³

Results

Adolescent Mental Health

Table 4 describes the prevalence of adolescent emotional and conduct problems across all three cohorts, overall and by sex.

Across all cohorts, somewhat more females than males were categorised as having emotional problems in the ‘severe’ range (around 15-20% of females vs 10-15% of males). In contrast, ‘severe’ conduct problems were reported for somewhat more males than females across the cohorts (around 8% vs 6%). ‘Mild’ emotional problems were reported for around a third of males across all three cohorts, whereas for females this proportion ranged from 40% in NSHD to around 30% in BCS70. Regarding ‘mild’ conduct problems, these were reported slightly more frequently for males than females in NSHD (20% vs 16%), for around a quarter of both males and females in NCDS (26% vs 23%), and for a slightly smaller proportion of respondents in BCS70 (14% vs 12%).

Frequency of Health Service Use

Table 5 provides an overview of data on health service use across the three cohorts, at different data collection timepoints (around ages 20, 30 and 40) and based on presence of adolescent mental health problems.

Within each cohort and at each particular age, the proportions with restrictive and/or urgent care, outpatient, GP contacts or the composite ‘any service use’ were broadly comparable between individuals with no mental health problems, and those with emotional problems in adolescence. Across all ages and cohorts, however, those with conduct problems tended to report more frequent service use than those with emotional problems or those with no mental health problems during adolescence.

There were also differences in service use between the cohorts, and when comparing by age within each cohort. Comparing between cohorts, the proportion of participants with ‘any service use’ was generally highest among those born in 1958 (NCDS) and lowest among those born in 1970 (BCS70). In relation to age, within NSHD the proportion of participants in contact with any health care services increased with age, although at age 26, participants were only asked about service use due to accidents. Within NCDS, the

Table 4. Adolescent Emotional and Conduct Problems across Cohorts Overall and By Sex*.

	NSHD (1946)	NCDS (1958)	BCS70 (1970)
Total sample	n= 5,362	n=18,558	n=19,023
Emotional			
Absent	2,114 (50.0%)	5,734 (49.6%)	4,293 (51.7%)
Mild	1,566 (37.0%)	3,858 (33.3%)	2,591 (31.2%)
Severe	552 (13.0%)	1,978 (17.1%)	1,426 (17.2%)
Missing	1,130	6,988	10,713
Conduct			
Absent	3,162 (74.7%)	7,911 (68.3%)	6,773 (80.1%)
Mild	771 (18.2%)	2,863 (24.7%)	1,122 (13.2%)
Severe	298 (7.0%)	807 (7.0%)	565 (6.7%)
Missing	1,131	6,977	10,563
Males only	n= 2,815	n= 9,596	n=9,686
Emotional			
Absent	1,223 (55.4%)	3,203 (54.0%)	2,223 (54.7%)
Mild	749 (33.9%)	1,841 (31.1%)	1,227 (30.2%)
Severe	235 (10.6%)	885 (15.0%)	614 (15.1%)
Missing	608	3,667	5,622
Conduct			
Absent	1,587 (71.6%)	3,948 (66.5%)	3,229 (77.8%)
Mild	444 (20.1%)	1,541 (26.0%)	589 (14.2%)
Severe	175 (7.9%)	450 (7.6%)	330 (8.0%)
Missing	609	3,657	5,538
Females only	n= 2,547	n= 8,959	n=8,943
Emotional			
Absent	891 (44.0%)	2,531 (44.9%)	2,070 (48.8%)
Mild	817 (40.3%)	2,017 (35.8%)	1,364 (32.1%)
Severe	317 (15.7%)	1,093 (19.4%)	812 (19.1%)
Missing	522	3,318	4,697
Conduct			
Absent	1,575 (77.8%)	3,963 (70.2%)	3,544 (82.2%)
Mild	327 (16.1%)	1,322 (23.4%)	533 (12.4%)
Severe	123 (6.1%)	357 (6.3%)	235 (5.6%)
Missing	522	3,317	4,631

NSHD = MRC National Survey of Health and Development; NCDS = National Child Development Study; BCS70 = British Cohort Study.

* NSHD Age 13/15 Years; NCDS Age 16, BCS70 Age 16.

proportion of participants using any services was similar at ages 23 and 33 and decreased slightly at age 42. For BCS70, the highest proportion of any service use was reported at age 30, and the lowest at age 42, yet a comparable proportion of participants reported outpatient service use at the data collection points at ages 30 and 42. The proportion of ‘any’ service use was more than two and a half times higher at age 30 compared to age 42.

Health Service Use Costs

Table 6, Table 7 and Table 8 display the total cost of health service use in adulthood at key ages in the three cohorts according to adolescent mental health status.

For NSHD, at each age where health service use data were considered, the median cost of restrictive and/or urgent care

and outpatient service use costs was comparable for all three groups of participants (emotional problems, conduct problems and no mental health problems in adolescence). These median costs did, however, vary with age. Restrictive and/or urgent care costs were highest at age 36, and lowest at age 26. Outpatient costs increased with age. Higher median GP costs were reported at age 43 than at ages 26 and 31, and at age 43 those with adolescent conduct problems reported higher GP costs than those with emotional problems or no problems.

For NCDS, restrictive and/or urgent care service and GP contact median costs did not differ between the three adolescent mental health groups, but costs differed at the different ages. Restrictive and/or urgent care costs were highest at age 23, and lowest at age 42; and GP costs were similar at ages 23 and 33, but higher at age 42. Outpatient service costs at age 23 were lower for participants with

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Table 5. Prevalence of Health Service Use at Key Ages In Adulthood According to Adolescent Mental Health Status.

Health service use at key ages	NSHD (1946)			NCDS (1958)			BCS70 (1970)		
	Emotional	Conduct	None	Emotional	Conduct	None	Emotional	Conduct	None
Adolescent mental health status*									
NSHD age 26**/NCDS age 23, BCS70 age 26									
Any service use ^a	46.0% (782)	n=4,232 61.7% (659)	55.5% (811)	86.9% (4,029)	n=12,529 88.6% (2,436)	85.8% (6,475)	40.7% (1,018)	n=8,605 47.1% (414)	41.6% (1,939)
Restrictive and/or urgent care (incl. inpatient, day surgery and A&E) ^{#b}	5.9% (100)	12.7% (136)	9.6% (140)	30.7% (1,440)	33.4% (929)	28.9% (2,204)	38.0% (952)	44.9% (395)	38.8% (1,811)
Outpatient (incl. MH specialist) ^c	33.4% (568)	48.4% (517)	42.6% (622)	41.9% (1,962)	48.1% (1,333)	42.9% (3,273)	Outpatient contact data not available at this sweep		
GP ^d	18.3% (311)	21.9% (234)	22.0% (322)	69.9% (3,192)	68.8% (1,859)	66.3% (4,939)	9.9% (248)	12.0% (105)	10.4% (485)
NSHD age 31/36***/NCDS age 33, BCS70 age 30									
Any service use ^a	75.4% (1028)	n=3,020 77.2% (623)	76.4% (896)	83.8% (3,068)	n=11,372 87.2% (1,860)	84.5% (4,908)	68.1% (1,549)	n=11,205 68.1% (635)	63.0% (2,656)
Restrictive and/or urgent care (incl. inpatient, day surgery and A&E) ^{#b}	37.9% (458)	36.8% (265)	32.4% (343)	37.5% (1,575)	39.0% (962)	35.7% (2,454)	14.4% (255)	14.7% (111)	12.9% (436)
Outpatient (incl. MH specialist) ^c	39.6% (490)	44.2% (318)	46.9% (498)	58.5% (1,820)	63.4% (1,154)	60.2% (2,935)	28.5% (496)	32.6% (242)	25.0% (827)
GP ^d	57.6% (713)	55.6% (400)	57.8% (614)	27.0% (1,135)	26.2% (646)	24.8% (1,705)	38.5% (1,201)	38.3% (464)	34.7% (2,012)
NSHD age 43/NCDS age 42, BCS70 age 42									
Any service use ^a	78.6% (926)	n=2,908 80.3% (560)	77.0% (795)	83.0% (3,057)	n=11,391 79.0% (1,879)	74.9% (4,919)	28.3% (777)	n=9,789 29.7% (319)	23.3% (1,185)
Restrictive and/or urgent care (incl. inpatient, day surgery and A&E) ^{#b}	40.7% (480)	42.4% (295)	38.6% (398)	37.7% (1,580)	39.0% (970)	36.4% (2,491)	Data only available from n=2 participants		
Outpatient (incl. MH specialist) ^c	54.6% (643)	60.3% (420)	54.6% (411)	42.3% (1,507)	45.6% (972)	41.2% (2,462)	28.2% (775)	29.6% (318)	23.3% (1,184)
GP ^d	42.1% (496)	43.3% (302)	39.8% (302)	40.8% (1,707)	42.3% (1,051)	37.1% (2,545)	GP contact data not available at this sweep		

NSHD = MRC National Survey of Health and Development; NCDS = National Child Development Study; BCS70 = British Cohort Study.

* Emotional = mild/severe emotional problems; Conduct = mild/severe conduct problems; None = absent problems.

** NSHD services for age 26 included use of services due to accidents only.

*** NSHD inpatient data were considered from age 36, outpatient and GP data from age 31.

A&E was included as an outpatient in NSHD ~20 years. NSHD ~20 years counts any service use due to accident in past 10 years, ~30 years counts any service use last 5 years and ~40 years counts Inpatient and Outpatient use last 7 years and last year for GP. Proportions are in relationship with those with the mental health condition without service use.

^a Captures service contact in restrictive/urgent care, outpatient or GP services. ^b Includes service contact described as: Inpatient, inpatient following accident, inpatient/day surgery, mental health inpatient, A&E, A&E following accident, depending on data available at the data collection sweep. ^c Includes service contact described as: outpatient, outpatient following accident, mental health specialist/outpatient, depending on data available at the data collection sweep. ^d Includes service contact described as: GP, GP following accident, depending on data available at the data collection sweep.

Table 6. NSHD: Median Cost Per Capita of Service Use in Health Service Domains at Key Ages: Median Total Cost (£) Per Health Service Domain at Key Ages And Inter-Quartile Range (IQR) Costs, Categorized by Adolescent Mental Health Status.

	Service use	Key ages			Adolescent mental health*								
					Emotional problems			Conduct problems			None		
		n	Median (£)	IQR	n	Median (£)	IQR	n	Median (£)	IQR	n	Median (£)	IQR
Restrictive and/or urgent care (incl. inpatient) ^a	26 (n=4232)	100	324	324-324	136	324	324-324	140	324	324-324	140	324	324-324
	36 (n=2998)	458	838	838-1676	265	838	838-1676	343	838	838-1676	343	838	838-1676
	43 (n=2906)	480	599	599-1197	295	599	599-1197	398	599	599-1197	398	599	599-1197
Outpatient ^b	26 (n=4232)	568	16	16-30	517	16	16-30	622	16	16-30	622	16	16-30
	31 (n=2980)**	490	30	30-86	318	30	30-86	498	30	30-86	498	30	30-86
	43 (n=2908)	643	65	21-151	420	65	44-172	564	65	44-172	564	65	44-151
GP ^c	26 (n=4232)	311	4	4-4	234	4	4-4	322	4	4-4	322	4	4-4
	31 (n=2970)**	714	8	8-80	400	8	8-80	616	8	8-80	616	8	8-40
	43 (n=2908)	496	80	40-201	302	121	40-241	411	80	40-241	411	80	40-161

NSHD = MRC National Survey of Health and Development.

* Emotional problems = mild/severe emotional problems; Conduct problems = mild/severe emotional problems; None = absent problems. ** Estimated frequencies used in generating costs: Frequencies were estimated using the 1989 sweep, assuming a subject used the service in 1977. If no 1989 frequency, it was assumed at least one use and the yes/no was divided by 5 years. ^a Includes service contact described as: Inpatient, inpatient following accident, inpatient residential, inpatient/day surgery (36 and 46), mental health inpatient (36 and 46), A&E following accident (considered as outpatient for 26). ^b Includes service contact described as: outpatient (31 and 46) and outpatient following accident (26 and 46). ^c Includes service contact described as: GP for any reason (31 and 46) and GP following accident (26).

Table 7. NCDS: Median Cost Per Capita of Service Use in Health Service Domains at Key Ages: Median Total Cost (£) Per Health Service Domain at Key Ages And Inter-Quartile Range (IQR) Costs, Categorized by Adolescent Mental Health Status.

Service use	Key ages	Adolescent mental health*											
		Emotional problems				Conduct problems				None			
		n	Median (£)	IQR	n	Median (£)	IQR	n	Median (£)	IQR	n	Median (£)	IQR
Restrictive and/or urgent care (incl. inpatient) ^a	23 (n=12,528)	1440	599	599-1197	929	599	599-1197	988	599	599-1197	988	599	599-1197
	33 (n=11,289)	1561	419	419-838	952	419	419-838	1138	419	419-838	1138	419	419-838
	42 (n=11,360)	1571	91	91-182	966	91	91-273	1165	91	91-182	1165	91	91-182
Outpatient ^b	23** (n=12,484)	1832	48	45-134	1262	89	45-134	1503	89	45-134	1503	89	45-134
	33*** (n=11,322)	1568	32	32-64	1024	32	32-64	1226	32	32-64	1226	32	32-64
	42** (n=7,434)	93	219	208-219	50	213	139-219	61	208	124-219	61	208	124-219
GP ^c	23** (n=12,204)	3187	53	48-53	1858	53	48-53	2244	53	48-53	2244	53	48-53
	33** (n=11,339)	1129	50	50-102	642	50	50-102	767	50	50-102	767	50	50-102
	42** (n=11,377)	1707	101	97-201	1051	101	97-201	1124	101	97-201	1124	101	97-194

NCDS = National Child Development Study.

* Emotional problems = mild/severe emotional problems; Conduct problems = mild/severe emotional problems; None = absent problems. ** Estimated frequencies used in generating costs. ^a Includes service contact described as: Inpatient, inpatient following accident, inpatient residential, inpatient/day surgery, mental health inpatient, A&E, A&E following accident, depending on data available at the data collection sweep. ^b Includes service contact described as: outpatient, outpatient following accident, mental health specialist/outpatient, depending on data available at the data collection sweep. ^c Includes service contact described as: GP, GP following accident, depending on data available at the data collection sweep.

Table 8. BCS70: Median Cost Per Capita of Service Use in Health Service Domains at Key Ages: Median Total Cost (£) Per Health Service Domain at Key Ages And Inter-Quartile Range (IQR) Costs, Categorised by Adolescent Mental Health Status.

Service use	Key ages	Adolescent mental health*											
		Emotional problems				Conduct problems				None			
		n	Median (£)	IQR	n	Median (£)	IQR	n	Median (£)	IQR	n	Median (£)	IQR
Restrictive and/or urgent care (incl. inpatient) ^a	26 (n=8,568)	167	324	324-324	87	324	324-324	168	324	324-324	168	324	324-324
	30 (n=11,157)	230	819	819-819	94	819	819-819	205	819	819-819	205	819	819-819
	42** (n=9,841)												
Outpatient ^b	26***	307	208	208-219	161	208	208-219	265	208	208-219	265	208	208-219
	30**** (n=6,091)	775	34	34-68	318	34	34-68	520	34	34-68	520	34	34-68
	42 (n=9,841)												
GP ^c	26**** (n=8,568)	247	6	6-6	104	6	6-6	247	6	6-6	247	6	6-6
	30**** (n=11,157)	1200	50	50 - 101	463	50	50 - 101	969	50	50 - 101	969	50	50-101
	42****												

BCS70 = British Cohort Study.

* Emotional problems = mild/severe emotional problems; Conduct problems = mild/severe emotional problems; None = absent problems. ** Data only available from n=2 participants. *** Data on this service contact was not collected at this sweep. **** Estimated frequencies used in generating costs. ^a Includes service contact described as: Inpatient, inpatient following accident, inpatient residential, inpatient/day surgery, mental health inpatient, A&E, A&E following accident, depending on data available at the data collection sweep. ^b Includes service contact described as: outpatient, outpatient following accident, mental health specialist/outpatient, depending on data available at the data collection sweep. ^c Includes service contact described as: GP, GP following accident, depending on data available at the data collection sweep.

adolescent emotional problems compared to those with conduct problems or no problems. At age 33, median cost was the same across groups, and at age 42 the costs were broadly comparable across participants with different adolescent mental health status. Overall, the highest outpatient cost was at age 41, and the lowest at age 33.

For BCS70, where median costs were available these were the same regardless of adolescent mental health status, but again costs varied with age. Restrictive and/or urgent care costs and GP costs were higher at age 30 compared to age 26, but no cost data were available at age 42. On the other hand, outpatient costs were higher at age 30 compared to 42, with no cost data available at age 26.

Discussion

We sought to identify consistent and comparable data on adolescent mental health status and health service use up to mid-adulthood using the oldest three major British birth cohort datasets (NSHD, NCDS and BCS70) and to provide a methodology to estimate harmonised costs for health service use outcomes. We have demonstrated the potential for comparison of rates of service use and associated costs by age, type of health service contact, adolescent mental health problem and cohort.

Our paper focuses on describing the methodological approach for harmonising estimates of economic impacts in relation to adolescent mental health problems rather than making statistical comparisons between cohorts. Nevertheless, we identified some patterns which support the validity of our approach. We found, for example, that those adolescents with conduct problems tended to have higher health service costs later in life compared to those with emotional problems or those with no mental health problems. Conduct problems are more strongly associated with poor adult mental health and life chances outcomes compared to emotional problems and they generate higher costs across a range of public sector budgets,^{5,15,34} though the magnitude of impact on health services is modest.^{14,35}

Estimates of economic impact in relation to health service use tended to be robust within each cohort; however, comparisons of absolute costs between cohorts were weakened because of variations in questions asked about health service contacts. Although this resulted in challenges when comparing absolute monetary values associated with health service use between cohorts, relative values and effect sizes when contrasting individuals with and without mental health problems can be compared between datasets. For instance, in NSHD, the median costs associated with GP service use at age 43 for cohort members with adolescent conduct problems was about 1.5 times higher than those for cohort members with emotional or no mental health problems during adolescence. In the NCDS (cohort born in 1958), adolescents with conduct problems had similar GP costs in adulthood, but higher outpatient health service costs over the entire follow-up period (from cohort member age 22 to age 42) than adolescents with emotional or no mental health problems.

Examining patterns of health service costs across three cohorts which assessed individuals at times of political and societal changes can illuminate any trends in health service costs associated with adolescent mental health problems at different points in policy history. For example, health delivery systems and particularly hospital admission rates have changed markedly over time, which we found when comparing our three samples of adolescents: there were general decreases in restrictive and/or urgent care service use for each successive cohort. (An exception is the age 23 data sweep of the 1946 NSHD cohort which shows relatively lower rates compared to the 1958 NCDS and 1970 BCS cohorts. However, this sweep of data collection focused only on the narrower group of participants who were admitted to an inpatient ward following an accident.)

Many studies of economic impacts of adolescent mental health problems focus on mental health-related service use, whereas our approach allowed us to examine impacts across a wide range of health services. People with mental health problems are very likely to use services for both physical and mental health at higher rates than the general population.³⁶ Moreover, barriers to mental health care are often greater than for physical health care because of stigma, limited mental health literacy, and low availability of mental health specialists. Thus, focusing only on mental health care may underestimate the impact of adolescent mental health problems on the health system.

Improving our understanding of the long-term impacts of early mental health problems can improve decisions about how to invest limited public and private resources. To evaluate existing policies and to make effective decisions on what interventions are worth investing in, policy makers need evidence about total and component economic impacts, which subgroups of people are most vulnerable to high and persistent costs over the life course, and which service sectors are impacted at different timepoints. The approach explored in this study provides a basis for calculating costs for different types of health services which can be aggregated and compared according to adolescent mental health characteristics and compared according to cohort (time in history).

Implications for Further Research

Our purpose was to identify comparable variables in three different birth cohort datasets on mental health status during adolescence and on health service use up to mid-adulthood across the datasets, and to monetise the economic impacts associated with the latter. This approach can therefore be a resource for future research, which could conduct more detailed explorations, such as to examine how economic impacts among specific subgroups; or, when combined with information on costs and outcomes of interventions, to help identify those with the potential to provide good value for money, either for the full population or for key target groups identified from the life course profiles. Although the cohort datasets used in this study are British, our approach could be applied to comparable cohort data from other country contexts too.

Future studies could focus on harmonising health service use costs beyond the ages considered in this study. There are also other long-term consequences of adolescent mental health problems which have economic impacts, such as employment difficulties, lower earnings and asset holdings, difficult interpersonal relationships, criminal activity and contacts with the criminal justice system. These, too, could be explored in future research, although the three cohort datasets that we analysed include indicators for some but not all of these domains.

Implications for Health Care Provision and Use and Health Policies

Our primary purpose with this study was more methodological than empirical. The methodological approach explored in this study, and the platform of harmonised measures could contribute to evidence-based health and social policy discussions to improve life course experiences of children and adolescents experiencing mental illness through early intervention and prevention initiatives.^{5,37,38} Comparisons between the three cohorts could help decision-makers understand how longer-term economic impacts of early mental health problems are influenced by historical context.^{5,37,38}

Limitations

This study provides an important resource for exploring costs associated with health service use across the three British birth cohorts, initiated in three different historical policy contexts, but it has some limitations.

Data collection methods varied between cohorts and across time-points. There were differences in the extent to which types of health service contacts were documented in the questionnaires (over which we had no control, of course). For example, in NSHD the only service contacts recorded at age 26 were those due to accidents, thus data do not reflect service contacts for other reasons. A second example is that in BCS70 at age 30, separate questions were asked for GP contacts which specified over twenty reasons, whereas at age 23 there were only four such items, and at age 42 there were no questions regarding GPs. Generally, however, there was consistency in the way that questions were asked about the main types of services across the cohorts, and we made sure that we chose data sweeps at the most comparable ages and with the widest range of available service use data. The data on health service use are based on interview responses and self-report, rather than clinical records, although this is standard practice in UK research because other data sources have tended not to be available (and are today still not routinely available for research purposes). These approaches to data collection might have introduced bias through the impact of social desirability or stigma when responding, and might subsequently underestimate levels of service contact. However, these data represent the best available information, and have frequently been used to assess service use.^{39,40}

Data on health service use frequency were not

comprehensively available for NCDS and BCS70. We attempted to address this limitation by generating service frequency indicators by combining multiple non-overlapping questions regarding service contact when available in the datasets, and by drawing on alternative contemporaneous resources. These approaches generally yielded quite conservative estimates of service use, as data on contacts in previous weeks/months were estimated without adjustment as annual frequencies. This cautious approach was taken so economic impacts would not be overestimated.

Data on adolescent mental health were provided via teacher reports for NSHD, and parent reports for NCDS and BCS70. No adolescent self-report data were available to corroborate these scores; however, these data still provide a valid reflection of adolescent emotional and conduct problems across the cohorts.^{41,42}

Conclusions

A great deal of research has shown the significant and wide-ranging social and economic impacts of mental health problems in childhood and adolescence, as well as in mid-adulthood. There is, however, little evidence on the longer-term economic impacts of mental health problems associated with health service use, particularly those which consider a broad spectrum of health services beyond the mental health sector. In part, this gap reflects limitations in datasets: there are very few that include service utilisation information as well as detailed mental health assessments for representative populations. We provide a methodology to estimate harmonised costs for health service use and describe how this approach could be used across three different British birth cohort datasets. Further application of these methods could be used for more in-depth studies of economic impacts in other population subgroups or, when combined with effectiveness data, used to model longer-term costs and benefits of preventive and other mental health interventions.

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