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The origins and innovatory nature of the 1946 British national birth cohort study

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Abstract

The first of Britain's six large-scale birth cohort studies began in 1946, within eleven months of the end of the Second World War. Evidence is given in support of the argument that the initial aims of the first study were determined mostly by pre-war policy and scientific concerns with falling fertility and the social gradient in infant mortality. It is also shown that the methods and dynamic of the study were provided by the enthusiasm and expertise of a young demographer, and by a young physician's expertise and war-time experience of data collection and analysis. Their pioneering methods of data collection, their concern with both science and policy, and with biological as well as social questions, and the physician's determination and persistence in swimming against the tide of contemporary scientific opinion, provided a strong basis for the study, which still continues.

Keywords: Longitudinal study; history; epidemiology; social science.

Introduction

Britain has a series of large-scale birth cohort studies of individuals that spans the period from the end of the Second World War until today. The first of these studies began in 1946 (Wadsworth et al 2005). The present paper argues that there are specific links between the design of the first national birth cohort study and the science and the policy concerns of the preceding decade, without which that study might not have evolved.

Between the two World Wars there was concern in Britain about the role of science in society (Bernal 1939; Werskey 1971; Pemberton 2002). Inevitably, however, by the end of that time, science had achieved a role which was defined by the demands of the economic depression, the need for healthy and well-nourished children, mothers, the labour force, and the armed forces (e.g. Boyd-Orr 1937). At the end of that period Bernal (1939) wrote that 'It used to be believed that the results of scientific investigations would lead to continuous progressive improvements in conditions of life; but first the War and then the economic crisis have shown that science can be used as easily for destructive and wasteful purposes, and voices have been raised demanding the cessation of scientific research as the only means of preserving a tolerable civilization' (p.xiii).

When Bernal wrote, British scientific research was concentrated in the munitions industries and the Armed Forces, which were gearing for the coming war (Bernal 1939 p.427). The Medical

Research Council was occupied with the predominant disease problems, and published research reports, for example, on the clinical value of radium (Wood et al 1938; Medical Research Council 1938, 1939a), the care of poliomyelitis (Medical Research Council 1939b), nutrition (Cathcart et al 1940), and pulmonary illness in miners (Medical Research Council 1942). The Government was worried about social inequity and possibilities for social insurance against poverty, income insecurity, ill-health, poor education and unemployment (e.g. Boyd-Orr 1937; Beveridge 1942). In addition there was anxiety and research about why fertility had been falling in Britain and in many other countries since the second half of the nineteenth century (Hogben 1938; Kuczynski 1938). Falling fertility was feared a threat to national economies and influence because of its association with a shrinking work force and an ageing population, and it became part of the arguments for extremist views in politics and eugenics. Anxiety about the changing population structure was so great that a Royal Commission was set up in 1944 to study the problem; it reported in 1949 (Royal Commission on Population 1949).

Despite this range of research, the British scientific civilian research establishment in the inter-war years was small, and compared with the years after the Second World War, there were 'fewer barriers between different fields of scholarship' (Zuckerman 1981). In terms of scale, for example, there were 193 professors and heads of departments associated with all branches of medicine in English, Welsh and Scottish university departments in 1935-36 (Bernal 1939 p.418), as compared with 17,240 at professorial level in the United Kingdom in 1999-2000 (Higher Education Statistics Agency 2001).

Once war seemed inevitable, the relatively small scientific establishment was quickly involved in all its aspects. It is argued in this paper that the development of scientific methods of problem evaluation and solution during the Second World War, profoundly influenced the design and undertaking of the initial data collection in Britain's first national study of maternity, and its continuation as a longitudinal study. It is also argued that contemporary policy and scientific concerns about fertility and infant deaths influenced the establishment, design and working methods of that study, much more than the longitudinal studies extant at that time.

Methods

Four sources of information have been explored in a search for the original ideas which prompted the study. First is the influence of wartime field studies of the physical and psychological effects of air raids. Second are the effects on the new study's design of contemporary policy and scientific concerns with falling fertility and socially-biased infant mortality. Third, the design of the first data collection is outlined, and its links with the first two areas are examined. Finally, the design of the follow-up studies, up to age fifteen years, is described, and influences from the initial study, and from existing longitudinal studies already in progress in 1946 are outlined.

Source material for this paper includes contemporary publications, the Zuckerman archives at the University of East Anglia, the archives of Richard Titmuss and of the Population Investigation Committee (PIC), both at the London School of Economics, Langford's (1988) history of the PIC, and publications from the 1946 national birth cohort study.

Influences of field studies undertaken during the Second World War

In 1931 Dr Solly Zuckerman, director of the University of Oxford's Extramural Unit, inaugurated with others a group that debated 'the question of the general significance of science to society, and the conscious role science might play in social development' (Zuckerman 1978 p.394). Meetings of the small group of young scientists and thinkers who formed the so-called Tots & Quots[i] continued for ten years. They were addressed by leading politicians and political thinkers as well as scientists, including F.A.Lindemann (who became Churchill's Scientific Adviser during the war), Henry Melchett (deputy chair of Imperial Chemical Industries), H.G. Wells (novelist and socialist thinker), Tom Driberg (journalist), J.B.Conant (President of Harvard University), Herbert Morrison (Minister of Supply and later Home Secretary), and Jack Drummond (Chief Adviser to the Ministry of Food) (Zuckerman 1978 pp. 393-404; Crowther JG 1970; Werskey PG. 1971).

When the Second World War started most members of the Tots & Quots became involved in policy and research, and used scientific methods to evaluate the impact and processes of war. For example, they were concerned with 'the physics of explosions…the resistance of structures to various types of shock…and the risk that people in underground shelters might suffer from concussion as a result of shock-waves which passed through the earth when a bomb exploded nearby' (Zuckerman 1978, p113). Members of the club also discussed 'plans for post-war reconstruction' (Zuckerman 1978 p 401).

The involvement of these scientists was not initially widely welcomed. In *Science in war* (1940), which the Tots & Quots published anonymously, they wrote that 'the tradition of civil servants belongs to the age of Victorian Liberalism and is one of laissez faire and of Government non-interference. …What we are calling for, not as an ideal, but as an urgent practical need in a desperate situation, is the effective utilization of scientific method, scientific advice and scientific personnel' (*Science in war* 1940). This tone reflects the prevailing view that scientists had been accorded 'low status…by the nation's political and intellectual elites until 1939' (Werskey 1971). Zuckerman (1978) notes how in his study early in the war 'of the biological effects of explosions…(he) had committed the sin of embarking on researches into unfamiliar problems without the preliminaries of committee discussion, and without taking into account the views of the men who were presumed to know more than I did' (p.121).

Zuckerman's studies were nevertheless welcomed both by new Government Departments set up to manage the war, and by the armed forces (Zuckerman 1978, p.121, pp.324-344). The Ministry of Home Security established a Research and Experiments Department which supported Zuckerman's Oxford Extra-Mural Unit (begun in 1939) as it pressed forward rapidly with experimental studies of injuries associated with blast waves and innovative studies of air-raid casualties. Population samples were selected to represent all those exposed to air-raids in Hull, Birmingham and London in 1940-41, in order to study disruption to production, transport, and morale. Expert statisticians, who advised on sampling and analysis, included Dr Frank Yates from Rothamsted Experimental Station (the national centre for agricultural research renowned for its pioneering and innovative statistical work), and Dr Austen Bradford Hill from the Ministry of Home Security's Research and Experiments Department.

In the air-raid studies, a wide range of data was collected from post-mortem examinations, interviews with survivors, and essays written by children aged 10-16 years especially for the study, and information was gathered on patterns of work absence, police sickness, rail and road passenger traffic, and on patterns of use of libraries, cinemas, baths and wash-houses. About 8,000 interviews were undertaken by psychiatric social workers, psychiatrists and members of the research team, and about 2,000 essays were delivered (Zuckerman archive 56/9-14). Systems were devised for classifying injuries and the processes that led to death (Blake et al 1942), as well as for the classification of information obtained from questionnaires and from essays about material circumstances and morale. Psychiatrists and psychologists gave advice, including Dr Susan Isaacs of Cambridge University and Professor Aubrey Lewis of the Institute of Psychiatry at the University of London.

It is clear that Zuckerman's small team (never more than 25, including administrative staff) had a 'can do' attitude. They worked systematically, and rapidly delivered results that can be found in the papers produced for the Ministry of Home Security (Zukerman archive e.g. 59/10/2 and 57/5).

Influences from policy concerns about fertility and infant mortality

The nature of anxiety about fertility between the two World Wars is evident in some of the influential British work on the topic, including *Twilight of parenthood* (Charles 1934), later reissued as *The menace of under population*, Beveridge's (1925) *The fall of fertility among European races,* and *Parents revolt* (Titmuss & Titmuss 1942).

The perceived problem of falling fertility was associated also with the problem of the risk of death in the first year of life. Infant death rates in the United Kingdom had fallen consistently from 1870 (150 per thousand live births) until a period of little change, between 1920 (62 per thousand) and 1937 (61 per thousand): that followed the introduction of the National Insurance Act (1911). Once the fertility rate began again in 1938 to show a fall it was seen as less of a problem, and in 1940 the president of the Royal College of Physicians wondered 'whether the stinting production and careful saving of infant lives today is really, biologically speaking, as wholesome as the massive production and lavish scrapping of the

last century.' (quoted by Titmuss 1943). However, as Titmuss (1943) noted, 'Despite a considerable fall in the absolute rates, the range of inequality for total infant mortality is as great as, if not greater than, in 1911' (p.57). There was, in addition, concern that falling fertility was in part caused by the high costs of child-bearing and up-bringing (Carr-Saunders 1936).

Anxiety about falling fertility had 'led many authorities to conclude that, with a continuance of the present pattern of differential fertility, a decline in national intelligence is threatened' (Glass 1946). Government concern about fertility led to the appointment of the Royal Commission on Population in 1944. It deliberated for 5 years.[ii] The Population Investigation Committee (PIC) began in 1936 and was, in effect, an energetic independent group, based at the London School of Economics. The PIC's full-time research secretary was Dr DV Glass, a demographer then aged 35 years, who had just published his first book (Glass (1936), a study of measures taken to increase population in a number of European countries (Langford 1988). The PIC aimed to stimulate interest and undertake research in all aspects of population change from fertility to ageing (Langford 1988).[iii] The PIC partly funded[iv]a repeat of the Scottish Mental Survey which, in 1932, had measured intelligence in all children (over 80,000) born in Scotland in 1921; the repeat study took place in 1947 (Scottish Council for Research in Education 1949). The PIC also established a sub-committee in 1943 to plan a study of maternity. Miss W. Burt, a member of the PIC, reported that she had undertaken a pre-war study of maternity by sending questionnaires to all health authorities in England and Wales asking about 'costs of maternity which might have acted as partial deterrents from parenthood' (Population Investigation Committee Archive 1944), but the war had stopped that study. The sub-committee pressed ahead with a design for a national study, and in 1945 received a grant from the Nuffield Foundation for a study of child-bearing 'with particular reference to costs, quality and adequacy of services' (Population Investigation Committee Archive 1945a).

The management and design of the first data collection

Defining the aims

The PIC sub-committee planned a two-stage enquiry into the working of maternity services. The first part of the enquiry was to be 'A short-term enquiry consisting of a factual survey of existing maternity services…and the opinions held as to the value of these services in war-time conditions.' The second part was to be 'A long-term enquiry…on the basis of which recommendations could be made for reconstructing the services after the War' (Population Investigation Committee 1943). The need for information on the mother's expenditure on pregnancy was added. During the following year discussions about the design of the enquiry were held initially with the Royal College of Obstetricians and Gynaecologists (RCOG). As the idea of a new data collection was developed, representatives of the Society of Medical Officers of Health (public health directors at the area level), and the Midwives and the Health Visitors Association (public health nurses) also joined the discussion. It was clear that a combination of concerns about fertility, and infant and maternal mortality, should be accommodated in the study design. The sub-committee recognised that the enquiry would inform plans for the proposed post-war national health care services.

The PIC and the RCOG established a small Joint Committee comprising a Chair, a Secretary, and 11 representatives of the bodies already consulted, to set up and manage the study, together with the study's Director and Research Assistant (Joint Committee 1948). They refined the aims so that the questions the study addressed were (Joint Committee 1948, pp.1-2):

- What was the availability of maternity services to different social classes, in different parts of the country?
- What use was made of these services?
- How effective were the services in educating mothers, and in reducing mortality among mothers and infants?
- What was the extent of need for domestic help during pregnancy and the puerperium?
- What was the nature and extent of expenditure on child-birth?

The timeline of the process of setting up the national study of maternity is shown in figure 1.

Figure 1. Time line of the data collection, management of data, and publication of findings in the first national study of maternity.

July 1943	First meeting of PIC sub-committee set up to plan a maternity study
July 1945	Nuffield Foundation grant notified
October 1945	Dr JWB Douglas appointed as Director
November 1945	Pilot studies begin in Bristol, Kensington and Inverness
February 1946	Concern about questionnaire length
April 21st 1946	Data collection begins (sample attempted all 15,130 births during one week in March 1946)
mid-June 1946	Data collection completed (achieved sample 13,687, 91% of sample attempted)
November 1946	Coding and checking almost complete
Summer 1947	Area studies undertaken
1948	Publication of the first book

It is not clear from the documentary evidence how much preparatory work the Joint Committee had completed before Dr James Douglas, a physician, was appointed as director, but it was enough to convince the Nuffield Foundation to support the project. They gave the greater part of the funding, and the rest was provided by the National Birthday Trust. It is clear, however, that Douglas was actively concerned, once appointed, with how the sample was to be selected, and who would collect the data, and he undertook the pilot studies and at least finalised the questionnaires. Sampling methods considered initially, were either to take representative samples from across the national range of area data on maternal mortality with a target sample of 10,000, or to sample from the Confidential Notifications of Births with a target of 4,000 (Population Investigation Committee 1945b). Douglas (1976) later noted that ideally the sample would have included all births in one year. The sampling base finally agreed on was all births in England, Wales and Scotland during a single week.

The questionnaire began to be developed by members of the Population Investigation Committee sub-committee, and Richard Titmuss was asked to recommend 'questions on the social aspects' (Population Investigation Committee 1945b). Three methods of collecting information were considered. Initially it was debated whether consultant obstetricians could undertake the task (Population Investigation Committee 1944). Later, Douglas and Glass considered interviewing by staff of the Wartime Social Survey, or by health visitors. There was concern that health visitors rarely visited the higher income groups, and that interviewers would not be permitted to handle data from the Confidential Notifications. Midwives and health visitors were agreed to be the best data collectors (Population Investigation Committee 1945b). The questionnaires included instructions about their use, and all area health authorities were sent questionnaires for each birth in the chosen period, to be completed by staff using medical notes and interviews with mothers.

Douglas was in post only one month before piloting began and only seven months before data collection started. Even in February 1946, three months before the first data collection, concerns were still being expressed about the length of time required to complete the questionnaire (Population Investigation Committee 1946a). All local health authorities in England, Wales and Scotland were invited, by letter, to participate, and 424 authorities (92 per cent) agreed; 1.9% of mothers refused to be interviewed, 7.3% could not be traced and 0.3% of forms were not usable (Joint Committee 1948, p.3 and p9). Membership of the Joint Committee included representatives of the health professions that were asked to collect data, and that was intended to encourage participation.

The study's strikingly short developmental period after Douglas's appointment and the rapidity of data collection periods are particularly notable, given that the war in Europe on ended on May 8th, little more than 11 months before the data collection began.

Data coding and checking was undertaken by students at the London School of Economics, and Douglas and his colleagues responded to 'some 3,000' queries from the local health authorities (Population Investigation Committee 1946b). The coded information was transferred to punched cards by the British Tabulation Machine Group who also tabulated the data, on instructions from Douglas and his colleagues.

The first substantial publication came in 1947 (Joint Committee 1947) and was followed in the next year by a book (Joint Committee 1948).

Identification of influences on the design and management of the first data collection

The design and management of the initial study was influenced both by Douglas's work with Zuckerman before becoming director, and by the nature of the Population Investigation Committee and its way of thinking and acting.

Appointment of the study's director

In 1937 Douglas had been appointed as a research student studying animal behaviour under Zuckerman in the Anatomy School at Oxford University, and he had been a member of Zuckerman's Oxford Extra-Mural Unit from 1941 to 1945, working on air-raid casualty studies. Douglas's application for the directorship of the study was supported by Dr Frank Yates, statistical advisor to Douglas and Zuckerman in their air-raid studies (Zuckerman 1978, p135; Blake et al 1942). Dr Richard Schilling of the Industrial Health Research Board also recommended Douglas's appointment (Population Investigation Committee 1945).

Field work design

The influence of the air-raid casualty studies may be detected in the initial sampling; Douglas and Glass were very concerned to select representative samples (Population Investigation Committee 1945). The decision to ask health professionals to collect data follows the method used in the war-time fieldwork.

Data management

The rapid pace of the data collection, the handling of fieldwork queries, the coding and the analysis and writing also reflect the pace and decisiveness of work of the Oxford Extra-Mural Unit and the Population Investigation Committee.

Pace of development work and delivery of findings

The rapid pace of development of the maternity study is similar to the development of the work of Zuckerman's group during the war, cutting across 'official' boundaries and taking decisions without lengthy consultation with experts of all kinds. Arguably that experience strongly influenced Douglas's work style and expectations. Similarly the nature of the Population Investigation Committee as a dynamic and young organisation, eager to tackle problems, and unwilling to await the deliberations of a Royal Commission, was reflected in the pace of the new study's development.

Continuation of the influences on the maternity survey during the first 15 years of follow-up

Soon after data collection for the maternity study was completed Douglas and Glass decided to follow-up that sample, in order to investigate the extent to which those disadvantaged at birth recovered, and the causes of any recovery. Douglas (1964, p12) later noted that 'It had not originally been intended to continue the research beyond the 1946 study. But the potential value of a follow-up study was so evident' (Douglas 1964 p.12).

Because of concerns about funding (Douglas 1976) follow-up was undertaken on a sample of 5,362 members of the birth cohort initially studied. The sample retained geographical representation and was selected from all regions of England, Wales and Scotland, sampling only those whose mother was married, and only singleton births. The sample was stratified by socio-economic circumstances by including all those whose father worked in either a non-manual or an agricultural occupation, and a random one in four of those whose father was employed in a manual occupation. The 672 children born to unmarried mothers were not sampled because most were then adopted at birth and untraceable because there was no access to the Adoption Register. The 180 multiple births were not sampled since they were thought too few for analysis. The sub-sample proved to be reliably representative in the long-term (Wadsworth et al 1992). However the disadvantages of omitting those born out of wedlock (672) and the multiple births (180) were later regularly regretted, and it was sometimes argued that the sample size was too small for the study of less prevalent health conditions.

Location and funding

The influence of the Population Investigation Committee (PIC) initially remained strong. Although Douglas moved the study from the PIC at the London School Economics to the Department of Public Health and Social Medicine at Edinburgh University in 1954, Glass remained on the study's advisory committee throughout the period. Douglas brought the study back to Glass's Department of Demography at the London School of Economics in 1962.

After the study's first data collection, funding continued to be successfully sought from independent sources in Britain and the United States. They included, primarily, the Nuffield Foundation, the Eugenics Society, the Rockefeller Foundation[v], the Ford Foundation, and the Population Council. During the study's first fifteen years, funding was a constant concern and struggle.

The continuing influence of the war-time experience on the follow-up study

Four effects of the continuing influence of Douglas's war-time experience in Zuckerman's unit can be seen. They are (a) the continuing use of health and later also educational professionals to collect data; (b) the concern with children's psychological development, which is close to the air-raid studies' interpretations of children's essays; (c) the continuing statistical advice from Dr Frank Yates who had worked closely with Zuckerman's unit during the war; and (d) the continuation of advice from another war-time colleague, namely Professor Aubrey Lewis who was an expert in mental health and psychological development. Both Yates and Lewis were later to be members of the study's Advisory Committee, full membership of which throughout this period is given in Douglas and Blomfield (1958) and Douglas (1964)).

The continuing influence of the Population Investigation Committee

The Population Investigation Committee's continuing influence (and in particular that of David Glass who chaired the PIC from 1958) after the initial maternity study can be seen in the study's concern for education and intelligence and the relationship between educational opportunity, aspiration and socio-economic circumstances of the family of origin. Glass and Gray (1938) compared undergraduate populations and scholarship awards at Oxford and Cambridge universities from 1913 to 1934 in relation to type of secondary school of origin, and showed a bias in favour of the fee-paying schools. Glass was also greatly concerned with social mobility (Glass 1954); he wrote the Preface to *The home and the school* (Douglas 1964). Douglas wrote about inter-generational social mobility in that book and elsewhere (Douglas 1965).

Potential sources of academic influence on the design of the follow-up studies

Most of the influential longitudinal studies that existed before the 1946 study began were developed in the United States as investigations of mental and physical development. For instance, Terman and colleagues began a follow-up study in Stanford in 1921-22 of the intellectual progress of 1,470 children aged 3 to 19 years, and in 1927-28 fifty eight of their siblings were added to the study (Burks et al 1930).The Berkeley Growth Study, in California, began as a follow-up of 61 infants from birth in 1928, and the Berkeley Guidance Study investigated the effects on the behaviour of 248 children, of parental counselling, beginning when the child was aged 3 months (Jones and Bayley 1941). The Fels study of child growth recruited between 80 and 100 children in Ohio in the periods 1929-33 and 1934-1939 as well as at later dates (Roche 1992). The Oakland (California) Growth Study followed-up the physical and psychological development of 212 children beginning in 1931 when they were aged 8 years (Jones 1939). The Cambridge Somerville (Boston) study included intervention (designed to reduce risk of delinquency) as well as follow-up of 325 children and 325 matched controls (Powers and Witmer 1951), and Glueck and Glueck (1934a, 1934b) began their follow-up studies of 500 delinquents and 500 non-delinquents. Other studies include the observational work of Gesell and Ilg (1943), and others reviewed by Kagan (1964) and Reinert (1979). Although most of these studies went on to have extensive periods of follow-up, there is no evidence that the design of the first British national birth cohort study was influenced by any of these relatively small contemporary follow-up studies.

Two large-scale Scottish investigations which were to become follow-up studies were influential in the design of the data collections in the 1946 national birth cohort. They were the Scottish study of intelligence in 87,498 children born in 1921, that

had begun when they were aged 11 years in 1932 (Scottish Council for Research in Education 1933), and the second study of intelligence in Scottish children born in 1936 (N= 70,805) which began in 1947 (Scottish Council for Research in Education 1949). The director of the 1946 study (Dr J.W.B. Douglas) and Professor D.V. Glass (Secretary of the Population Investigation Committee) were on the advisory board of the second Scottish study and were involved in its planning.

Follow-up data collections

During the pre-school and school years the pace of data collection did not slacken (figure 2). Data collections from the whole sample selected for follow-up (5,362) took place at intervals of 2 years or less while respondents were aged 2 to 15 years, with very little loss of sample members through refusal or failure to trace (Wadsworth et al 1992). Douglas was determined to measure growth and physical and mental development as frequently as possible during these years.

Health data were collected by health visitors at home visits at the first two follow-up contacts, and thereafter, school doctors and nurses undertook medical examinations designed by the study. All references to hospital admissions were followed up with postal questionnaires to each hospital requesting further details.

Educational data was collected from the contact at age 6 years onwards. Each school attended by one or more study children was asked to complete postal questionnaires about its facilities and pattern of attainment, and teachers were asked about the child's attitudes, behaviour and progress, and teachers supervised the study children as they undertook cognitive and attainment tests at ages 8, 11 and 15 years; printed instructions to teachers were provided. In addition parents were asked about their concerns and ambitions for their child's educational progress. A considerable additional effort, in terms of data collection and data management, was required to collect this large amount of information, as well as health data.

Each data collection involved discussion of its design with health and educational representatives on the study's advisory committee, design of the data collection instruments, letters to all health and educational authorities asking for their co-operation in data collecting, mailing out the instruments and instructions to each school, and dealing with queries and re-directing questionnaires for children who had moved. The study team undertook all aspects of the data collections.

Each collection was funded separately, and so each involved new grant applications. Nevertheless the study team remained small, and Douglas usually worked with only 2 or 3 scientific colleagues in his team.

Figure 2. Time line of data collections on the sub-sample of 5,362 during the pre-school and school years

Date of data collection and age of children	Data collectors	Places of data collection
1948 2yrs	Health visitors	Home
1950 4 yrs	Health visitors	Home
1952 6 yrs	Health visitors and school doctors and nurses	Home
1953 7 yrs	Health visitors and school doctors and nurses, and teachers	Home and school
1954 8 yrs	Health visitors, school nurses and teachers	Home and school
1955 9 yrs	Health visitors and school nurses	Home and school
1956 10 yrs	Teachers	School
1957 11 yrs	Health visitors, school doctors and nurses, and teachers	Home and school
1959 13 yrs	Teachers	School
1961 15 yrs	Health visitors, school doctors and nurses, and teachers	Home and school

Data management and analysis

Throughout the first 15 years of the study, coding of information was entirely manual, and coded data were transferred to punched (Hollerith) cards, as in the initial data collection. The original paper questionnaires and test booklets were also stored. Some punching of original data and preparation of sets of cards for analysis was out-sourced.

These years preceded the introduction of computers, and analysis was undertaken using a counter-sorter. This often involved abstracting data from the original cards to make new sets of cards that contained only the information required for the analysis. Since the original coded data about each of the 5,362 sample members was stored on many cards, and several cards of data were usually required for an analysis, this was a cumbersome and time-consuming process. Methods of analysis were greatly constrained by the counter-sorting method of handling punched cards.

Consideration of these difficulties of managing and analysing data is likely to have influenced the decision to follow-up only a sample of the original cohort, rather than all 13,687 births initially studied.

Policy concerns

Throughout its first fifteen years the study continued to be responsive to policy concerns, and expanded its interests to include educational and social as well as health policy. It contributed evidence to Government committees appointed to review primary school education (Plowden Report 1967), and the welfare of children in hospital (Platt Report 1959), and published findings about problems of current policy, including the effectiveness of the health visitor service in maintaining child health during the pre-school period (Douglas and Blomfield 1958). Other policy related publications from this period include studies of the contribution of breast-feeding to infant health (Douglas 1950a), the effects of prematurity on growth (Douglas and Mogford 1953), the psychological effects on children of parental divorce and separation (Rowntree 1955; Douglas and Blomfield 1958), mothers' employment (Douglas and Blomfield 1958) and attendance at nursery school (Douglas and Ross 1964a), the relationship of psychological maladjustment with delinquency (Mulligan et al 1963), the effects of absenteeism on educational attainment (Douglas and Ross 1965), and the prevalence of bed-wetting (Bransby et al 1955)[vi].

Probably the most influential research from the study during this period was concerned with the operation of the education system, as laid down in the 1944 Education Act. The data about educational attainment, school and home circumstances, and parents' interest in the education of their study child, were all used to show the influence, from early life onwards, of family circumstances and parental concerns on attainment. They also showed the socio-economic variation in attainment, in educational opportunity, and in the operation of selection processes for entry to secondary schools at age 11 years (Douglas 1964; Douglas et al 1966; Douglas et al 1968).

Scientific aims

The study's scientific aims during the first fifteen years of follow-up were primarily influenced by contemporary policy concerns in health and education. The aims of the first three follow-up data collections (up to and including age 6 years) were to continue the study of survival, health and illness and physical growth and development, particularly in relation to maturity at birth and to the family's socio-economic circumstances (e.g. Douglas 1950a; Douglas 1950b; Douglas 1951; Douglas and Mogford 1953; Douglas and Blomfield 1958).

From age 7 to 15 years the scientific aims were expanded to also include investigation of cognitive development in relation to health and growth and family circumstances. In addition to studying cognitive function for educational policy purposes, Douglas and his colleagues explored the reasons for poor and deteriorating cognitive performance in relation to intrinsic sources of risk, including personality, prolonged exposure to family insecurity, premature birth, age at physical maturity, short-sightedness, and laterality (Rowntree 1955; Douglas and Ross 1964b; Douglas et al 1965; Douglas, Ross & Simpson 1967; Douglas, Ross & Cooper 1967). Those studies showed the importance of height, prematurity and short-sight in relation to cognitive function as measured by the studies' tests. The conclusions were concerned with the interactions of socio-economic and biological factors, with the interaction of family characteristics and short-sight as an inherited trait, and with the question of whether nutrition and parental social mobility played a part in relation to height.

In health the scientific contribution also made good use of the longitudinal nature of the data, and was concerned with socio-economic differences in growth, illness and survival, the impact of atmospheric pollution from coal burning and the association of physical growth with breast-feeding, and of prematurity with cognitive and physical development (e.g. Douglas 1951; Douglas and Simpson 1964; Douglas 1964; Douglas and Waller 1966). However it is argued that, after the findings of the initial study of maternity, the lines of thought about health during the study's first fifteen years, were less consistently developed compared with those in education and cognitive development.

The study did not develop consistent hypotheses, either about persistent socio-economic differences in risk of illness, or about the development of illness risk. The exceptions to this are three papers about the consequences of prematurity, which show it to be a source of risk for later development of walking and for poor scores on attainment and cognitive function tests at ages 8 and 11 years. These findings were hypothesised to be either the result of birth injury or abnormality or poor concentration and application at school (Douglas 1956a, 1956b; Douglas 1960).

The inconsistency in health findings during these early years of the study is, arguably, attributable to the fact that there was no comparable 'ready market' in the health sciences for the study's scientific concerns. Consistent thinking about health risk in relation to early growth and development had not then been developed in child health. Paediatrics, or child health, was in its infancy and predominantly concerned with care and prevention of disease rather than the processes of development. Even twenty years after the study began, Joseph and MacKeith (1966) noted 'the continuing absence of professorial departments of paediatrics from half the undergraduate medical schools in the country' (p97). Epidemiology was still largely concerned with illness and causes of death, rather than normal development, and the pioneering work of Barker (1991) on the long-term health effects of growth in early life was still almost another three decades in the future. During the whole of the period reviewed here, the study was one of only two large-scale longitudinal studies of health in childhood and adolescence in Britain (the other was the Newcastle Family Study (Spence et al 1954) of a thousand families) and the first follow-up of the 1958 national birth cohort, which took place in 1965, when 1946 cohort members were aged 19 years.

Nevertheless the early health data, in particular the measures of physical development, have, together with the early cognitive data, since been of unique and great value and have been extensively used (see the study's web site at http://www.nshd.mrc.ac.uk).

The study's autonomy

The study's continuing concern with topics regarded by contemporary scientists as outside its range of expertise, attracted rebuke of the kind experienced by Zuckerman for his pioneering work. Burt (1969), for example, in a review of Douglas et al (1968), was critical of the educational aspects of the study, concluding that 'for really trustworthy results, it is desirable that the investigator should be an educational psychologist who is himself a member of the education authority staff, preferably (as in the early days) a member of the inspectorate. Teachers and others will take far more care over reports or replies that are to be examined by such an official.' Burt, himself an educational psychologist, concluded that this sort of research needed 'to be planned, discussed and supervised not by one or two individuals, but by a group of specialists – the psychologist, the senior school medical officer, the senior social worker, the chief inspector, a teachers' representative, and a statistical expert, all working together.' Douglas a physician, Dr Jean Ross his educational psychologist colleague and co-author, and Mr Howard Simpson their statistician co-author, gave a robust response (Douglas et al 1969).

Douglas persisted with his policy of independent thinking and, as exemplified above, this was at times against the grain of convention as he pioneered this new method of large-scale longitudinal data collection. His approach and his management of the study was undertaken in the medical sciences tradition of a Principal Investigator with a small team, supported and guided by an advisory committee representing the scientific and policy areas of the research. Douglas's war-time experience and the influence of the Population Investigation Committee and David Glass, as well as the location of the study at the London School of Economics for eight of the first fifteen years, ensured that the data collections crossed disciplines.

Douglas's independent thinking, in terms of the study's cross-disciplinary interests and frequency and content of data collection, was all the more remarkable in the context of the low level of contemporary scientific interest in longitudinal studies and the opportunities they offered, especially in health, as already described. Although the study was then well regarded for its contribution to educational policy, it was Douglas's innovative collection of longitudinal data on health and growth during these early years of the study, that in the longer term became of great value.

The study's publications

The record of publications during the first twenty five years of the study is considered, because that allows time for publications of work arising from the first fifteen years of data collection. During that time the study published most on education and cognitive development, with a total of 2 books and 33 papers. Douglas's (1964) book *The home and the school,* was reprinted three times and re-issued as a paperback that was reprinted five times. His book with Ross and Simpson (1968), *All our future,* was also re-issued as a paperback: both books were widely used in teacher training. Rather less was published on health (2 books and 30 papers), and on socio-economic (8 papers) and methodological topics (1 paper). Despite these publication achievements, the demands of data collection and fund-raising at intervals of two years or less, together with the time-consuming methods of data handling and analysis, constrained the publication rate.

Discussion

The initial impetus for the first data collection in the British longitudinal study of a national sample of births in 1946 has been shown to lie in the Population Investigation Committee's scientific and policy concerns with fertility and infant mortality.

The origins of the design and methods of the first and the follow-up data collections from ages two to fifteen years have been argued to lie in the war-time experience of its director, Dr James Douglas, who had studied the physical and psychological impact of air-raids on the civilian population, including children as well as adults. Those large-scale studies involved designing data collection instruments and persuading and then teaching health professionals how to use them, collecting great quantities of data in different cities using interviewers, coding and classifying the

information, and reporting the analyses in a short time. Douglas used all these methods during the first fifteen years of the birth cohort study. He designed the study's scientific and policy study agenda, and was the source of energy and originality that began and continued the follow-up the study and maintained its progress.

After the initial data collection Douglas had two difficult decisions to make about the design of the follow-up studies. The first was whether to follow-up the whole sample studied at birth (N=13,687), and the second was how frequently to collect data. Deciding to follow-up only a sample of those originally studied was no doubt influenced by the perceived availability of funding, and by the costs and difficulties of data collection and handling when only punched card facilities were available. The sample of roughly a third of those initially studied, that was consequently selected for follow-up, was seen then (and sometimes since) as too small for the study of some disease and disability outcomes. However the trade-off was that the sample size made it possible to undertake follow-up at intervals of two years or less during the first fifteen years of the study, so that for the first time a remarkably sensitive characterisation of children's growth, cognitive development, health, educational experience and attainment, and home environment was achieved in a national sample. This was the result of Douglas's can-do attitude and autonomy, and the fact that he worked with only a small advisory committee and a small staff, and could make decisions without extensive consultation. Douglas's perception and autonomy achieved a striking and innovative success in establishing a strong data resource for his research, and for what has become a very long-term and productive follow-up study that has maintained the measurement of health as well as ill-health during adulthood (http://www.nshd.mrc.ac.uk). However, it is argued here that Douglas's demanding data collection schedule during the first fifteen years of the study, together with the contemporary methods of data analysis, and the small staff size were not favourable to a high rate of publication.

The study's most consistent work during its first fifteen years of follow-up was in education and cognitive development, more so than in health. This, it is argued, was the result of differences in demand, at that time, for longitudinal findings, and the contemporary concentration of medical scientific interest on disease rather than development.

The collaborative inclination and the more trusting approach to science in British society in the period reviewed here, enabled the study to secure a high response rate, and the co-operation of health and educational professionals in data collections.

As a national study of maternity and neonatal health and survival two years before the establishment of the National Health Service, the 1946 cohort study formed the basis for later comparisons with the situation after ten years of the new Service. The first comparative study was of births in 1958 (Butler and Bonham 1963; Butler and Alberman 1969), and a second was begun after a further twelve years in 1970 (Chamberlain et al 1978). Each of those studies also became a national follow-up study, enabling inter-cohort comparisons of many aspects of socio-economic and family circumstances, education and development, as well as health (Ferri et al 2003).

These British studies are in the long national tradition of empirical research concerned with both policy and science, for which data are collected in the community. The British birth cohort studies have continued and enriched that tradition by their longitudinal nature, their value for inter-cohort comparison, their concern with both health and social topics, with policy as well as science, and their use from the beginning, in 1946, of biomedical and social measures.

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Endnotes

[i] From 'quot homines, tot sententiae' or, idiomatically, 'as many opinions as people'. Members included JZ Young (Biologist), JD Bernal (crystallographer), John MacMurray (philosopher), MM Postan (economist), Roy Harrod (economist), Joseph Needham (biochemist and sinologist), Hyman Levy (mathematician), Lancelot Hogben (zoologist), JBS Haldane (geneticist and evolutionary biologist), Gordon Childe (archaeologist), RHS Crossman (politician), and Hugh Gaitskell (civil servant and politician). Guests at various times included William Penney, John Cockcroft and Allen Lane, whose publishing house produced the society's only formal publication *Science in war* in 1940 (Zuckerman 1978 Pp. 109-112 and 393-404).

[ii] The Report wearily concludes that 'Few Royal Commissions have sat longer or wrestled with more difficult and disputed material. Parts of the subject might be likened to that fabled morass 'Where armies whole have sunk.' Para. 686.

[iii] The Secretary of the PIC, Dr DV Glass, was a member of the Statistics Committee of the Royal Commission, and Prof Alexander Carr-Saunders, also chaired that Committee and the PIC, and was Director of the London School of Economics from 1937-1957.

[iv] Together with the Nuffield Foundation, the Rockefeller Foundation and the Eugenics Society.

[v] From whom Zuckerman had sought social science expertise and advice in 1941 (Zuckerman archive SZ/OEMU/56).

[vi] Bed-wetting was not only a clinical but also a policy concern because it was a cause of rejection for military conscription (Bransby et al 1955).