

**METHODS FOR ECONOMIC EVALUATION ALONGSIDE A RANDOMISED  
CONTROLLED TRIAL OF ACCESS TO SUBSIDISED PRE-SCHOOL DAY CARE FOR  
LOW-INCOME HOUSEHOLDS WITH YOUNG CHILDREN**

**Ruben Mujica  
Miranda Mugford**

**Health Economics Group  
School of Health Policy and Practice  
University of East Anglia  
Norwich**

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## **Introduction**

The UK government is proposing a package of interventions to reduce 'social exclusion', and the associated social dependency and improving health, educational status and other measures of "social success" ( Department of Social Security 1999) in the longer term. In the growing culture of "evidence based" decision making, some of these interventions are being introduced with accompanying evaluation (Department of Health 1999, ESRC 1999). Such evaluations are being conducted alongside two early childhood interventions in London, UK. In one of them, the Hackney Day Care Study, the effects of access to out-of-home day care for families living in a socially disadvantaged estate in Hackney are studied. The other study, The Social Support and Family Health Study (SSFH), investigates the effects of different forms of social support for new mothers living in poorer zones in Camden and Islington. Both studies include economic evaluations based on the respective randomised controlled trials.

This paper explores the economic issues surrounding the former, day-care intervention, and describes and attempts to justify the methods for economic evaluation that will be used in the Hackney Day Care Study. Those methods are intended to be consistent with those to use for the economic evaluation alongside the SSFH, so as to allow adequate comparison of results from both studies.

## **Background**

Day-care for preschool children in low-income families has been high in the research and policy agenda of many industrialised countries due to advocated health, educational, and welfare benefits accruing to the child and families directly affected by the intervention. Arguably, society also benefits through spill-over effects in terms of future incidence of crime and productivity gains. Whether those claims are evidence-based is a matter of debate that varies by type and nature of outcome. Moreover, the specific institutional and social contexts are certainly factors that may render proven benefits from one country or community as non-transferable to other communities. This is particularly important since the great majority of the available evidence on effectiveness and economic aspects of the subject refer to studies conducted in the US.

Whilst differing by its orientation towards educational or custodial ends, the importance of childcare for today's household economy has been documented by survey data. In 1991-92, UK families with at least one child under 5 years of age were using a wide range of childcare services, with the average charge being positively associated with the average amount of hours of childcare use per week. [Duncan, et al. 1995] Thus, childminding and multiple forms of organised and/or paid care are associated with higher average hours of use per week and much higher charges faced by parents than say, Local Authority nurseries and playgroups (10 hours per week) or nursery schools (20 hours). Nevertheless, the choice of specific childcare option seems to be affected mostly by the age of the children. When the forms of childcare used for the youngest child and all other children under five years of age in the household are combined, the use of informal care decreases from 70 percent in families with the youngest child being less than one year old to 24% in households having a 4-year-old as the youngest member. On the other hand, the use of nursery schools (likely to be free of charge) increases from less than 5% at age 1 to around 45% for households with the youngest child being a 4-year-old. Evidence from a study by the Department of Education and Employment 1995 (Duncan et al. 1995, page 43) shows that 77 per cent of all four-year-olds were attending nursery schools for at least part of the year prior to their first full primary school year.

### *Health and cognitive/educational benefits of day-care interventions*

As Waldfogel (1999) notes, different types of intervention are often included under the label 'Day-care interventions', which may comprise day-care alone, or a combination of an educational curriculum and day-care. Since the curriculum often varies between studies in the literature, the type of intervention is likely to differ accordingly in an important way.

An interesting review of studies in the area is given by Zoritch, et. al. (1998). It used systematic review methods to analyse the available evidence on the effectiveness of day-care. To minimise potential bias in interpretation of the evidence, the review included only randomised or quasi-randomised controlled trials. From the eight studies that met the conditions for inclusion in the review, there was a better cognitive development and a lower rate of school failure, the outcomes most commonly investigated in the studies. Benefits were also observed in terms of children's behaviour. For example there was a reduced rate of criminal activity in children in the day care group from the study with the longest follow-up of 27 years (Barnett 1996) increased maternal education and employment were observed, thus positively affecting the socio-economic status of households. The authors pointed that "this is likely to mediate outcome for the children in terms of cognitive development and school success" (Zoritch, et al. 1998, p 324). This single study also gave evidence about positive effects in terms of mother-child interaction, with children in day-care communicating better with their mothers than the controls.

There have been other reported reviews of studies of early childhood interventions including out-of-home day-care for young children, but these reviews have been including less strict criteria for inclusion of studies than the systematic review reported above [Waldfogel 1999, Barnett 1988].

In summary, health outcomes of the index child and other household members have rarely been measured and adequately reported in prospective studies (the Infant Health and Development Program (IHDP) being a notable exception; Brooks-Gunn et al. 1991) and the effects on parents are analysed only in a few cases. Even those studies that measure outcomes for the mother (there are no prospective studies measuring outcomes for the father), focus only in the educational, employment and health insurance status outcomes (Brooks-Gunn et al. 1991). This represents an important omission, in view of the argument that a lower incidence of maternal depression is a potential indirect benefit from subsidised day-care, which by increasing labour force participation and employment may positively affect the psychological health of mothers.

### *Other benefits*

Given an observed link between poverty and unemployment, governments from western countries have tended to advocate the use of subsidised child-care policies as a way to take out low-income families with young children from poverty. If, as it is argued, access to subsidised out-of-home child-care is associated with an increase in maternal employment, then there is strong case from the societal viewpoint for providing subsidised means-tested child-care providing the increase in household income of the poorest households is enough to take them out of poverty. Since poverty is associated with negative health and developmental outcomes for children and their parents, this appears to be a compelling initiative (Acheson 1999).

The link between maternal work and household poverty derives from the more general link between female work (i.e. work of women with and without children) and poverty. A decreasing tendency in the gender pay gap (i.e. the differential in earnings between working men and women) and the increase and decrease in female and male labour force participation rates, respectively, have led to an increase in women's earnings as a proportion of the total household income

[Harkness, et al. 1998]. Data from GHS has shown also that the proportion of adult lone women heading a household has risen from 27 percent in the late 1970s to 29 percent in the early 1990s [Harkness, et al. 1998].

On the other hand, Joshi et al (1998) present results not so favourable to the policy of encouraging women to seek paid employment as a way of reducing poverty. They note that non-working poor women living on benefits may represent a self-selected group with poorer job prospects. In particular, the job opportunities open to those women would appear to be restricted to part time jobs.

In addition, economic theory suggests that the changes in welfare benefit entitlements corresponding to changes in labour force participation affect the number of hours and the minimum wage that a mother is willing to work for. Although lower non-earned incomes are associated with positive incentives to work (income effect), the income-dependence of welfare benefit levels may render the reservation wage of poorer households higher than that of those immediately above in the income scale, thus making the latter more likely to work than the former. This may be one of the major causes for a lack of supply response from women on low-incomes to 'welfare-to-work' policies producing little effect on their household economies [Bayley et al. 1994]. Fixed time and monetary costs of maternal work have also been found to be substantial, and, more importantly, labour supply studies have noted the choices open to women for substituting between money and time costs of childcare, the single most important cost item for mothers in paid employment (Cogan (1980)). Consequently, mothers may need higher expected wages and longer working weeks in order to be willing to take up paid employment, the more young children they have.

### **Economic evaluations of day-care for under fives**

To date, only two economic evaluations of day-care have been reported under the framework of cost-benefit analysis [Barnett, Escobar & Barnett] and at least 8 of them have associated reports on both their *programme costs* and educational and health outcomes. It is interesting to note that since most studies have mainly focused on educational outcomes of children, and that an economic evaluation including the overall welfare of the household has not been attempted yet.

These studies were conducted a long time ago (1960's and 1970's). Given the much higher labour force participation of mothers in the 1990s, the nature of day-care has changed. Although recognising the important positive role that it may have as an educational intervention for disadvantaged groups, the emphasis has somewhat shifted towards the benefits that day-care may have in the overall household welfare *via* poverty relief and longer-term economic sustainability.

Thus, new elements need to be considered into the equation. In particular, the effects on the labour status of not only the mother but that of the father (and possible any other adult living in the household) may be determinant in an economic evaluation of a day-care intervention. Furthermore, the additional issues that maternal employment present for the emotional, social and cognitive development of the child (children) involved in the intervention need to be addressed within the economic evaluation framework.

### **Evidence on the economic implications of day-care**

The Perry Preschool Study (Barnett 1998) is probably the only one properly reported full economic evaluation of day care to date and certainly the one with the longest follow-up data, thus deserving special attention. It measured child outcomes in terms of education, productivity,

and social behaviour (crime), as well as welfare benefit, child care and health care use of African American, low-income families with 3 and 4 year olds in a deprived community in Michigan, US. The study was a well-conducted, randomised controlled trial, with an extensive follow-up up to age 27. Probably the greatest strength of the study may lie on its low, group-balanced attrition rate (mean across time of 8.7%, median 4.9%). On the other hand, the most serious weakness of the study was the fact that two participants were transferred from the (intervention) group they were originally randomised to the alternative (due to non-compliance with the programme) and so were analysed. In doing that, the analysis implicitly adopted the principle of ‘treatment completers’ as opposed to ‘intention-to-treat’, in opposition to what is considered as ‘best practice’ in the clinical and biomedical literature. Finally, the study did not include an estimate of effects for dropouts, whereas it did include the corresponding costs incurred by them in using the service of the programme.

The Perry Study concluded that there is an enormous potential for ‘Pareto improving’ day-care interventions due to the observed benefits across the educational and welfare fields. The study argue about the possibility of long-term health benefits (not measured in the study), whilst finding no short-term health effects (no estimate provided). Barnett (1987) presents a review of studies dealing with some costs and benefits associated with day care interventions in the US. He reports the programme costs for 13 different studies of “centre-based programmes”, only six of which included a population of disadvantaged children (the remaining studying only handicapped children) with only two of these being studies meeting the quality criteria in the review by Zoritch et al. (1997) referred to above. One of the studies, namely the Carolina Abecedarian Project, no published report could be obtained (conference paper cited in Barnett 1988), whilst the other was the Perry Preschool Program just described.

### **The Hackney Day Care Study**

The remaining sections of this of the paper describe our planned economic evaluation alongside a randomised controlled trial of access to subsidised day-care. The evaluation intends to measure the relevant costs and benefits across the areas of human life involved and affected the most by a day-care intervention for households with children younger than 5 years of age living in a deprived area of London.

Out of home day care for families with young children (=5 years of age) living in a disadvantaged area in Hackney, London, is being evaluated in a randomised controlled trial, co-ordinated from the Institute of Child Health. The trial was designed to include an assessment of economic factors as well as the effects on health and wellbeing of mothers and children and household welfare.

The methodology of the trial has been described before (Roberts, et al. 1997). The Hackney Day Care Study aims at determine the effect of out-of-home day care on the health and welfare of socially disadvantaged families with children aged 6 months to 3 ½ years. The study intervention comprises subsidised, means-tested access to full- or part-time day-care, with the study being conducted in the deprived inner London Borough of Hackney.

The community day care centre, Mapledene Early Years Centre (hereafter ‘Mapledene’), was provided by Hackney Council. Mapledene is a brand new centre which opened at the start of the study. There have been changes to its physical and administrative organisation and educational structure during the course of the study. The centre is staffed by a multi-disciplinary team including nursery teachers, early years educators, primary helpers, speech and language therapists

and administration staff. The Centre curriculum conforms to the specifications detailed in Hackney Local Education Authorities Early Years Curriculum Guidelines.

The entry criteria require study families to be resident within the Borough, and have a child between the ages of six months and three and a half. A total of 110 families on the waiting list of the Local Education Authority have been randomised (September 1999) to either receive subsidised out-of-home day-care at a new 'Early Years' day care centre (Mapledene) or to serve in the control group. A stratified blocked randomisation procedure (strata based on a standard socio-economic scale of the participant's residence) using the family as the relevant unit was conducted after asking families for their consent to participate. The allocation of patients was performed by telephone contact with a randomisation service based at the Department of Epidemiology at the Institute of Child Health.

The revised fees for each child taken into the centre, as effective from 4 January 1999, are the following: Minimum fee, £5.00 per week for those receiving income support; Assessed places, from £10.50 to £70 per week according to income and outgoings; Maximum fee places, £70 per week for service from 9 am to 5 pm (£2.50 per session before 9 am and after 5 pm for the whole or part of an hour). As of December 1998, Hackney contains a high proportion of families on low-incomes, with nearly one quarter of children in Hackney (approx. 11,000) living in one-parent families.

Mapledene also houses Education Department training programmes leading to NVQ 13 qualifications, and other occasional training services run jointly by Mapledene and Hackney Education.

#### *Measurements and data collection in the trial*

Baseline information has been collected using self-administered postal questionnaires from all participants at the start of the study period. The questionnaire covered the family composition, background, socio-economic circumstances, social support and networks, experiences of child rearing, use of health care and child-care services and parents' assessment of their own and their children's health and well-being and life-style behaviours such as smoking. A community paediatrician has also collected baseline information on health status including weight, height, speech and language development, hearing, cognitive and social development. Quantitative and qualitative follow up data on the effects of the intervention at 9 months is collected using a similar postal survey as that used for the baseline data. Data will include information about the incidence of child injury and infections, maternal depression, associated health care and child care resource use, employment, and household income. The children's physical and developmental status will be measured again at the end of the 18-month study period, at which time the final follow up survey will also take place.

Parallel to the above questionnaire data collection process, qualitative interviews will be conducted with a sub-sample of the study participants so as to collect qualitative data and specific quantitative data which could not be collected in the trial questionnaires due to space constraints (further on this below).

#### *Outcome measures in the trial*

The power calculations for the trial were based on ability to show a 25% increase in labour force participation, reflecting policy interest in 'welfare to work'. This power will also allow detection

of important differences in childrens' development and maternal depression. In more detail, outcomes are to be measured as follows

Maternal health Maternal depression is being assessed using the Edinburgh Postnatal Depression Scale. The authors of the research proposal report that the scale and smoking self report data have been shown to have satisfactory validity and reliability (and adequate sensitivity over time for the former) (Roberts et al. 1997)

Child health, development and behaviour The Griffith's Developmental Scale is being used to assess developmental outcome. Particular attention is being placed on the incidence of otitis media with effusion, as this is considered to be a possible consequence to day-care attendance and because of its potentially adverse effect on hearing. Consequently, the presence or absence of middle ear effusion will be assessed by tympanometry. The trial questionnaires include the Child Behavioural Checklist so as to record behaviour problems, with the Total Problem Raw Score being used for the analyses (as in the US IHDP (Brooks-Gunn 1991)). The latter associates more behaviour problems with higher scores.

Safety: Child injuries and infections The number of injuries requiring medical attention is measured in the parental trial questionnaires. Using parental questionnaires rather than seeking hospital records or GP casenotes has been demonstrated a valid main source of data on injuries requiring medical attention (Pless and Pless 1995; Agass M et al. 1990). Point prevalence estimates will be derived for infections by asking the mothers about the use of antibiotics at trial measurement points and the reasons for using them for those who do so. Mothers are also being asked to report the presence of any of the following: diarrhoea, vomiting, cough, high temperature, snuffles/cold, earache, ear discharge, eczema, wheezing, and constipation.

Due to the potentially long recall period for the events and outcomes since the start of the study, the questionnaires will focus mostly on questions designed for one and six month recall periods, depending on the frequency of the event in question. The specific recall period chosen for each outcome measure was selected based on the available evidence on recall bias and the optimal recall period (Loftus, et al. 1994).

*Economic data and analysis.*

Aims The overall aim of the economic evaluation is to determine costs and compare the costs and benefits associated with the day care intervention. There are many dimensions to benefit. For economic analysis it is important to define the key measure(s) which reflect(s) the objectives of the service.

The simplest form of *health* economic evaluation, cost-effectiveness analysis (CEA), compares the costs of achieving a single objective, such as prevention of child injury. The analysis can be repeated for each important outcome (maternal depression, etc.).

When there are several, possibly conflicting health objectives, they can be combined by considering an overall health status or quality of life measure, which incorporates other factors (such as EuroQol and SF36). From these, it is possible to estimate so-called utility, which is weighted valuation of the health gain, based on weights derived from population studies. Alternatively, the family members' preferences in relation to the outcomes mentioned above would need to be measured. Such data are used in cost-utility analysis (CUA) which estimates the

costs of achieving utility gain. The trial has not been designed to measure parents' utilities, nor does it include a general health instrument.

Utility or quality of life measures do not reflect the full range of benefit of the day-care intervention under study. There are dimensions of wellbeing (e.g. parents' value given to the receipt of welfare benefits or educational effects of day-care for young children) not included in the utility measure as well as a potential overall gain to society other than that to the families in the study (e.g. from economic activity, changes in taxation and benefits or reduced crime of future adults).

Although the range of benefits and costs involved in a day-care intervention might suggest a clear case for CBA, we have decided that the approach to be adopted will be that of CEA, which will look separately at ranges of outcomes and costs of interest to differentiate stakeholders. This decision reflects time and feasibility constraints in the study.

Viewpoint for the analysis The concept of costs and benefits generally differs between stakeholders or policy makers, such as families, education department, local authority, health authority, and treasury. Each viewpoint is thus associated with a specific set of definitions of total costs and benefits, unit costs, and resource consumption, which is likely to differ with the different decision makers involved in the programme. For this reason, the consideration of the different viewpoints in separate analyses of an economic evaluation may be informative for decision-making. Nevertheless, from the theoretical point of view, an overall welfarist 'societal' evaluation, which attempts to sum up net costs and benefits to society, is a recommended evaluative strategy to use in health economic studies. Under this framework, the relevant concept of unit cost of resources used is the 'opportunity cost' (Johannesson and Jonsson (1991)).

The opportunity cost concept is used to describe the value of the activities forgone by having resources tied to an intervention. Thus the value of one hour of GP care is the monetary amount equivalent to the value of its most productive alternative use. When a perfect market exists, the unit cost used to value resource consumption is generally the price of the item in question. In the more general case of no availability of price, the 'opportunity cost' would have to be calculated based on the related resource use data. The cost of one GP hour would be based on the salary of the GP, his workload, the items used for the consultation, overheads at the GP surgery, etc.

On the other hand, if the analysis adopts the partial view of a specific economic agent (e.g. a government department or the Treasury), although the proper definition of unit cost should be the same as before (i.e. the opportunity cost or societal value), certain cost elements included in the societal analysis will not be relevant to and need to be excluded from an analysis using the partial perspective. An example in the context of day care is the productivity gain brought about by the intervention, in the form of increases in the labour supply of mothers. Whilst this productivity gain potentially represents a net gain in societal benefit, the increase may have little if any effect on the decision making process of, say, the UK Department of Health.

Whilst we shall carry out an economic evaluation using both the 'partial perspective' and the 'societal perspective' framework, our analysis will draw as much as possible from readily available data from either market activities or from plausible, estimated data based on clear methodology consistent with economic theory (e.g. SSRU's compilation). However, we still have to conduct our own costing exercise of the costs per child/year for the Mapledene Early Years Centre.



The categories of cost and benefit considered in the economic evaluation of the day care intervention of the Day Care Study are presented in Table 1, according to the perspective used in the analysis. The benefits and costs described are related mostly to the short term in keeping with the study design. Costs are allocated to columns in Table 1 on the basis of the agent paying the price for using the resource (rather than the one who uses it, who is always the household directly affected by the intervention), whilst benefits are assigned according to the agent whose interests are affected by the programme. Note that the societal perspective is included and covers the benefits accruing to all agents. Since some costs and monetary benefits are either just transfers (welfare benefits) or can be integrated into a single overall measure (gross wages as opposed to net wages, income tax and National Insurance contributions), some terms in the last column may not follow directly from those in the previous columns.

#### *Data collection and Analysis*

Outcomes Since the aim of the economic study is to perform a cost-effectiveness analysis, the benefits will be measured in natural units (e.g. injuries avoided, reduced incidence of depression, etc.). Data on health-related, educational and welfare outcomes will be obtained from the trial questionnaires and paediatric examinations as reported above.

Costs The estimation of costs requires the collection of data on quantities of resource use and the prices or unit costs associated with those resources. We defined the units of resource use needed for to the cost analysis. For example, the costing of the day care service at Mapledene can be carried out using different levels of detail. One could either get information on the number of hours that the service was provided to each child (needing a ‘cost per service hour’ unit cost to value the quantities of resource consumption) or, simply to get information on the number of days of service provision (having its unit cost defined as ‘cost per day of service’).

The decision on the level of detail to use in the costing exercise requires a cost-benefit exercise by the researchers. We have chosen to use a level of costing as simple as possible, while still consistent with previous costing studies of day care and with common practice in health economic evaluations.

- The costs included in our study can be classified into seven major categories according to the nature of resource involved. The term ‘mother’ is used to describe the main carer, whilst the use of ‘children’ as an alternative to ‘child’ reflects the fact that the allocation to intervention and control groups was performed in ‘clusters’ with the household as unit of allocation. Thus, an intervention household with more than one child aged 6 months to 3½ years of age would have those children receiving the intervention.

Resource use Data will be obtained from two sources: the parent’s questionnaires; and review of Mapledene records of daily child attendance, staff returns, supplies, utilities, capital and equipment and other overheads.

A description of the resource use categories as defined in the tools used for their measurement is presented in Table 2. The main resource use categories are the following (We refer to Roman Numbers in Table 2).

Child care hours per week by main carer and partner (I and II, respectively), others out-of-home (VII) and formal care (VI and XVIII)

Travels per week related with health care service use by mothers and children (V)

Medication use by mother and index child (IV, X, and XI)

Health care use by mother and index child (XII, XIII, XIV, XV, XVI)

Community service use by mother and index child (XIV, XVI)

Education service use by mothers and time in paid work by mothers and partners (IX and VIII, respectively)

Welfare benefit claims by any adults in the household and level of household income (which may be approximating household consumption, except for those families investing heavily on education; XVII and III, respectively)

The direction of expected effect is also described in Table 2, according to the evidence in the literature and related work. Thus, 'hours of childcare per week by main carer' (I), is expected to show a negative effect since the intervention mothers would face a lower cost of day-care, thus encouraging them to substitute more of their own time for out-of-home day care (Cogan 1981, Duncan, et al. 1995). This leads to our next hypothesis. Labour supply (represented by VIII in Table 2) of the main carer is expected to increase more on average in the intervention group than in the control. Since day care, and family support in general, has been observed to be associated with lower incidence of maternal depression (Olds, et al. 1998), at least in principle the intervention is expected to be associated with a lower maternal use of medicines for such condition (XI).

Data from previous randomised controlled trials on day care do not provide a clear direction of effect for the intervention in terms of primary care visits and hospital encounters. Similarly, a hypothesis on the use of GP services (XII) may be difficult to establish due to the possibility of having more infections as a consequence of an increased exposure to potential infecting agents by intervention children.

The welfare benefit uptake by households (XVII) in the study is expected to decrease, based on the arguments stressed above for the effects of subsidies in childcare costs on employment. Welfare benefits will play an important part in the crucial stage of mothers deciding whether or not and how much work is a good choice for them and their families. Thus, for example, the lack of reduction in welfare benefit levels can be used to identify a negligible effect on employment (and household income) of better access and increased use of formal child care.

Finally, the use of subsidised childcare at Mapledene will be measured to a greater level of detail than that for any other child care service used by study participants. That is due to the high costs involved in tracking down the various types of childcare used apart from Mapledene and then adjusting them to a comparable quantity measure. One possible way out of this is directly valuing them in monetary terms and then comparing total childcare costs (rather than fees) per participant. The problem then arises as whether to treat the fees paid by control subjects (and possibly some of those paid by intervention subjects) as reflecting true costs or not. The latter question can be resolved only to a limited extent by knowing whether or not study households have access to alternative subsidised childcare services. This information will be available up to a certain extent in the study.

For all other elements of cost we have no clear evidence as to the possible direction of effect if it exists at all, and this will be reflected in the design of our statistical testing of observed inter-group differences for the items in question.

Resource use estimation issues Two cost items deserve special attention due to the implications for the analysis. One is the measurement and valuation of informal care provided by the partner

(when there is one). Given the high costs of obtaining a precise estimate of the amount of childcare provided, a simplified tool will be used to measure the frequency of care provided by the partner. Therein, the main carer will be asked 'How often does your partner (if you have one)...?' and will give options to tick from 'Daily', 'A few times a week', 'A few times a month', and 'Never', for the items 'look after your children', 'bath the child/ren', 'feed the child/ren', 'go shopping for groceries', 'do household tasks' and 'cook for the children'.

The estimate of the partner's total number of childcare hours will need predetermined values being assigned to each answer choice for the item 'look after your children'. This item alone is thought to adequately measure child care due to the possibility of joint production in housework (i.e. of one taking care of a child at the same time is performing household tasks). Thus, for example, 'Daily' may be given a value of 2, 4 or 8 hours a day depending on the partner being unemployed, working part-time, or working full-time, respectively.

The corresponding estimate for the main carer time will be derived as a residual after subtracting from day time the care time from all other sources. The issue then turns to how to adequately value any use of informal care time. To this purpose, we follow the lines suggested by Posnett and Jan (1996), who differentiate the valuation of non-market time according to the labour market structure (perfect competition versus monopoly), the opportunities forgone by tying time to care (leisure, housework, labour market activities), whether lost production is being replaced or lost, whether unemployment is voluntary or involuntary, and whether income and sale taxes are present.

Paid work time poses problems associated with extrapolation. Our questionnaire tool uses the design described in Table 3. As designed, the employment question 1a covers a period of one month only, leaving a void of information for an eight-month window between baseline and the first follow-up and between the first and second follow-ups. Thus, question 2a will complement it by providing information on the variability of working status during the past 9-months. This format won't of course be enough to provide precise estimates for those cases with high mobility in and out the labour force or those who change from part-time to full-time work at some point in the 9-month period in question. Nevertheless, it was thought that this was a preferable option than having a more detailed question (due to recall biases) or not having a question 2a at all (due to the gain obtained by reducing uncertainty to those highly variable cases only).

Unit costs In order to estimate costs for each programme participant, the respective quantities of resource use will be multiplied by their corresponding unit costs. Unit costs will be predetermined or fixed, since their value would be independent of the quantities of resource use consumption by study participants except for one case. The unit cost of day care service provision will vary with the amount of resource use consumption by the study children because they compose the huge majority of the children being serviced at the centre (Mapledene). Thus, although one can refer to published information to value resource utilisation, for the estimate of costs of the intervention a costing exercise is needed to obtain valid unit costs.

Information on unit costs will be obtained from the following sources:

- A review of Mapledene records
- Published 1999 and 2000 data on unit costs of health care and home care services (Kent PSSRU),

- Treatment courses and acquisition costs of medicines in the UK (British National Formulary),
- Full-time and part-time education (DoE), occupation-specific wage data for London, and official information on the monetary levels of welfare benefit entitlements for January-September 1999, September-December 1999 and January -June 2000 (ref DSS);
- Interviews with a subsample of the study participants to be conducted during January and May 2000 (travel costs only).

Some information on unit costs (various childcare services) will not need specific collection since it will be reported in the form of total outlay figures by respondents in the trial questionnaire (i.e. will be reported as the product of unit costs and quantities of resource use).

Total cost estimation Since the primary data collected from the parent's questionnaires and other sources will cover only part of the period of interest, the estimation of costs for the period of analysis will require of the extrapolation of estimates for the remaining period for which data do not exist. Table 4 describes the methodology for deriving cost estimates across all relevant cost categories for the whole study period January 1999- June 2000, from the collected data on resource use and unit prices described above.

The sum over all row totals on the third column of Table 4 above yields the estimate of total costs for a given household. Then summing up across all participants/households in each group one obtains the total cost by group. Since the study groups have different number of participants, costs have to be normalised by the respective number of members of each group to make the estimates comparable. The average cost per household by group is thus calculated by the following formulae:

$[Ch_{i1} + Ch_{i2} + \dots + Ch_{in}] / n_i =$  Average total cost per household intervention group

$[Ch_{c1} + Ch_{c2} + \dots + Ch_{cn}] / n_c =$  Average total cost per household control group

where

Ch<sub>ix</sub> = cost of household x in intervention group

Ch<sub>cx</sub> = cost of household x in control group

n<sub>i</sub> = number of households in intervention group

n<sub>c</sub> = number of households in control group

### *Statistical analysis*

After the cost of each household in the study has been estimated, one can explore the pattern of variability in the data by study group. Means, medians and standard deviations will be available to perform statistical tests. Depending on the distribution of the observations, t-tests will be used to analyse cost differences when normality appears to be a plausible description of that distribution, whereas Man-U Whitney tests will be used to test for differences in costs between groups when a non-normal distribution is thought to exist.

### *Sensitivity analysis*

From the above discussion it seems clear that there will be an important degree of uncertainty in key variables for the economic study. Two areas will be covered by such analyses. 1) The variation of assumptions on resource use quantities associated with paid working time and the childcare hours of the partner; and 2) the variation in unit costs used to value paid work, health care encounters, and informal child care. The analysis would also look into the generalisability of the results by varying unit costs of day-care provision and wage levels to reflect practices and

labour market contexts in other countries with experience of day-care service provision (e.g. Sweden, US).

### **Presentation of results**

Given the cost-effectiveness framework chosen for the economic evaluation of the day care intervention, the results could be presented in the following formats, which represent different interests or viewpoints for those who are affected by the day care intervention. For example, Cost per injured young child (less than 3 1/2 years of age) avoided (CICA), calculated as:

$$\text{CICA} = \frac{[\text{Total average costs per child in intervention group} - \text{Total average costs per control child}]}{[\text{Proportion of control children with occurrence of injury} - \text{Proportion of children intervention group with occurrence of injury}]}$$

This outcome measure may be relevant to different stakeholders; thus, the analysis may be conducted under three different perspectives, namely,

The Department of Health (DoH)'s perspective

The household's perspective

The government's (not only the DoH) & the household's perspective

All perspectives mentioned before are relevant to different potential users of the study results and will be analysed. The trial allocation is by family rather than by child. Although some will be interested in the effects of day care on individual child outcomes, the policy interest is in effects on the household as a support system. By using the household approach to costing and measuring outcomes (unit of economic analysis), economies of scope are allowed for in the results of the analysis, whereas the use of the child as unit of analysis results in the exclusion of such an effect from the results. We could also present the results in an 'hybrid form'. For example, by reporting costs and benefits in terms of additional child costs per additional household without a child infection or injury (or, alternatively and more plausibly, additional household costs per additional child without an injury or infection). That would implicitly assume that the sample distribution of family structure is representative of that in the population to which the results are expected to be applicable.

### **Points for discussion**

This paper is a preliminary attempt to describe our plans for data collection alongside a multidisciplinary trial, based on our review of existing evidence.

There are several unresolved or problematic issues which can be divided into those specific to the study design and short term evaluation, and those concerned with the extrapolation of this study's findings to give valid policy advice, including external validity of the results and long term implications.

#### *Study design issues*

Appropriate outcome measures We have chosen to present a cost-consequence or cost effectiveness analysis of the results, as the study will not have data on values of outcomes. We think this is appropriate as a first step, but if a cost-benefit approach is relevant, as we think it is, then more data are needed.

Unit costs of day care use We have had to estimate unit costs of Mapledene using a top down accounting methodology. Families in the control group use day care facilities elsewhere, and

these will be costed from routine data about typical costs. We will not be comparing unit costs on a like with like basis, and are not sure if this matters.

Measurement and Valuation of Informal care. The use of time from parents for child care purposes represents a difficult item not only to measure but value. The task gets more complicated when one allows for out-of-home informal care networks like those constituted by the relatives and friends into the analysis. The problem might be critical to the results in view of the possibility of intervention participants becoming more intensive users of formal vs informal child care than those in the control group.

Measurement of resource use and costs not included in trial data forms. As far as possible we have made sure we capture use of key resources within the trial, however, some elements are not included. These include parents' costs of accessing health and day care (travel costs), and also possible recall bias in numbers of health care contacts reported.

### *Policy analysis*

Generalisability of the study results. Given the increasing importance of the labour market and its associated social security context in the household economy, the short-term health and other outcomes are likely to be heavily affected by the socioeconomic characteristics prevailing in Hackney, the community where our study is being conducted. Therefore even after ensuring that valid estimates are obtained in our economic study, it will be important to be able to say something about how the study setting affected our results.

Extrapolation of results beyond the 18 months of study. Recent evidence on the effects of maternal work before the children's first birthday on the latter maths ability, lack of aggressiveness, lack of anxiety, and reading skills, points towards negative results (The Guardian's report on Joshi's study, Reeves October 10, 1999). Similarly, health issues like the appropriate timing to stop breastfeeding (suggested to be at least until the 1<sup>st</sup> year) are clearly related to the labour conditions status of the mother. The problem arises as how to extrapolate the results at 18 months of follow-up (ages between 24 months and 5 years) to, say, 8 years of age of the study children. In particular, what indicators should be used to accomplish that? In the same report, Heather Joshi notes other factors more influential to child development than work, specially the education of the mother and the income status of the family. "A mother having a couple of O-levels, compared to no qualifications, more than makes up for any employment related effect. Living in a council house is twice as bad for a child's reading ability as having a mother who goes out to work before their first birthday".

### *Role of economics in the trial*

Finally, and relating to the above issues, we still wonder where economists fit into trial planning and design: it is clear our role is considered as a technical input to the design rather than as more fundamental one of making sure the right question is posed in the first place. We think both are important, but that hearts and minds still need to be won by us if trials are to be designed from scratch to address economic questions.

## **References**

Acheson, D. Independent Inquiry into Inequalities in Health. Report. London the Stationery Office, 1998.

Agass, M.; Mant, D.; Fuller, A.; Coulter, A.; Jones, L. Childhood accidents: a practice survey using general practitioner records and parental reports. *British Journal of General Practice* 1990; 40: 202-205.

Barnett, Steven W (1996). *Lives in the Balance. Age 27 Benefit-Cost Analysis of the High/Scope Perry Preschool Program.* The High/Scope Press. Ypsilanti Michigan, USA.

Bayley, R; Condy, A.; Roberts, C. Policies for families : work, poverty and resources. Proceedings of seminars held in London, 27 and 31 October 1994.

BMA. British National Formulary. September 1998. BMJ Books 1998.

Brooks-Gunn, J.; McCarton, C. M.; Casey, P. H.; McCormick, M. C.; Bauer, C. R.; Bernbaum, J. C.; Tyson, J. Swanson, M.; Bennett, F. C.; Scott, D. T.; et al. (1994) Early intervention in low-birth-weight premature infants. Results through age 5 years from the Infant Health Development Program. *JAMA.* 272 (16); 1257-62

Cogan, J. Labour supply with costs of labour market entry. In Smith J.P (Ed.) *Female labour supply: Theory and estimation.* Princeton University Press, Princeton New Jersey, 1980.

DSS. Opportunity for all. Tackling poverty and social exclusion. First Annual Report, September 1999. Cm 4445.

Duncan, A and Giles, C. The impact of subsidising childcare. Research Discussion Series No. 13. Institute for Fiscal Studies. UK, Equal Opportunities Commission, 1995.

Ermisch, John. *Familia conomica. A survey of the economics of the family.* Scottish journal of Political Economy, Vol. 40, No. 4, November 1993: 353-374.

Harkness, S; Machin, S.; Waldfogel, J. Evaluating the pin money hypothesis: The relationship between women's labour market activity, family income and poverty in Britain. London; WSP, Suntory Toyota, International centre for Economics and Related Disciplines. LSE, 1995. Discussion Paper WSP/108.

Joshi, H; Paci, P; Makepeace, G; Waldfogel, J. Unequal pay for women and men : evidence from the British birth cohort studies. Cambridge, Mass.; MIT Press, 1998

Joshi, H, Paci, P and Jane Waldfogel. The wages of motherhood : better or worse? London ; Welfare State Programme, Toyota Centre, Suntory and Toyota International Centres for Economics and Related Disciplines, London School of Economics, 1996. Discussion paper (Welfare State Programme); WSP/122

Johannesson, Magnus; Jonsson, Bengt. Economic evaluation in health care: Is there a role for cost-benefit analysis?

Lennon, M.C.; Wasserman, G. A. Allen, R. Infant Care and Wives' Depressive Symptoms. *Women and Health*, Vol. 17(2) 1991: 1-23.

Netten, A; Dennett, J; Knight, J (Comp.). Unit costs of health and social care 1998. PSSRU University of Kent at Canterbury.

Oakley, A. *Social support and Motherhood; Natural History of a research project.* Oxford: Basil Blackwell, 1992.

Olds, D et al. Improving the life-course development of socially disadvantaged mothers: a randomized trial of nurse home visitation. *Am Journal of Public Health* 1988; Vol. 78: 1436-1445.

Pless, C.E.; Pless, I.B. How well they remember: the accuracy of parental reports. *Archives of Pediatric Adolescent Medicine*, 1995; 149:553-558.

Posnett, J.; Jan, S. Indirect costs in economic evaluation: The opportunity cost of unpaid inputs. *Health Economics*, 5, 1996: 13-23.

Reeves, R. Relax, you're a good mum. In the *Guardian*, The observer. October 10, 1999.

Roberts, Ian; Oakley, Ann and Gabrielle Laing. Proposal submitted to the Department of Health for research project 'Day Care Study', London, 1997.

Ross, C. E. and Mirowski, J. Child Care and Emotional Adjustment to Wives Employment. *Journal of Health and Social Behavior* 1988, Vol. 29 (June): 127-138.

Loftus, E.F.; Smith, K.D.; Klinger, M.R.; Fiedler, J. Memory and mismemory for health events. In Tanur, J. (Ed.) *Questions about questions. Inquiries into the cognitive bases of surveys.* Russell Stage Foundation 1994.

Zoritch, B; Roberts, I; Oakley, Ann. The Health and Welfare effects of day-care: a systematic review of randomised controlled trials. *Social Science and Medicine*, 1998: 317-327.



**Table 1 Cost-effectiveness analyses for day care project**

	Viewpoint					
	Families	Health	Education	Inland Revenue/SS	Employers*	Societal
Key outcome(s)	<u>Maternal</u> Incidence of depression <u>Child</u> Incidence of injuries Cognitive and Social development <u>Overall</u> Poverty (proxies maternal & paternal employment/education)	Maternal and child outcomes as in 'Families' except for Cognitive outcomes	<u>Maternal</u> Education achievement <u>Child</u> Cognitive outcomes	Welfare dependency	Avoidance of absenteeism or turnovers	Incidence of maternal depression Incidence of child injury Cognitive & social child development Poverty Welfare dependency (stigma) Maternal education
Key costs	Childcare time at home Childcare expenses (fees & travel) Travel expenses (medical care) Medications Education fees Working time Benefit claims	GP service use Hospital visits, In- & outpatient Medications Community services, health visitor, etc	Day care centre service use Education service use –mothers Special education use –child	Welfare Benefit awards Income Tax revenue	Nil	Childcare time at home & expenses Travel expenses Medications Education fees Working time Medical care -GP, med, com Day care centre Education service Production

**Table 2 Resource use categories in the economic evaluation of the Day care trial.**

Payer / Study group	Household		Employer	Government				
	Home inputs to health and childcare	Childcare services	Home inputs to health & childcare	Healthcare services (NHS)	Social security services	Childcare & Education services		
Types of resources	(1) Resource use at home	(2) Use of transport	(3) Use of out-of-the-home childcare services	(4) Use of time off work	(5) Use of medication	(6) Health service resource use	(7) Use of welfare benefits	(8) Use of subsidised childcare services
Resources consumed by Intervention (I) group & Control (C)	Hours of childcare p/week by main carer/mother Hours of childcare p/week by partner Monthly level of household income IV) Monthly use of paid medication	Monthly and six-monthly number of travels associated with health care visits	Weekly hrs of & expenditure on formal childcare use VII) Weekly hrs of out-of-the-home informal childcare use	VIII) Six-monthly hrs of paid work by members of the household IX) Monthly hours of education by adult members of the household	X) Index child's weekly medication use XI) Weekly use of maternal medication for depression.	XII) Index child's GP visits p/month XIII) index child's six-monthly hospital days/visits XIV) Other monthly visits by index child XV) Monthly GP visits by the mother XVI) Other monthly visits by the mother	XVII) Point prevalence of welfare benefit entitlements	XVIII) Days of formal registration in different services run at Mapledene during the 18- month study period (intervention group only)
Expected difference between groups (I = intervention, C= Control)	I-C >=/ I-C >=/ I-C < I-C >=/ I-C <	V) I-C >=/ I-C <	I-C > VII) I-C <	VIII) I-C > IX) I-C >	X) I-C >=/ XI) I-C <	XII) I-C >=/ XIII) I-C < XIV) I-C >=/ XV) I-C < XVI) I-C >=/ XVI) I-C <	XVII) I-C <	XVIII) I-C-I-0-I >

**Table 3 Nine-month follow-up tool on employment**

**1a. In the past month, have you done any paid work? (please tick one)**

Yes, full time

Yes, part time

Not at all

On maternity leave

Other (please explain) \_\_\_\_\_

If 'Not at all', please answer the following question; if 'Yes' go to question 2a.

**1b. In the past month, have you been looking for any paid job?**

Yes

No

**2a. In the last nine months, have you changed the number of hours you work? (please tick all that apply)**

Yes, given up work \_\_\_

Yes, started work \_\_\_

Yes, cut down \_\_\_

Yes, increased \_\_\_

No

Other (please specify) \_\_\_\_\_

**Table 4 Resource valuation and extrapolation to total study period (first 9-month study period)**

Cost category to be estimated	Resource use quantity (Numbers as in Table 1)	Prices	Extrapolation Method (first 9 months)	Perspective
A Childcare costs at home	I, II	I, II <i>net wage</i> estimate used to value VIII	I, II- Weekly hrs of care X net salary X 39 weeks = Total cost of care by the mother/father.	Household
B Costs in income level changes	III	Implicit	Weekly level of income X 39 = Total income.	Household
C Childcare-related travel expenses	IV	Implicit (Focus groups)	Weekly expenditure X 39 weeks = Total expenditure.	Household
D Healthcare-related travel expenses	V	-‘Expenditure for most recent GP visit’ and  -‘Expenditure for most recent visit to hospital/A&E’ (both as collected from trial survey/focus groups).	Monthly primary care-related (PCR) number of travels X ‘expenditure for most recent GP visit’ X 9 = Total PCR travel costs. Six-monthly hospital-related number of travels X ‘expenditure for most recent hospital visit’ X 1.5 = Total travel cost to hospital.	Household
E Out-of-the-home childcare	VI, VII	Formal care, implicit Informal care, range: nil- ‘net wage’ used for maternal care costs (see above)	Weekly expenses formal care X 39 = Total expenditure in formal childcare.  Weekly hrs of informal, out-of-the-home childcare X 39 X ‘net wage’ = Total costs of informal care	Household
F Time off work	VIII, IX	VIII; <i>gross wage</i> for mother, and any other adult in the household.  IX; (expected) <i>net wage</i> for mother.	Nine- (and monthly) working hrs by mother/father X respective gross wage (X 9) = Total earned income in the period (society)  Monthly hrs of maternal education X [net wage + tuition fees] X 9 = Total cost of education	Societal (paid work); Household (education)
G Income loss	III	Implicit	Weekly level X 39= Total income	
H Costs of medication & prescription	X, XI, IIIa	X,XI- BNF IIIa- Prescription charge by type of medication and recipient status	Weekly medication use X 39 X BNF acquisition cost = Total cost of medication [Paid medication from X,XI] X Prescription charge X 39 = Total prescription charges paid.	Household
I Costs of health care service	XIII, XIV, XV, XVI, XVII, XVIII	-XIV; local & national data on per diem hospital costs.  -XIII, XIV, XV, XVI, XVII, XVIII; local & national data on cost p/visit.	Monthly visits [XIII+ XVI, XVII+ XVIII] X 9 X cost per visit = Total cost of child/mother visits Hospital days [XIV+ XV ] X per diem costs X 1.5 = Total costs of hospitalisations	Government
J Cost of Welfare support**	XIX	National/local monetary figures	Sum across types of benefit X the corresponding amount of money X 39 = Total welfare costs	Government
K Cost of subsidised childcare (Mapledene)	XX	Cost per service-child day	Sum of days of each service provided to each child X respective cost p/service-child-day across all children and services = Total costs of subsidised childcare.	Government