School meals and the rate of growth of primary school children

R J RONA, S CHINN, AND A M SMITH

From the Department of Community Medicine, St Thomas's Hospital Medical School, London SE1, and Town Planning Service, London Borough of Harringey, UK

SUMMARY The effect of school meals on the rate of growth was assessed in two sets of children over one, two, and three-year periods in England and Scotland between 1973 and 1979. In all analyses children were subdivided into three groups: poor, not poor, and undefined, according to a set of questions on social circumstances. The rate of growth was assessed for children receiving school meals, lunches prepared at home, and those who changed scheme during the study period. No relation between rate of growth and uptake of school meals was found at any of the levels of poverty in England. In Scotland there was some indication in the poor group that children who received school meals had a smaller rate of growth than children having lunches prepared at home. There was inconclusive evidence that children from the poorer sectors of the community whose mother's worked outside the home may benefit from the school meals system. Although children selected for welfare support were smaller than other children, in so far as the design of the study allowed school meals during the 1970s did not increase the rate of growth of primary school children in any social stratum.

From 1944, when the scheme was introduced, until 1980 local authorities in the United Kingdom were obliged to provide a midday meal for children at maintained schools. The school lunch was to meet all the requirements appropriate to the main meal of the day and recommendations about its nutritional value were made by a working party. Under this system 60–70% of all school children in England and 41–56% in Scotland received school meals throughout the 1970s. Free meals were provided to those children whose families were receiving family income supplement, supplementary benefit, or whose income was below a minimum value on a national scale of income. During the 1970s, around 10% of children in England received free school meals while the percentage in Scotland fluctuated from 11% to 17% according to returns to the Department of Education and Science collected in October every year.

In 1980 the government introduced changes in policy that released local authorities from the obligation to provide school meals. The charges for refreshments are no longer determined by central government. Pupils whose parents are receiving supplementary benefit or family income supplement, however, should receive free of charge a midday meal or refreshment whose content is left to the discretion of local government.

Most published studies about school meals and health in the United Kingdom have concentrated on analysing the nutritional value of the school meals or they have looked at height measurements at one point in time according to whether the child had lunch provided by the school or not. There is no information in the United Kingdom, however, about the possible effect of school meals on the growth of children.

In the National Study of Health and Growth we have collected information since 1972 on the growth of children, their social and family circumstances, and the type of midday meal they receive, whether prepared inside or outside the school system. These data have been collected annually for every child in each of the participating primary schools and have been used to assess whether the rate of growth is associated with the type of midday meal received. No assessment was made of the nutritional value of school meals. Therefore the results in this study should be interpreted as the association of growth and the school meals policy as implemented by local authorities before 1980 rather than the properties of any particular recommendation.

Materials and methods

The National Study of Health and Growth is a mixed longitudinal survey of primary school children with data collected from 22 study areas in England and six

8
The areas were selected in each country by stratified random sampling, with proportionately more from poorer social groups.*

Two sets of children were chosen, those participating in our 1973 and 1977 surveys who were assessed at least once more in a subsequent year. Results for these sets of children allowed us to ascertain the consistency of any finding in the analyses. The results were used to assess the association of school meals and children's growth up to 1979 before local authorities started to implement the recent changes in school meals policy.

Height was measured following the recommendations of Tanner et al* on a specially designed stadiometer made by Holtain Ltd. Until 1976 the readings were recorded to last completed 0·5 cm on the scale and from 1977 onwards to the last completed 0·1 cm. The children's height was measured by a trained local nurse supervised by a fieldworker. Approximately 10% of the measurements taken were checked by our fieldworkers. The standard deviation for the difference in height between fieldworkers and local nurses was 0·4 cm.

The results are presented in terms of height and height gain. The former assesses a child's existing nutritional state which is only marginally influenced by welfare policy at school, especially in younger age groups. The latter reflects, among other things, the possible effects of the school lunch on nutritional state.

Results on height are reported in centimetres or standardised units. In the latter case height was standardised for age, sex, and country of residence (England and Scotland) dividing the difference in height between each child and the mean for his group by the standard deviation for that group.  

Height gain was compared between children receiving and not receiving school meals over a two or three-year period for the children participating in the 1973 survey and for a one or two-year period for children in the 1977 survey. A third group was included for those who changed the type of lunch between assessments in either order.

We expected that any effect of school meals on growth would be dependent on the degree of poverty of the family. Thus the total sample in each set has been divided into three groups: children from families defined as poor (poor group), those whose families were not apparently from a disadvantaged social background (not poor group), and those whose parents provided incomplete information and whose socioeconomic status could not therefore be classified (undefined group). The degree of poverty of each child was obtained from a self-administered questionnaire completed, in general, by the mother or female guardian. Father's occupation, number of siblings, and receipt of family income supplement or supplementary benefit were used to assess poverty. In the 1973 survey we also included, as part of the classification, father's and mother's income (this information was not available from 1977 onwards, and it caused the poor group in the 1977 set to have, in comparison with the 1973 set, fewer children). A child was included in the poor group if any of the following criteria were fulfilled: father in social class V; four or more siblings and father in social class IV; family receiving family income supplement or supplementary benefit; income of father and mother equal to or less than £20 a week in 1973. The information provided in 1973 or 1977 was used to classify children into poverty groups. A change in social circumstances of an individual child in the follow-up period was not incorporated in the analysis.

Covariance analysis of height at the end of a period adjusted for height at the beginning of the period was used to compare rate of growth by type of midday meals within each degree of poverty. In the 1973 set the heights of children in 1975 or 1976 were adjusted for height in 1973 and in the 1977 set the heights in 1978 or 1979 were adjusted for height in 1977. In this way measures of height gain were obtained for a one-year period, 1977–8 analysis, two-years periods, 1973–5 and 1977–9 analyses, and a three-year period, 1973–6 analysis. Further adjustments were made in each covariance analysis for age, sex, and time gap to allow for small changes in height gain between the ages of 5 and 10 years, earlier accelerations for height gain in girls than boys, and slight deviations from one, two, and three complete years between measurement sessions.

Significant lack of parallelism between the three regression lines was observed in some covariance analyses. By plotting the regression line of later height on initial height corresponding to each type of midday lunch we were able to assess the relation between group and type of lunch. If the significant lack of parallelism was entirely due to one of the three lines we could still compare the other two lines but if the three lines crossed each other we refrained from making inferences from that analysis.

We did not measure children after they left primary school and consequently the older age groups of the 1973 and 1977 sets could not be included in the analyses of height gain. In the 1973 set enough information was available to include 4896 out of 6434 (76%) children in the 1973–5 analysis and 3523 out of 4760 (74%) children in the 1973–6 analysis. In the 1977 set 5520 out of 7588 (73%) children were included in the 1977–8 analysis and 3941 children of 5700 (69%) in the 1977–9 analysis.
A child was excluded from the analysis either because the question on school meals was not completed by the parents on at least one occasion, or a height measurement was missing. The former was the main reason for excluding children from the analysis as measurements were available for more than 95% of the target sample on each occasion.

An exploratory analysis with data available only for the 1973 set of children was used to assess the relation between the type of midday meal, degree of poverty, and whether the mother was working outside the home. Mothers' working status was divided into three groups: working full-time, working part-time, and not working outside the home—that is, housewife.

Results

Scotland and England differed in many characteristics related to the uptake of school meals. In England between the years 1972 and 1978 the uptake of school meals was unrelated to father's social class. This was not the case in Scotland, where children with fathers in social class V had a higher use of the school meal system than any other social class in Scotland, although the percentage of children in this class having school meals was well below that of any social class in England (fig 1). The percentage of children receiving free school meals was slightly higher in Scotland than in England (13% and 11% respectively), but the total percentage of children taking school meals was appreciably lower. A larger percentage of Scottish than English children whose families were receiving family income supplement or supplementary benefit did not receive school meals. For example, in the 1977 survey 20.5% of Scottish children whose families were receiving supplementary benefit and 43.7% who were receiving family income supplement did not have school meals. The same figures for English children were 14.8% and 18.9% respectively. These differences in the uptake of school meals in the two countries prompted the decision to analyse the data separately for each country.

Figure 2 gives the attained height in England and Scotland divided into three groups: children receiving subsidised school meals, free school meals, or meals prepared outside the welfare system in 1977. Children receiving free school meals were much shorter than children in the other two groups. Heights were similar for children receiving subsidised school meals or meals prepared at home. The difference in mean height between children receiving free school meals and the other two groups was larger in Scotland than in England. The magnitude of the differences was similar for all age groups in England and Scotland, approximately 2 cm in England and 3 cm in Scotland.

We compared standardised heights of children in the groups classified as poor, not poor, and undefined. In both countries poor children were appreciably shorter than the not poor children; children in the undefined group occupied an intermediate position indicating the mixed nature of this subject (fig 3). We found no differences in mean height within each group according to the type of lunch received in England, but in Scotland children receiving meals prepared at school were shorter than children receiving meals prepared at home in the poor and undefined subsets (table 1).

Table 2 presents the results for the 1973 and 1977 sets in England. The rate of growth by type of lunch was not significantly different within any of the poverty groups. In the 1977 set the regression lines in the covariance analyses of the "not poor" and the 1977–8 analysis of the "undefined" were significantly non-parallel. By plotting the three regression lines corresponding to each type of midday lunch for these subsets we could not detect any other meaningful difference between the groups.

![Figure 1](http://jech.bmj.com/)
R J Rona, S Chinn, and A M Smith

FIG. 2 Height of children by age and type of lunch in 1977.

FIG. 3 Height of children in standardised units by poverty group in England and Scotland in 1977.

Table 3 gives the results of the rate of growth in the Scottish sample. In the 1973 set no significant differences were found in the “not poor” and “undefined” groups. In the poor subset, however, children eating lunches prepared at home grew more than children receiving school meals, while those who changed scheme had an intermediate rate of growth in the 1973–5 analysis. Unfortunately, in the 1973–6 analysis there was a significant lack of parallelism between the regression lines and the three regression lines corresponding to the types of lunch intersected.

The results for the 1977 set in Scotland are consistent with the results obtained from the 1973 set. In the poor subset children receiving lunches prepared at home grew significantly more than children eating school lunches in the 1977–9 analysis but not in the 1977–8 analysis. In the not poor subset there was a significant lack of parallelism between the regression lines in both 1977–8 and 1977–9 analyses. None of the three regression lines were parallel in the 1977–8 analysis. In the 1977–8 analysis the significant non-parallelism was entirely due to the group changing type of school meal. Children receiving school meals grew more than those receiving lunches prepared at home (p<0.05). No significant differences were found in the undefined subgroups other than the lack of parallelism between the regression lines in the 1977–8 analysis.

The 1973 set was used to assess the relation between type of lunch, mother’s working status, and degree of poverty on children’s rate of growth. Enough children were available to analyse only the 1973–5 period and even then some groups were very small indeed. Figure 4 shows the relation between working status and type of lunch on the growth rate of poor English children. Within the group of children whose mothers were working full-time, those who ate meals prepared at school grew more than those who ate meals prepared at home (p = 0.1). Among those
### Table 1: Mean height in standardised units* for 1973 and 1977 sets of English and Scottish children according to type of lunch and level of poverty

<table>
<thead>
<tr>
<th>Lunch in 1973-5 period</th>
<th>England Poor Mean SD</th>
<th>England Undefined Mean SD</th>
<th>England Not poor Mean SD</th>
<th>Scotland Poor Mean SD</th>
<th>Scotland Undefined Mean SD</th>
<th>Scotland Not poor Mean SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepared at school</td>
<td>515 -0.12 1.00 1150 0.03 0.98 936 0.11 0.99 104 -0.25 1.06 91 -0.04 1.06 94 0.06 0.87</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changed scheme</td>
<td>127 -0.26 1.02 266 -0.09 0.97 257 0.12 0.96 53 0.01 0.97 118 0.04 0.97 99 0.03 1.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepared at home</td>
<td>108 -0.19 1.11 297 0.08 0.94 209 0.01 1.01 45 0.13 1.09 284 0.11 1.00 209 0.22 0.98</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 2: Mean adjusted height† in the 1973 and 1977 sets of English children by type of lunch within each poverty group

<table>
<thead>
<tr>
<th>Lunch in 1973 set</th>
<th>England Poor Mean SD</th>
<th>England Undefined Mean SD</th>
<th>England Not poor Mean SD</th>
<th>Scotland Poor Mean SD</th>
<th>Scotland Undefined Mean SD</th>
<th>Scotland Not poor Mean SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepared at school</td>
<td>339 136-68 811 136-14 632 136-49 244 132-61 506 134-30 1248 134-68</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changed scheme</td>
<td>96 136-56 211 136-09 210 136-66 40 132-63 126 134-50 319 134-78</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepared at home</td>
<td>76 136-29 204 136-09 150 136-64 37 132-62 105 133-86 363 134-74</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of parallelism</td>
<td>**</td>
<td></td>
<td></td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Differences in means</td>
<td>**</td>
<td></td>
<td></td>
<td>**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3: Mean adjusted height† in the 1973 and 1977 sets of Scottish children by type of lunch within each poverty group

<table>
<thead>
<tr>
<th>Lunch in 1973 set</th>
<th>England Poor Mean SD</th>
<th>England Undefined Mean SD</th>
<th>England Not poor Mean SD</th>
<th>Scotland Poor Mean SD</th>
<th>Scotland Undefined Mean SD</th>
<th>Scotland Not poor Mean SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepared at school</td>
<td>100 131-08 87 132-85 94 133-65 113 127-81 90 129-87 200 131-44</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changed scheme</td>
<td>51 131-31 117 133-09 99 133-73 32 128-12 48 130-16 129 131-27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepared at home</td>
<td>45 131-80 279 132-90 209 133-98 44 128-31 107 129-86 489 131-22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of parallelism</td>
<td>**</td>
<td></td>
<td></td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Differences in means</td>
<td>**</td>
<td></td>
<td></td>
<td>**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*See method.

---

* p<0.05; ** p<0.01; *** p<0.001. † Mean height at the end of period adjusted for height at the beginning, age, sex, and time gap.
receiving lunches prepared at home children whose mothers were in full-time jobs grew less than housewife's children, while part-timers' children had an intermediate rate of growth. The lesser growth of children who had lunches prepared at home and whose mothers were in full-time work in comparison with housewives' children receiving the same type of lunch \( (p = 0.1) \) was also observed in the undefined group. In the poor subset in Scotland children whose mothers were housewives tended to have a higher rate of growth if their lunches were prepared at home. Those whose mothers were housewives and who changed the type of school meal during the two-year period had an intermediate rate of growth. None of these associations was observed in the non-poor subset either in Scotland or England.

**Discussion**

This study has shown that children receiving free school meals have a poorer nutritional state than other children as assessed by attained height in each age group. The differences in mean heights between children receiving free school meals and other children were very large in England and still larger in Scotland. We believe that these differences may be entirely accounted for by the degree of poverty of the child's family. We could not show, however, a favourable effect of school meals on the rate of growth of primary school children. Regardless of the social status of the family, school meals in England were not related to growth, while in Scotland there were indications that in the poor subset of children those receiving school meals had the lowest rate of growth, especially over two-year periods. These results were consistent for the 1973 and 1977 sets within each country.

This paper has entirely concentrated on the outcome measure of growth, which is the most relevant in terms of nutritional state. Two other aspects, however, which may be contributory factors in determining a food policy at school are worth mentioning: the contribution of school meals to the dietary intake of children in subgroups of the community and the perceived social value of school meals by these subgroups. Two studies carried out at the beginning of the 1970s showed that children with many siblings or in social classes IV and V obtained a bigger proportion of their daily intake from school meals than their counterparts. The social concomitants of school meals have been investigated at some length in other surveys and information obtained in the National Study of Health and Growth in 1981 will contribute to this issue too.

Any favourable effect of school meals should have been more obvious in the poor sector of the population. None of the results for one, two, or three-year periods in the poor group show the
expected effect either in England or Scotland. We did not assess whether local authorities followed the recommendations concerning the nutritional composition of school meals. Studies on the nutritional value of school meals showed some degree of disagreement as to whether they meet the standards set out by the Department of Education. While Cook et al found that the school meals provided, in comparison with recommended levels, slightly less protein and more fat, Bender et al found that the served portions were well below target in terms of protein and energy from all nutrients. Both these studies were carried out in South-east England. It would not be appropriate to extrapolate any of the results reported to the National Study of Health and Growth with study areas drawn from most parts of the country. Therefore our results should be interpreted as the effect on growth of school meals as implemented by local authorities.

As the design of this study was not a randomised controlled trial the sample was subdivided by degree of poverty to control for factors that would affect the rate of growth in different ways in children having meals and those having lunch prepared at home. In England this method eliminated differences in attained height within each poverty group, but in the Scottish sample those having school meals within the poor and undefined groups were smaller than those having lunches prepared at home. This does not explain the significantly greater rate of growth of children having lunch prepared at home in the poor group, because adjustments for initial height were made in all the analyses. If the results in Scotland were due to the differences in initial height within each poverty group then similar results would have been found in the poor and the undefined groups but this was not the case. Other factors may explain the higher rate of growth of Scottish children in the poor group who have lunches prepared at home. School meals in Scotland may be of a poorer quality and acceptability than those prepared in English schools. Direct evidence of the quality of school meals, the nutritional composition of school meals, or the amount of food children actually ate are not available. Nevertheless, there is a social class trend associated with the uptake of school meals in Scotland. A higher percentage of families in Scotland with family income supplement or supplementary benefit do not ask for school meals for their children when compared with these groups in England, and the lower rate of growth for children having school meals is exclusively in the poorest group. An underlying cause may be that the standard of services that are used mainly by a deprived sector of the population tend to deteriorate over time. While children taking school meals who are from the better-off groups may compensate in other meals served during the day for the lower intake of food the poor group would not make up the deficit.

Children from families where the mother worked outside the home were selected for special study since we were interested in looking at children who had been more vulnerable to undernutrition due to specific family circumstances. There were indications, especially in England, that school meals may be beneficial for those children in the poor and undefined groups whose mothers were working outside the home. The inference from this analysis is weak because the sample size in some of the relevant groups was very small. This is a potentially important result, however, because more women are looking for gainful employment outside home. We recommend that the growth of children in these families should be closely monitored. Should new results indicate a similar pattern to that presented here protective measures for these children will need to be encouraged.

We are left with the uncomfortable conclusion that while children selected for free school meals are in smaller, presumably indicating a poorer initial nutritional state, and correctly chosen for welfare support, in so far as the design of the National Study of Health and Growth allowed there was no evidence that the provision of school meals has helped the poorer sectors of the community to grow more quickly than children of similar status who have not used the scheme. Children of working mothers are perhaps an exception. It is open to discussion if in a developed country a single measure, such as the provision of school meals, will ever suffice to diminish differences of nutritional state in the community. With the worsening of the economic situation and changes in welfare policy the value of school meals should be reassessed periodically.

We are most grateful to Professors W W Holland and C Florey for their encouragement and helpful criticism of the manuscript. We are greatly indebted to all people involved in the National Study of Health and Growth: doctors, nurses, teachers, and administrators in the study areas and colleagues in our department.

The National Study of Health and Growth is supported by the Department of Health and Social Security and the Scottish Home and Health Department.
R J Rona, S Chinn, and A M Smith

References