PAPERS AND ORIGINALS

Effects of solid foods on growth of bottle-fed infants in first three months of life

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Summary

We studied 821 infants who were bottle-fed from birth to determine whether non-milk solids begun within the first 3 months of life affect early growth. The infants were seen seven to 10 days and three months after birth. They were divided into three groups—those who had started solids before 6 weeks of age (657 infants); those who had started solids between the ages of 6 weeks and 3 months (124 infants); and those given cow's milk formulae alone during the first three months (40 infants). The infants were weighed and measured seven to 10 days after birth and at three months. Mean weekly rates of weight and length gain over the 3 months were calculated and did not differ significantly between the three groups. As no record was made of quantities of food taken we cannot explain the failure of solid foods to affect growth. Studies of how young infants utilise these foods are needed.

Introduction

In the early part of this century infants were seldom introduced to solid foods before one year of age.[1] Since this time, however, infants have been offered solids at increasingly early ages, and the 1974 report by a working party of the DHSS[2] drew attention to the fact that 80-93% of infants in the United Kingdom were being started on solids before the age of three months. Although most babies tolerate solids at an early age,[3] there is no evidence of advantages or benefits to health. On the contrary, available evidence shows the practice may be harmful, as it contributes to the development of hyperosmolar states[4] and the early presentation of coeliac disease.[5] Early mixed feeding may also contribute to excessive weight gain,[2 6] particularly in view of the high energy content of many of these foods. Nevertheless, we have been unable to find evidence to substantiate this claim. We therefore set out to determine whether starting solids within the first 3 months of life affects the early growth of bottle-fed infants.

Methods

From 1159 infants who were consecutively born in two South Wales towns between March 1972 and October 1974, 821 full-term infants were chosen for the study. These represented all the infants who were bottle-fed from birth. The infants were seen in their homes by a nurse (one for each town) seven to 10 days after birth. Birth weights were noted and crown-heel lengths measured with a neonatometer.[7] They were seen again at three months when they were weighed on a beam balance (accurate to 10 g) and measured, and the mothers were asked whether or not solid foods had been started before six weeks. For about half of the infants the nurse recorded the actual time when solid foods had been started and the data for these is shown in table I. The complete series of infants was divided into three groups: group 1—solids started before the age of 6 weeks (657 infants); group 2—solids started between the ages of 6 weeks and 3 months (124 infants); and group 3—cow's milk formulae alone during the first three months (n = 40).

Weekly rates of increases in weight and length over the three months were calculated for each infant in each group. Mean values for the

TABLE I—*Mean ages (± SE) of infants at actual time of starting solids**

Group	Mean ages in weeks	No of infants
Solids started at age 6 weeks to 3 months:		
Boys	9·9 (±0·52)	36
Girls	8·2 (±0·36)	64
Solids started before age 6 weeks:		
Boys	2·6 (±0·13)	135
Girls	3·2 (±0·15)	111

*Actual date of starting solids not available for all 821 infants.

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three groups were compared. The statistical significance of differences was tested using Student's *t*-test.

Results

Table II gives the data for length and weight at the first home visit.

TABLE II—*Mean weights and lengths (± SE) in the three infant groups at start of study*

Group	Birth weight (kg)	Length at 7–10 days (cm)	No of infants
Group 1—Solids started before age 6 weeks:			
Boys	3·56 (±0·05)	51·8 (±0·20)	367
Girls	3·41 (±0·05)	51·8 (±0·23)	290
Group 2—Solids started between age 6 weeks and 3 months			
Boys	3·37 (±0·06)	51·4 (±0·28)	50
Girls	3·23 (±0·05)*	51·2 (±0·26)*	74
Group 3—Cow's milk formulae alone for 3 months			
Boys	3·67 (±0·16)	51·0 (±0·47)	23
Girls	3·68 (±0·21)	51·9 (±0·24)	17

*Represents mean values for weight and length that differ at 5% level from groups 1 and 3 within the same sex.

TABLE III—*Mean weight gains and linear growth (± SE) in the first three months after birth in the three feeding groups*

Variable	Feeding group*			
	Solids started before age 6 weeks	Solids started between ages of 6 weeks and 3 months	Cow's milk alone for 3 months	Significance
Weight gain (g/week)				
Boys	277 (±6·1)	271 (±8·1)	270 (±28·0)	NS
Girls	237 (±8·2)	230 (±8·3)	233 (±10·1)	NS
Linear growth (mm/week)				
Boys	8·4 (±0·16)	8·3 (±0·15)	7·8 (±0·30)	NS
Girls	8·2 (±0·20)	7·9 (±0·13)	8·3 (±0·28)	NS

NS = Not significant.
*Numbers within each group given in Table I.

The infants who started solids between the ages of 6 weeks and 3 months (group 2) were lighter and shorter than the other two groups, but differences were statistically significantly only among the girls. We cannot explain these differences, but we do not believe that they substantially affect the conclusions we have drawn.

The mean rates of increase in weight and length among the infants in group 1 (solids started before age 6 weeks) are similar and do not differ significantly from the rates among infants in group 2 (solids started between the ages of 6 weeks and 3 months) (table III). The mean growth rates of the smaller number of infants in group 3 (those fed milk alone) are similar to the other two groups.

Discussion

Many differing amounts and varieties of solid foods are given to infants in the first few months of life. Some are given only an occasional teaspoonful of cereal, while others receive fruit, eggs, cereal, meat, and vegetables as well as milk.[2] Shukla *et al*[8] have shown that infants who are started on solids in the first three months have an energy intake substantially above recommended values. Greater weight gain might therefore have been expected over this time among the infants in our study, particularly when solids had been started within the first six weeks. Surprisingly this was not so. Our study provides no evidence that the introduction of solids to bottle-fed infants at any time in the first three months has a significant effect on growth. Admittedly the numbers in the three groups varied considerably, and group 3 (those who had never been given solids) was particularly small. Some of the differences between the groups might have reached statistical significance had numbers been greater. Nevertheless, the differences between the groups are so small that they are unlikely to be clinically important.

Without a record of quantities of food taken we cannot explain why solids given at an early age did not affect growth, particularly weight gain, despite Shukla's findings[8] that infants who are started on solids at an early age consume extra energy. Excessive energy intake in adults has been shown to result in less weight gain than expected, since much of the extra energy is expended in increased heat production.[9] If this theory may be applied to infants, it might explain why the early commencement of solids does not affect growth. Further studies of how young infants utilise these foods are needed.

Failure to show that early mixed feeding affects growth does not mean that this practice should be encouraged. Its contribution to hyperosmolar states[4] should still be sufficient to deter the uncritical commencement of these foods in the first few months of life. Nevertheless, some infants, even those aged less than 3 months, are dissatisfied on milk alone. For these, the introduction of cereals and other non-milk foods according to individual need is often necessary and unlikely to cause harm.

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