Obesity and Respiratory Infection in Infants and Young Children

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Summary

A controlled trial has been carried out to test the widely held "clinical impression" that overweight infants have a greater liability to respiratory infections than those of normal weight. Two matched groups of children aged between 3 months and 2 years were studied, containing children whose weight was above the 90th percentile, or was between the 25th and 75th percentiles, at the start of the trial.

Data from 120 children of the overweight group were available for analysis, of whom 47 experienced at least one respiratory infection during the trial and 73 did not. Of children remaining over the 90th percentile at the end of the trial 19 had suffered respiratory infections and 28 had not. One baby in the overweight group suffered a "cot death" from acute bronchiolitis. In the control group, 103 cases were analysed—23 had suffered a respiratory infection and 80 had remained free of respiratory infection throughout the trial. These figures are statistically significant and suggest that obesity in infants and young children is associated with an increased incidence of acute respiratory infections.

Introduction

Obesity is becoming increasingly recognized as one of the commonest nutritional disorders in the more highly developed countries, and considerable attention is currently being given to the relatively uninvestigated subject of obesity in infancy and early childhood (*British Medical Journal*, 1970). Most of this work relates mainly to the long-term dangers of obesity and does not consider the immediate ill effects of obesity in early childhood. Obesity at this age may be considered from two main aspects: firstly, the tendency for it to persist into late childhood and adult life, with all the associated dangers to life and wellbeing; and, secondly, its immediate effects on the health of the infant and small child.

Many doctors working with children believe that overweight babies are more liable to acute respiratory infections than those of average weight. Little published work, however, exists on this subject to confirm or disprove this clinical impression. Hutchinson-Smith (1970) provided evidence which lends support to the theory that obesity in the first few months of life is associated with an increased incidence of respiratory infection.

Our purpose was to confirm or disprove the existing clinical impression that overweight babies are more liable to respiratory infection than those of normal weight. This was done by observing the incidence of respiratory infection in a group of overweight infants and children and comparing it with that found in a control group.

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Subjects and Methods

As health visitors had records of all children of preschool age living in the areas for which they were responsible, they were asked to record details of any children who came within the criteria of obesity set for the trial. Children in the age range of 3 months to 2 years are seen frequently by health visitors at routine visits, when making arrangements about immunizing procedures and when attending child welfare centres. There was therefore little possibility that a child with a history of ill health would be more likely to be included in the survey than one with a good health record. All health visitors participated irrespective of whether their work was based on geographical districts or on general practices where attachment schemes are in operation. Before we embarked on the survey a meeting with the group advisers of the health visitors was held to explain our objectives and to ensure that the criteria to be applied to children taking part were fully understood. Control cases, matched with the survey cases for as many factors as possible, were selected in the same arbitrary manner.

Group A consisted of 131 children whose weight was above the 90th percentile (Tanner and Whitehouse, 1966) for age and sex at the start of the trial. Group B (the control group) comprised 112 children whose weight at the start of the trial fell between the 75th and 25th percentiles. Initially, every effort was made to provide each child in group A with an exactly matched control in group B. This proved to be impracticable and the matching was therefore modified to some extent in order to obtain sufficient numbers of controls. In view of this modification, distributions of age, sex, family size, and socioeconomic class in groups A and B were analysed to ensure that the two groups were comparable in these respects (see Tables II and V).

Children were weighed only at the start and end of the trial. It is the practice to reduce to a minimum the amount of routine weighing at child welfare clinics, and repeated weighing of children taking part in the survey was thought to be undesirable as being apt to induce anxiety in the mothers.

The purpose of the trial was explained to mothers when they were invited to take part, but care was taken to present it as a general survey of the incidence of respiratory infection in young children to avoid creating undue awareness of respiratory symptoms in the parents of children in the overweight group.

Two months before the start of the survey a letter was sent to all general practitioners in the area explaining the purpose of the survey and requesting their co-operation. Practitioners were later informed of the names of children on their list included in the trial, either as cases or controls, and special cards were provided on which details of respiratory infections could be recorded. It was obvious when planning the trial that it was unlikely that many children would require admission to hospital, and therefore recording of incidents of respiratory infection would need to be done almost entirely by general practitioners.

For the purpose of the trial a "respiratory illness" was defined as follows: "An illness presenting with respiratory symptoms, sufficiently severe to make the mother call in the family doctor, and lasting for a minimum of three days irrespective of whether or not any specific treatment was given, acute specific infections of childhood being excluded."

The use of the 90th percentile (Tanner and Whitehouse, 1966) as the determinant of obesity in our trial is a stricter criterion than in some similar series (Hutchinson-Smith, 1970) where the 70th percentile was taken as the dividing line between a normal and an obese child. Our control group was chosen from children whose weights were between the 25th and 75th percentile lines, which is a generally accepted definition of normality so far as weight is concerned. The age group 3 months to 2 years was chosen as approximating to the age category in which the "clinical impression" of a relationship between obesity and increased liability to respiratory infection was thought to exist. The period of the trial during which the children were under observation, and respiratory infections were recorded, started on 1 November 1968 and ended on 30 April 1969, thus comprising a six-month winter period.

Results

The numbers in the two groups are given in Table I, and the age distribution, family structure, and socioeconomic class are compared in Table II. The feeding history is shown in Table III.

Both groups of children were weighed again at the end of the survey period and Table IV shows the percentile ranking of the weights. Groups A and B are subdivided into those who experienced episodes of respiratory infection and those who did not.

Because of the considerable number of children in both groups whose weight at the end of the survey no longer conformed to the set criteria, the 47 cases and 67 controls who maintained their weight rankings were analysed separately and the findings in these subgroups are given in Table V.

Discussion

Our results show a higher incidence of respiratory infection in the group of overweight children compared with controls of average weight. As previously noted by Hutchinson-Smith (1970), our figures also show the tendency towards early introduction of solids into the diet and away from breast-feeding to be associated with obesity. The incidence of breast-feeding in our series is low and therefore there are too few breast-fed infants in the series for statistically significant conclusions to be drawn from them.

Probably by appropriate dietary advice in early infancy the incidence of potentially serious respiratory infection in this age group might be considerably reduced in addition to the long-term benefits to be achieved by the avoidance of obesity in the older child and adult. Interestingly only two of the children in the trial (both in the control group) required admission to hospital with a respiratory infection, thus show-

TABLE I—*Numbers in the Two Groups*

	Group A (Cases)	Group B (Controls)
Number at start of survey	131	112
Left the county during survey	6	5
No information received	5	4
Number of cards analysed at end of survey	120	103

TABLE II—*Age Distribution, Family Structure, and Socioeconomic Class*

	Group A (120 Cases)	Group B (103 Controls)
Age distribution:		
3– 5 months	38 (31·7%)	22 (21·4%)
6– 8 months	49 (40·8%)	47 (45·6%)
9–11 months	18 (15%)	20 (19·4%)
12–17 months	13 (10·8%)	11 (10·7%)
18 months and over	2 (1·7%)	3 (2·9%)
Family structure:		
Only children	60 (50%)	49 (47·6%)
With siblings:		
Preschool only	43 (35·8%)	36 (34·9%)
Preschool and school age	17 (14·2%)	18 (17·5%)
Socioeconomic class structure:		
Classes 1/2	18 (15%)	13 (12·6%)
Class 3	68 (56·7%)	65 (63·1%)
Classes 4/5	4 (3·3%)	3 (2·9%)

TABLE III—*Feeding History*

	Group A	Group B
Breast-fed for less than 3 months	24 (20%)	18 (17·5%)
Breast-fed for 3-6 months	3 (2·5%)	4 (3·9%)
Breast-fed for more than 6 months	6 (5%)	11 (10·7%)
	33 (27·5%)	33 (32·1%)
Breast-feeding never established	87 (72·5%)	70 (67·9%)
	120 (100%)	103 (100%)
Mixed feeding introduced under 3 months	105 (87·5%)	76 (73·8%)
Mixed feeding introduced at 3–6 months	14 (11·7%)	25 (24·3%)
Mixed feeding introduced after 6 months	1 (0·8%)	2 (1·9%)

TABLE IV—*Weight Change during the Survey Period*

	Percentile Ranking				
	Over 90th	90th-75th	Below 75th	Not Weighed	Total
Group A:					
Children experiencing episodes	19	15	12	1	47
Children not experiencing episodes	28	14	27	4	73
	47 39·2%	29 24·2%	39 32·5%	5 4·1%	120
	25th-75th	Below 25th	Over 75th	Not Weighed	Total
Group B:					
Children experiencing episodes	13	6	3	1	23
Children not experiencing episodes	54	13	11	2	80
	67 65%	19 18·4%	14 13·6%	3 3%	103

Respiratory Infections Experienced

	Episodes	No Episodes	Total
Group A	47	73	120
Group B	23	80	103
	70	153	223

$\chi^2 = 7{\cdot}25$ $P < 0{\cdot}01$; D.F. = 1.

TABLE V—*Age Distribution, Family Structure, and Socioeconomic Class in Those Who Maintained Their Weight Ranking*

	Subgroup A (47 Cases)	Subgroup B (67 Controls)
Age distribution:		
3– 5 months	12 (25·5%)	12 (17·9%)
6– 8 months	19 (40·4%)	31 (46·3%)
9–11 months	6 (12·8%)	13 (19·4%)
12–17 months	8 (17·0%)	8 (11·9%)
Over 18 months	2 (4·3%)	3 (4·5%)
Family structure:		
Only children	27 (57·4%)	29 (43·3%)
With siblings:		
Preschool only	13 (27·7%)	24 (35·8%)
Preschool and school age	7 (14·9%)	14 (20·9%)
Socioeconomic class structure:		
Classes 1/2	9 (19·1%)	9 (13·4%)
Class 3	24 (51·1%)	42 (62·7%)
Classes 4/5	13 (27·6%)	16 (23·9%)
	46*	67

* One father serving in H.M. Forces.

Respiratory Infections Experienced by these Subgroups

	Episodes	No Episodes	Total
Subgroup A	19	28	47
Subgroup B	13	54	67
	32	82	114

$\chi^2 = 6{\cdot}44$; $0{\cdot}02 > P > 0{\cdot}01$; D.F. = 1.

ing the importance of the data in this type of survey being primarily recorded by general practitioners.

There is an impression among those dealing with a large number of "cot death" cases that these infants tend to be significantly overweight for their age (J. L. Emery, personal communication, 1970). One child in our series suffered a cot death during the period of the trial, and this infant was in the group of children who were over the 90th percentile for age; necropsy gave the cause of death as resulting from acute bronchiolitis. This may well be a chance finding in a relatively large series of children, but it points the need for further investigation in this field.

If it be assumed that the case is proved, and that obese infants do have a greater liability to respiratory infection than those of normal weight, the question arises why this should be the case. Two possibilities emerge as indications for further investigation. Firstly, that obesity leads to underventilation of the lungs, with possible impairment of coughing and clearing of secretions from the respiratory tree, leading to a tendency for minor respiratory infections to become more serious and prolonged. The second possible mechanism by which obesity might predispose to an increased incidence of respiratory infection could be due to a defect in the immune defences of the body, associated either directly with the obesity or indirectly with the early introduction of artificial feeding. The early abandonment of breast-feeding may also play a part in the reduction of the immune response at this age. Further work on both of these possibilities would be valuable and interesting, and we hope that our clinical survey will stimulate more detailed biochemical and respiratory function studies in this field.

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Infectious Complications in Bone Marrow Transplant Patients

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Summary

In 11 patients receiving transplants of allogeneic bone marrow, the graft was successful in six. Nine patients developed infections, and six died—five of septicaemia and one of Pneumocystis carinii pneumonia. Fifty individual infections occurred. Predisposing factors included severe underlying diseases, long-term exposure to resistant hospital organisms, heavy immunosuppressive therapy, and graft-versus-host disease. Gram-negative bacilli and Candida albicans were the most common causative organisms. In every instance of septicaemia identical organisms were isolated from blood cultures and simultaneously obtained stool cultures. Infection with exogenous organisms often occurred in patients occupying conventional isolation rooms. Isolation of one patient for 45 days in a laminar air flow room prevented infection with exogenous organisms.

Introduction

Infection remains a major problem in all types of internal organ transplantation (Rifkind *et al.*, 1964; Kelly *et al.*, 1967; Fulginiti *et al.*, 1968; Montgomery *et al.*, 1969). Bone marrow transplantation is still in its early stages (Pegg, 1966; Mathé *et al.*, 1967), and studies of associated infections are limited (Mathé *et al.*, 1965). It is apparent, however, that candidates for bone marrow transplantation are particularly susceptible to infection owing to the nature of their underlying disease processes (Mathé *et al.*, 1967; Bergsma and Good, 1968), the heavy immunosuppressive therapy often required to obtain a take of the graft, and the subsequent occurrence of graft-versus-host disease (Blaese *et al.*, 1964; Mathé *et al.*, 1965).

The present study reports the infectious complications in bone marrow transplant patients at the University of Minnesota Medical Center from 1968 to 1970. Results of extensive microbiological monitoring of patients established the origin of several infections and provided information for improved prophylaxis and therapy in future bone marrow transplantation.

Patients and Methods

Eleven patients received transplants of allogeneic* bone marrow. All suffered from a variety of serious life-threatening diseases. Details of the patients' diagnoses, age, sex, and bone marrow transplantation are presented in Table I. The methods of histocompatibility matching and the technique of bone marrow transplantation have already been described (Meuwissen *et al.*, 1969).

Demonstrable cell-mediated immune functions were completely absent in Cases 1-4, deficient in Cases 5-7, and unimpaired in Cases 8-11. Case 4 received small doses of methotrexate to facilitate the take of the bone marrow while Cases 1-3 received no immunosuppressive therapy. In addi-

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* Allogeneic: of same species but not of identical genetic constitution—for example, father and son.