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AN INVESTIGATION INTO THE EFFECT OF CERTAIN FACTORS UPON CHILD HEALTH AND CHILD WEIGHT.

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CONTENTS.

I. INTRODUCTION.

THE present paper is an attempt to make use of data appearing upon Child Welfare Centre cards, and Health Visitors' record cards, of 741 children who had attended Child Welfare Centres in Stockton-on-Tees.

There must be hundreds of thousands of Child Welfare schedule cards throughout the country which have been laboriously completed by the medical officers in charge of Centres, of which but little collective use has, so far, been made. It seems regrettable that more use has not been made of this mass of material.

It appeared probable to the authors that an examination of the data recorded upon a group of the Stockton record cards might throw some light upon the action, and interaction, of certain factors upon the health of children; and that the results might be of use in assessing the value of the local practice of child welfare teaching, and might serve as a future guide to some of the principles of the maintenance of normality among children.

In all, 741 schedule cards, each with its corresponding health visitor's card, came under review.

This number (741) falls considerably short of the number of children who attended the various Centres in the period of time during which the 741 cards had been in process of compilation. The selection of certain cards and the rejection of others may raise the objection that the population under review was not a true sample of those attending the Centres but was a weighted population. This objection may be partly met by explaining that the actual selection of cards was based upon the continuity and length of the record appearing upon them. Many cards were rejected because of gross irregularity of attendance, and some because the data recorded upon them were insufficient to give a consecutive record of the child's progress and physical condition.

The children whose cards were selected for analysis had been under observation at the Centres for at least twelve months. In many cases the period was double, or more than double, that length of time.

It will be appreciated by anyone who has had practical experience of medical work at Child Welfare Centres, that continued and detailed examination and note-taking at crowded Centres are attended with considerable difficulty; as a result of such practical difficulties the available records fall below the standard which, to a statistician, appears desirable.

Stockton-on-Tees is an industrial town and has suffered severely in recent years, in common with other towns on the north-east coast of England, as a result of trade depression in the leading industries of the area. The leading industries are heavy engineering, iron and steel manufacture and shipbuilding.

II. Physical condition of elementary school children.

Routine medical inspection of elementary school children provides the only means at present available for assessing the physical condition of practically the whole of the population at a particular age. We have no means of reviewing the population at any other age than the elementary school age. We do not know, and cannot estimate, the incidence of physical defects in the population above or below the school age.

Medical inspection of elementary school children has revealed that, approximately, 20 per cent. of the children in our elementary schools throughout the country suffer from physical defects so serious in nature as to require medical treatment at the time they are discovered. This figure is exclusive of uncleanliness and of dental decay.

Every school medical officer knows that a very much higher percentage of children than twenty presents deviations from the normal; which deviations are not considered sufficiently serious to warrant enumeration and investigation. Most of these minor defects are of the same nature, though less in degree, as those which are referred for treatment. By tracing obvious and serious defects backwards through smaller and smaller degrees of the same to normality, some estimate may be formed of the average age of onset of these defects, and also, by correlating them with other factors, their causation and the means of preventing them may, possibly, be arrived at.

The major (and minor) physical defects found in elementary school children are, broadly speaking, equally present at all ages of elementary school life. There is no marked increase (excluding defective vision) in the frequency of their occurrence in older, as compared with younger, children. The reasonable inference is, therefore, that the bulk of these defects have their origin during the pre-school years, *i.e.* under five years of age.

The School Medical Service is frequently referred to as a great agent in preventive medicine. So it is. Yet this service is mainly concerned with the detection and correction of established pathological conditions. So great is the total mass of pathology with which the School Medical Service has to cope, that a child presenting no obvious signs of abnormality can receive but little attention from the school medical officer.

The School Medical Service is concerned largely with actual diseased states, and with the early signs of disease and deviations from the normal. It is a medical service with a distinct bias towards pathology and not towards physiological, or normal biological, processes. When considered from this point of view it will be realised that the School Medical Service is, almost entirely, a curative service.

The school doctor sees children at an age when the time for purely preventive work has passed.

A recent investigation[1] into the incidence of certain defects among unselected, five-year-old, elementary school children in London disclosed that, when carefully looked for, some defects are exceedingly common.

In this report it is stated that the investigators appointed by the committee found that 87·5 per cent. of the children examined showed one or more signs of bony rickets; that 66·1 per cent. showed two or more signs of bony rickets; that 82·4 per cent. presented some abnormality of the naso-pharynx; that 67·7 per cent. had some degree of adenoids; that 93·8 per cent. had dental caries and 88·1 per cent. some degree of dental hypoplasia.

Acceptance of the findings of the five persons who took part in this investigation involves an admission that the physical condition of our five-year-old elementary school children is vastly different from what has been commonly supposed.

These conditions being present among five-year-old children, it is to the Child Welfare Service that we must turn for knowledge of the time of onset and methods of prevention of this huge mass of minor (and major) defects.

III. CHILD WELFARE SERVICE.

One of us (G. C. M. McGonigle) having been aware for some years of the very high incidence of bony changes among school children, indicative of rickets[2], has endeavoured to trace back to their origin in pre-school children

[1] *The Second Interim Report of the Board of Education Committee on the Causation of Enlarged Tonsils and Adenoids*, H.M. Stationery Office, London (1931), Price 6*d*.

[2] *Medical Officer*, XLIII, No. 26, 1930.

these, and other defects. As a result of these efforts this paper has been compiled.

In its early days the Child Welfare Service concentrated effort upon the young baby; and it is only quite recently that the importance, to the child, of the years intervening between infancy and its entry, at the age of five years, to the elementary school, has been realised.

There has been a tendency to measure the success of the Child Welfare Service by the decline in the infant mortality rate, though the influence of the one upon the other is not clear. A much more valuable scale by which to assess the value of work done for children in the pre-school years exists in the findings of the school medical officer when he examines five-year-old children on their admission to school.

The percentage of five-year-old elementary school children found by the school medical officers to have defects, so severe at the time of their discovery as to require medical treatment, has remained at twenty for ten years. The Child Welfare Service has not, taking the country as a whole, markedly reduced the incidence of defects among five-year-old children, though reductions in this percentage are reported from certain areas as occurring in children who have attended Child Welfare Centres.

The Child Welfare Service can get away from the pathological conception of a communal medical service and can envisage the progress of growth as a biological process. The maintenance of normal biological processes is the *raison d'être* of this service though, at present, our knowledge of how to do so is far from complete.

IV. Consideration of material analysed and of personal bias.

The method of recording the data on the 741 schedule cards examined is not better, but certainly not worse, than that adopted in the case of most Child Welfare record cards. Record cards of the type commonly used in Centres are not designed specifically to form the basis of a definite enquiry such as the present one. It requires to be emphasised that, although much useful information is probably to be found scattered throughout the country in the numerous Child Welfare Centres, it does not by any means follow that the information is of the proper nature to answer the questions which must necessarily follow the desire to institute a certain line of investigation.

The plan of campaign should precede, not succeed, the collection of information. In other words, the scope of the proposed enquiry, and the necessity of a special questionnaire, must primarily be decided upon.

Any attempt accurately to study the influence of any factor (such as diet) on the incidence of certain pathological conditions in childhood would require to take account of, at least, the three following factors:

(1) The degree of any such factor, *e.g.* the amount of any deviation from a "normal diet."

(2) The period of time over which the factor is operative.

(3) The age of the child at which the deviation began and over which it lasted.

Careful scrutiny of the original record cards clearly showed that any possibility of accurate assessment of the above three factors was impracticable. Even in the case of the date of commencement there are, as will be pointed out later, difficulties in obtaining this information in reliable form in the infant and pre-school population. To obtain any estimate of the degree of dietetic defect was, frankly, impossible. In the majority of instances only the presence of such was noted. This difficulty is bound to arise in field research work. In laboratory experimental work the factors can be controlled and accurately measured.

The duration of the defect, likewise, presented the difficulty that, although in some cases the presence of indiscretions was noted from time to time during the period of supervision, it was impossible to say whether or not it had been continuously in operation. The only practicable method of dealing with the information was to note the presence or absence of physical defects (rickets, etc.) and the occurrence, or otherwise, of preceding or accompanying dietetic abnormality.

With regard to the pathological conditions considered, only their presence or absence was taken into account. In some instances, such as bow-legs or dental decay, the severity of the condition, as indicated by the amount of separation at the knees in the former, and the categoric statements such as "slight" or "severe," or "upper incisors decayed," was noted on the original schedules. The proportion, however, in which the presence alone, and not the severity, was recorded, is so great that little of value seemed likely to be gained by more detailed subdivision.

It is no indictment of the method of recording the information utilised here, nor does it in the least affect the theoretical considerations on which this enquiry is based, if we consider at this point the possible intervention, and the influence of, personal bias. This certainly might, if operative to a substantial degree, influence materially the results which have accrued from the analysis of these data.

As already indicated, in the present enquiry on the question of diet itself, certain items fundamental to a really sound method of analysis are lacking.

Another point—possibly a minor one, but deserving of some notice—is that where a pathological condition is absent, the fact should be specifically stated and thus dispel the doubt whether, when no information is recorded, the child is, with respect to all the conditions under observation, absolutely free or whether, in actual fact, the child was at that date simply not subjected to a detailed examination.

Finally we come to the method by which the requisite information is obtained for the prosecution of an enquiry such as the present one. If no definite, and strictly adhered to, method of recording is in operation, it is

possible that the personal views of the observer may influence the zeal with which he directs enquiries along certain lines. Specifically, in this instance, one must realise that the major part of the information with regard to diet was obtained by questioning the mother as to the nature of the feeding of the child (supplemented by the observations of the Health Visitors in the home), and there is no doubt that the defects in diet, as given here, are so frequent that they may almost be regarded as the average, or typical, methods of feeding adopted among the general population at the present time.

If enquiry as to the presence of what are regarded here as dietetic indiscretions be more thorough in the case of children presenting evidence of the pathological conditions considered subsequently, it is obvious that correlation must arise between types of diet and presence of abnormality. Instances have occurred in the present series of schedules in which indiscretions in diet are noted on the schedule for the first time simultaneously with the record of the presence of a defect. This tends to arouse some suspicion that a more than usual amount of attention may have been given to the nature of the diet in children presenting abnormalities or *vice versa*.

The only really sound and unobjectionable method in enquiries similar to this would be for the investigator recording the nature of the diet to work independently of the physician who records the clinical data elicited on inspection of the child. Probably, however, this ideal is impracticable from the point of view of the medical officer of a Centre who has to devote a considerable amount of time to the teaching of practical dietetics to the mothers whose children he is examining.

At the moment, therefore, we must have regard to some, possibly slight, maybe even a negligible measure, of personal bias affecting the present results.

V. Dietetics taught at Stockton-on-Tees Centres.

1. The importance of breast feeding is brought continually to the notice of the mothers, and every possible endeavour is made to persuade the mothers of young infants to persevere with natural feeding.

2. In cases where artificial feeding is resorted to a high grade of dried milk is recommended. In addition the advisability of orange juice and cod-liver oil emulsion as adjuvants is stressed. For various reasons the use of fresh cow's milk has not been advised, the principal reasons being the doubtful cleanliness and freshness of the supplies, the danger of tuberculosis, the greater liability of fresh milk to turn sour and, in an impoverished population many of whose members live in furnished rooms or under overcrowded conditions, the difficulty of storage of the milk till it is used.

3. The uninstructed mothers in the town commence to supplement the infant's diet, whether this consists of breast milk or cow's milk, as early as the fifth or sixth month. The usual additions are soaked white bread, arrowroot, groats and other carbohydrate foods. The use of orange juice is becoming increasingly common and some mothers add "gravy" (which probably varies

greatly in its composition). Very few vegetables, other than potatoes, are commonly used. Bacon fat (locally known as "dip") is often given. Butter is rarely given.

4. From the age of twelve months onwards the diet usually given is the same as that partaken of by the older members of the family, but children under three or four years of age receive little or no meat. The general characteristics of the diet are a large amount of starchy food, a considerable amount of sugar (jam, sweets, etc.), little animal fat except bacon fat, a small amount of fruit, very little fresh vegetables (but a large quantity of potatoes) and very little fresh milk.

5. The diet recommended at the Stockton-on-Tees Centres is as follows:

(*a*) At six months of age, in addition to the breast or other milk, the child is given wholemeal bread with butter or, if butter is beyond the financial ability of the parent, beef dripping. In addition soups or stews with vegetables are recommended. No emphasis is laid upon sieving the vegetables as it has been found that babies from six months onwards can take mashed carrot, turnip, cabbage, etc., without ill-effect and without the production of diarrhoea. Egg yolk, meat juice and fruit are also recommended. The fruit actually given is usually orange juice, but tomato juice or pulp can be tolerated quite well. Potato is allowed in small quantities only. Cereals, sago, arrowroot, etc., are forbidden.

At first the quantities given are, of course, small but they are gradually increased and, at the age of ten or eleven months, breast feeding is discontinued. As the quantity of foods other than milk is gradually increased, the amount of breast or other milk taken is gradually diminished and, as a result, weaning is a very gradual process and is accomplished without fuss or disturbance.

(*b*) From one year of age upwards the diet is as above but potato and meat are added. The cereal foods, except bread, are kept down to the lowest possible limit, as also is sugar.

(*c*) Cod-liver oil emulsion is given in those cases in which it is doubtful if the mother will, or can, carry out the dietetic instructions faithfully and continuously. In actual fact a very large proportion of the children receive cod-liver oil emulsion at moderately regular, or irregular, intervals.

Most of the mothers ask for "emulsion" if the children are in any way out of sorts, lose appetite, have coughs or colds or are pale.

It is admitted by the observer that notes as to the diet which any particular child may have had can only be in the nature of generalisations. This particular point is considered under the heading of "bias," but it is necessary to emphasise it here. Anyone who has had extensive experience in child welfare work will appreciate the difficulties inherent in the recording, from month to month for a period of, say, two years, of accurate information as to a child's diet. So many factors may influence the nature of the actual foodstuffs given that it is impossible to do more than classify the type of diet broadly. Periods of un-

employment, illness of the father or mother, a subsequent pregnancy, periods of carelessness and of conscientious effort may occur singly or in various combinations, and may influence, in one way or another, the nutrition and nurture of the child.

VI. Incidence of and correlation between various conditions in 741 children.

(*a*) *Incidence.*

Table I shows the incidence of certain conditions discovered among the 741 children whose records are under review.

Table I.

Condition	Incidence (%)
(1) Diet unsatisfactory	49·8
(2) Bone conditions	43·0
(3) Pharyngeal conditions	17·0
(4) Dental decay	27·0
(5) Squint	3·8
(6) Anaemia	31·2
(7) Diarrhoea	39·0
(8) Bronchitis	36·7
(9) Otorrhoea	11·5

Certain explanatory notes are requisite in order that the significance of the above incidences may be appreciated.

The percentages in Table I indicate that the particular conditions had been noted at *some time or another* on the record cards. No calculation was possible of the duration of certain conditions, *e.g.* diarrhoea, which are, ordinarily, transient. Where a particular condition, *e.g.* bronchitis or diarrhoea, had been noted on more than one occasion on any particular schedule card its occurrence was, in the preparation of Table I, counted once only. It is possible, owing to the exigencies of medical work at Child Welfare Centres, that the percentages may represent some degree of understatement.

The incidence of the various conditions included in Table I may appear high, and may be considered to constitute an indictment of the Child Welfare teaching adopted; but if certain of these incidences are compared with those set out in the *Second Interim Report of the Board of Education Committee on Adenoids and Enlarged Tonsils* they will be found to be considerably lower than those among unselected five-year-old elementary school children in London.

It is of interest to compare the incidence of certain of the conditions contained in Table I with that found throughout the country among elementary school children, as reported in the *Annual Report of the Chief Medical Officer of the Board of Education for the year* 1928.

1. Dietetic conditions cannot be compared as no records on lines similar to those used here are kept by school medical officers.

2. Bone conditions as recorded by the school medical officer under the heading of rickets must, obviously, refer only to conditions of such severity as

to cause some degree of crippling and marked deformity. The incidence, therefore, cannot be compared.

3. Pharyngeal conditions (17 per cent.). The incidence among school children is given as 6·3 per cent., which is very much below that found among the Centre children. Some children would have had operative treatment for this condition before they were examined in school. The standard adopted by the school medical officers in noting the presence of this condition is, probably, one which takes account only of cases requiring treatment.

4. Dental decay (27 per cent.). This, as would be expected, owing, among other factors, to the lower age of the Centre children, is much lower than the percentage found in schools.

5. Squint (3·8 per cent.). Among school children 0·89 per cent. is recorded as suffering from squint. This figure is widely at variance with the incidence found among the Centre children.

6. Anaemia (31·2 per cent.). Not comparable.

7. Diarrhoea (39·0 per cent.). Not recorded by school medical officers.

8. Bronchitis (36·7 per cent.). The assistant school medical officer does not see cases of bronchitis. Children suffering from this condition are usually absent from school.

9. Otorrhoea (11·5 per cent.). In the schools 0·54 per cent. is found to have otorrhoea. These cases are probably all chronic and do not include the transient discharges from the ear which are included in the Centre figures.

(1) *Diet unsatisfactory.* The diet was considered to be unsatisfactory, and was recorded as such, when the mother admitted having deviated from the standard diet taught at the Stockton-on-Tees Child Welfare Centre, or when the Health Visitor who visited the home recorded such deviations upon her record card. The commonest error in diet (an error according to local teaching) was an excess of carbohydrate food (usually cereals) in the child's diet. It appeared that such excesses were associated with a corresponding decrease in fresh foods. Very strong emphasis is laid, in the local Child Welfare Centres, on the importance of avoiding such excess. Each child attending the Centres is provided with a small card, which the mother retains, showing the weight and having a space for instructions on feeding. All instructions as to the foodstuffs to be given are written in black ink, and a list of items to be avoided is added in red ink.

It is probable that a quantity of carbohydrate and cereals which, according to local teaching, is considered excessive, may, by many Child Welfare medical officers, be thought to lie within the bounds of reasonableness. Errors confined merely to the total quantity, as apart from the quality, of food given were not recorded as "diet unsatisfactory."

(2) *Bone conditions.* Under this heading are included changes in the chest wall, such as eversion of the lower ribs, Harrison's sulcus and beading of the ribs. The commonest change was eversion of the lower ribs. Beading of the

ribs was not common. Knock-knees, bow-legs and outward curvature of the tibiae are also included.

The omission of parietal and frontal bossing requires some explanation.

The observer's clinical experience is that parietal bossing occurs very early in life. It is present in a very high percentage of infants brought to the Centres for the first time when they are about four weeks old. No case has been observed in which this condition developed after this age in an infant who did not present it on its first appearance at the Centre. It appears probable that pre-natal factors may play a considerable part in the production of this sign. The Child Welfare records were not, primarily, made for the purposes of the present inquiry, and, having made the above observations on the age of incidence of this condition, during a period which preceded the accumulation of the data used here, further notes on the point were discontinued. Had records been kept of the occurrence of parietal bossing among the 741 children who are the subjects of this inquiry it would have been interesting to determine what correlation existed between it and certain other factors. Had its occurrence been merged among the other bony conditions it would, almost certainly, have confused the issue in certain respects and, particularly, when correlating dietetic conditions and the presence of rickets.

The recording of frontal bossing had also been discontinued before the present series of cards had been commenced. The reason for this omission was that the pressure of work at the Centres had become so great that it was necessary to limit the observations which were recorded. For similar reasons certain observations on the occurrence of flat-foot were suspended. It was also found to be impracticable to assess and record dental hypoplasia for the same reason.

The commonest bone change in the legs was a slight degree of knock-knees. There were a few cases of enlargement of the radial epiphysis.

Radiological examination of the bones was not made.

(3) *Pharyngeal conditions.* These refer almost entirely to enlarged tonsils, though in a very few the presence of adenoids was assumed. Such inferences were very few. It was recognised that a diagnosis of "adenoid" without a digital examination of the posterior naso-pharynx was not justified. In busy Child Welfare Centres the routine examination, by digital exploration, of the posterior naso-pharynx is neither practicable nor desirable.

(4) *Dental decay.* This condition was diagnosed by ordinary visual inspection. As examination by means of a dental probe and mirror was not carried out it is probable that the true incidence of dental caries was higher than 27 per cent.

(5) *Squint.* No detailed ophthalmic examination by means of an ophthalmoscope was made. The presence of squint was determined by inspection only.

(6) *Anaemia.* The presence or absence of anaemia was judged by the appearance of the skin and mucous membranes. Routine blood tests, even if

practicable, would have aroused too much opposition on the part of the mothers to have been continued.

(7) *Diarrhoea.* This condition was assessed by a consideration of the mothers' statements either volunteered, or in response to questions on this specific point. When a mother stated that a child had, or had had diarrhoea, details as to the number of motions per day were enquired into, though such details were not recorded upon the charts. In a great number of the cases a failure to gain weight or an actual loss of weight had occurred. As a routine the presence or absence of diarrhoea is enquired into specifically in all cases of failure to gain weight or of loss of weight.

(8) *Bronchitis.* The presence of this condition was determined by auscultation of the chest in some cases, but also by recording the mothers' statements.

(9) *Otorrhoea.* In almost all cases the presence of otorrhoea was determined by actually seeing the discharge.

(*b*) *Age incidence.*

The ages at which these various conditions were *first observed* are shown in Table II.

Table II. *Showing the ages at which the following features were first observed.*

Age in weeks	Faults in diet		Bone conditions		Pharyngeal conditions		Dental decay		Squint		Anaemia		Otorrhoea	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1–	22	5·96	—	—	1	0·79	—	—	—	—	5	2·16	8	9·41
13–	20	5·42	1	0·31	1	0·79	—	—	—	—	13	5·63	8	9·41
25–	49	13·28	—	—	—	—	—	—	—	—	11	4·76	19	22·35
37–	65	17·61	4	1·25	—	—	—	—	—	—	22	9·52	14	16·47
49–	49	13·28	17	5·33	3	2·38	3	1·50	1	3·57	36	15·58	7	8·23
61–	33	8·94	33	10·34	1	0·79	5	2·50	1	3·57	33	14·29	3	3·53
73–	33	8·94	33	10·34	5	3·97	7	3·50	—	—	32	13·85	4	4·71
85–	26	7·05	33	10·34	10	7·94	13	6·50	2	7·14	18	7·79	5	5·88
97–	15	4·07	25	7·84	4	3·17	11	5·50	3	10·71	10	4·33	4	4·71
109–	10	2·71	23	7·21	7	5·56	14	7·00	2	7·14	13	5·63	4	4·71
121–	11	2·98	25	7·84	12	9·52	14	7·00	2	7·14	6	2·60	—	—
133–	8	2·17	16	5·02	10	7·94	9	4·50	1	3·57	4	1·73	4	4·71
145–	4	1·08	4	1·25	7	5·56	14	7·00	1	3·57	2	0·87	1	1·18
157–	4	1·08	21	6·58	12	9·52	18	9·00	3	10·71	3	1·30	2	2·35
169–	4	1·08	16	5·02	11	8·73	13	6·50	—	—	2	0·87	—	—
181–	7	1·90	13	4·08	7	5·56	11	5·50	4	14·29	6	2·60	—	—
193–	—	—	9	2·82	5	3·97	11	5·50	1	3·57	—	—	1	1·18
205–	3	0·81	15	4·70	12	9·52	17	8·50	—	—	4	1·73	—	—
217–	1	0·27	9	2·82	2	1·59	8	4·00	2	7·14	3	1·30	1	1·18
229–	4	1·08	5	1·57	4	3·17	8	4·00	1	3·57	2	0·87	—	—
241–	1	0·27	8	2·51	5	3·97	10	5·00	2	7·14	5	2·16	—	—
253–	—	—	6	1·88	6	4·76	10	5·00	2	7·14	1	0·43	—	—
265–	—	—	1	0·31	—	—	2	1·00	—	—	—	—	—	—
277–	—	—	1	0·31	1	0·79	1	0·50	—	—	—	—	—	—
289–	—	—	—	—	—	—	—	—	—	—	—	—	—	—
301–	—	—	1	0·31	—	—	1	0·50	—	—	—	—	—	—
	369	100·00	319	100·00	126	100·00	200	100·00	28	100·00	231	100·00	85	100·00

Attendance at Child Welfare Centres is voluntary and not compulsory, and some children attend irregularly, so there may be a considerable time gap between two attendances. Careful and conscientious mothers bring their children

to the Centres at regular intervals, but even among such parents there is a tendency to less regular attendance with increasing age on the part of the child. Some women tend to omit periodical visits if their children appear healthy, while others fail to attend for a period of a few months owing to illness, a subsequent pregnancy or other domestic cause.

A result of irregularities in attendance is that the age at which any particular condition was first noticed, and recorded, is not necessarily identical with the age at which it commenced. It is not possible, from the available data, to assess this time lag.

Faults in diet. Examination of Table II shows that the critical period for the incidence of dietetic errors is the six months preceding the child's first anniversary of its birth. That this should be the critical age is not surprising when it is remembered that it is during these months that the infant's diet changes over from fluid to solid foodstuffs. It must also be remembered that the local dietetic teaching diverges considerably from that commonly taught by the grandmothers and other elderly relations and neighbours of the children, and it is during these months that the influence of these people is most likely to carry weight with the mother.

Bone conditions. The second year of life is the period when a large number of bone defects were first noticed. It will be noted that the incidence of this type of defect was small at ages under twelve months. Acute and severe rickets in young babies is uncommon in Stockton-on-Tees. Particularly noticeable was the rarity of beading of the ribs, a sign on which some textbooks lay considerable emphasis.

Pharyngeal conditions. The period of life during which pharyngeal defects were most frequently detected was the third year. This is considerably later than the age of maximum incidence of bone defects. It is probable that the time lag between occurrence and detection may be, in pharyngeal conditions, greater than in other conditions, for the examination of the posterior portion of the buccal cavity cannot be carried out, in very young children, without some distress unless some slight degree of co-operation on the part of the child is accorded.

Dental decay. Approximately 20 per cent. of the cases of dental decay noted was found during the second year. In the case of older children the time lag between occurrence and detection may be considerable.

Squint. Half the recorded cases of squint were discovered in the age period between eighteen months and three years.

Anaemia. The age period during which anaemia is commonly noted approximates fairly closely to that in which the maximum incidence of dietetic errors was noted.

Otorrhoea. The frequency of otorrhoea during the first year of life is a striking feature of the last column in Table II. The replies of the mothers to enquiries as to precedent illnesses among members of the household suggest that influenza, sore throats and "colds" among older members of the family

are liable to be followed in a few days or a week by otorrhoea in the infant. Measles and other infectious diseases could almost always be definitely excluded in the case of children under one year of age.

The duration of the otorrhoea in infants appeared to be, in most cases, short. Discharge usually ceased in from one to two weeks, but in some cases recurrences occurred at intervals and the condition became chronic.

(c) *Correlation.*

The principal object of the present enquiry was to determine what, if any, correlation exists between the various physical conditions recorded, and also if any relationship were demonstrable between the presence of these conditions, severally and collectively, and certain environmental factors.

Table III shows the correlations between unsatisfactory diet and the eight physical conditions recorded.

Table III.

	Diet satisfactory	Diet unsatisfactory	Difference	Standard deviation	Difference / S.D.
Bone defects	31·18	55·01	23·83	3·64	6·5
Pharyngeal conditions	10·22	23·85	13·63	2·76	4·9
Dental decay	17·47	36·59	19·12	3·26	5·9
Squint	1·34	6·23	4·89	1·40	3·5
Anaemia	21·51	40·92	19·41	3·40	5·7
Diarrhoea	39·52	38·48	− 1·04	3·58	−0·3
Bronchitis	33·33	40·11	6·78	3·54	1·9
Otorrhoea	9·14	13·82	4·68	2·34	2·0

From a consideration of Table III it appears that there exists a substantial correlation between diet and bone defects, pharyngeal conditions, dental decay, squint and anaemia. There is a very slight negative correlation between unsatisfactory diet and diarrhoea, but this is so trifling as to be without significance. At first glance this last result may appear contrary to all reason, but it must be taken into account that the unsatisfactory diet here considered is not a mere temporary indiscretion but a deviation from certain standards. Bronchitis and unsatisfactory diet show no significant correlation and that between diet and otorrhoea is also within the bounds of fortuitous occurrence.

Table IV.

	Bone defects present	Bone defects absent	Difference	Standard deviation	Difference / S.D.
Pharyngeal conditions	27·27	9·24	18·03	2·79	6·5
Dental decay	41·69	15·88	25·81	3·29	7·8
Squint	8·15	0·47	7·68	1·41	5·4
Anaemia	39·81	24·64	15·17	3·44	4·4
Diarrhoea	34·80	42·18	− 7·38	3·62	−2·0
Bronchitis	31·97	40·28	− 8·31	3·58	−2·3
Otorrhoea	11·91	11·14	0·77	2·36	0·3

Table IV shows a substantial correlation between the presence of bone defects and pharyngeal conditions. Correlation of a very high degree is shown between bone defects and dental decay and a substantial relationship between

bone conditions and the presence of squint. The relationship between bone conditions and anaemia is also substantial, whilst diarrhoea and bronchitis show correlations which are negative but which cannot definitely be considered as significant. Otorrhoea appears to be entirely unconnected with the presence of bone conditions.

Table V.

	Pharyngeal conditions present	Pharyngeal conditions absent	Difference	Standard deviation	Difference / S.D.
Dental decay	45·24	23·25	21·99	4·34	5·1
Squint	7·14	3·09	4·05	1·86	2·2
Anaemia	29·37	31·54	− 2·17	4·53	−0·5
Diarrhoea	40·95	38·54	2·41	4·77	0·5
Bronchitis	33·33	37·40	− 4·07	4·71	−0·9
Otorrhoea	15·08	10·73	4·35	3·12	1·4

The relationship between pharyngeal conditions and dental decay is substantial and Table V is of interest in that, apart from squint, the differences in which may be significant, it is the only condition in which this is shown. It is somewhat surprising that anaemia, bronchitis and otorrhoea present no apparent relationship to the presence or absence of pharyngeal conditions.

Table VI.

	Dental decay	No dental decay	Difference	Standard deviation	Difference / S.D.
Squint	8·00	2·22	5·78	1·58	3·7
Anaemia	36·00	29·39	6·61	3·83	1·7
Diarrhoea	44·00	37·15	6·85	4·04	1·7
Bronchitis	40·00	35·49	4·51	3·99	1·1
Otorrhoea	11·00	11·65	−0·65	2·64	−0·2

In Table VI there is a correlation of some significance between dental decay and squint. The remaining conditions appear to bear no relationship to the state of the teeth.

Table VII.

	Squint	No squint	Difference	Standard deviation	Difference / S.D.
Anaemia	46·43	30·57	15·86	8·92	1·8
Diarrhoea	28·57	39·41	−10·84	9·40	−1·2
Bronchitis	28·57	37·03	− 8·46	9·29	−0·9
Otorrhoea	10·71	11·50	− 0·79	6·14	−0·1

Table VIII.

	Anaemia	No anaemia	Difference	Standard deviation	Difference / S.D.
Diarrhoea	39·39	38·82	0·57	3·87	0·1
Bronchitis	38·53	35·88	2·65	3·82	0·7
Otorrhoea	11·26	11·59	−0·33	2·53	−0·1

Table IX.

	Diarrhoea	No diarrhoea	Difference	Standard deviation	Difference / S.D.
Bronchitis	41·87	33·41	8·46	3·63	2·3
Otorrhoea	13·84	9·96	3·88	2·40	1·6

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Table X.

	Bronchitis	No bronchitis	Difference	Standard deviation	Difference / S.D.
Otorrhoea	15·07	9·81	5·26	2·43	2·2

Tables VII–X. With the possible exceptions of diarrhoea and bronchitis and of bronchitis and otorrhoea, no correlation between the incidences shown in these four tables is apparent.

The various relationships shown in Tables III–X inclusive are apparent at a glance in the subjoined schema.

Condition	Correlation with	No correlation with
Unsatisfactory diet	Bone defects Pharyngeal conditions Dental decay Squint Anaemia	Diarrhoea Bronchitis Otorrhoea
Bone defects	Diet unsatisfactory Pharyngeal conditions Dental decay Squint Anaemia	Diarrhoea Bronchitis Otorrhoea
Pharyngeal conditions	Diet unsatisfactory Bone defects Dental decay	Diarrhoea Bronchitis Otorrhoea Anaemia Squint
Dental decay	Diet unsatisfactory Bone defects Pharyngeal conditions Squint	Diarrhoea Bronchitis Otorrhoea Anaemia
Squint	Diet unsatisfactory Bone defects Dental decay	Pharyngeal conditions Anaemia Diarrhoea Bronchitis Otorrhoea
Anaemia	Diet unsatisfactory Bone defects	Pharyngeal conditions Dental decay Diarrhoea Bronchitis Otorrhoea Squint
Diarrhoea Bronchitis Otorrhoea	—	Diet unsatisfactory Bone defects Squint Anaemia Dental decay Pharyngeal conditions

(*d*) *Influence of overcrowding and size of family.*

The preceding tables show a definite association between dietetic errors and the incidence of certain physical deviations from the normal, and an interrelation between the incidence of some of these physical deviations.

The influence of certain environmental factors upon these deviations must now be considered. From the information contained in the Health Visitors' record cards it is possible to take account of differences in size of family, of air

space (defined as the number of rooms per person, and calculated without taking into account differences of ages of the inmates), of the health and of the efficiency of the mother.

The average air space per person and size of family have been calculated for groups of children classified with respect to nature of feeding, presence or absence of bone changes, pharyngeal conditions, etc. These, together with the differences between the groups and their probable errors, are given in Tables XI and XII.

Table XI. *Showing the average air space for groups of children subdivided with respect to the following conditions.*

		Average air space (rooms per person)	Difference
Diet	Satisfactory	0·8889 ±0·053	0·1038 ±0·073
	Not satisfactory	0·7851 ±0·050	
Bone defects	+	0·7953 ±0·055	0·0739 ±0·074
	−	0·8692 ±0·049	
Pharyngeal conditions	+	0·8276 ±0·094	0·0113 ±0·102
	−	0·8389 ±0·040	
Dental decay	+	0·7484 ±0·066	0·1214 ±0·079
	−	0·8698 ±0·043	
Squint	+	0·6420 ±0·147	0·2022 ±0·151
	−	0·8442 ±0·037	
Anaemia	+	0·7473 ±0·059	0·1319 ±0·074
	−	0·8792 ±0·045	
Diarrhoea	+	0·7897 ±0·056	0·0774 ±0·074
	−	0·8671 ±0·048	
Bronchitis	+	0·8250 ±0·060	0·0189 ±0·076
	−	0·8439 ±0·046	
Otorrhoea	+	0·8451 ±0·112	−0·0092 ±0·119
	−	0·8359 ±0·039	

It seems to be quite clear that, in the case of overcrowding, although the average space available per person is lower in children possessed of these undesirable attributes (except in the isolated case of otorrhoea) than in children free from them, in no individual instance is one justified in attributing any significance thereto.

So far as these results go, we are entitled to infer that overcrowding is no worse in families where the child under observation is unsatisfactorily fed, or has rickets, or any of the remaining specified conditions and, consequently, that this is an unimportant factor in determining the incidence of these defects.

Table XII, which deals with the size of the family, gives negative results somewhat similar to those disclosed in Table XI.

With the exception of anaemic children, who seem, on the average, to belong to large-sized families, no substantial divergence among the several groups can be pointed out. The inference to be drawn from Table XII is that size of family is not of much importance in determining the differences of incidence of the conditions under review, or, as an indirect correlative, in the case of dietetic indiscretions.

Table XII. *Showing the average size of family from which the children contained in the following groups are derived.*

		Average size of family	Difference
Diet	Satisfactory	2·7817 ±0·072	0·1611 ±0·105
	Not satisfactory	2·9428 ±0·076	
Bone defects	+	2·9622 ±0·078	0·1760 ±0·105
	−	2·7862 ±0·071	
Pharyngeal conditions	+	2·6508 ±0·124	−0·2545 ±0·137
	−	2·9053 ±0·058	
Dental decay	+	3·0553 ±0·112	0·2649 ±0·127
	−	2·7904 ±0·059	
Squint	+	3·1071 ±0·358	0·2550 ±0·362
	−	2·8521 ±0·053	
Anaemia	+	3·2511 ±0·104	0·5667 ±0·120
	−	2·6844 ±0·059	
Diarrhoea	+	2·8706 ±0·088	0·0144 ±0·109
	−	2·8562 ±0·065	
Bronchitis	+	2·8148 ±0·080	−0·0741 ±0·106
	−	2·8889 ±0·069	
Otorrhoea	+	2·9405 ±0·159	0·0888 ±0·177
	−	2·8517 ±0·077	

(*e*) *Influence of maternal health.*

Table XIII shows the degree of association between maternal health and the nine conditions under consideration.

Table XIII. *Showing the relationship between maternal health and the following conditions.*

	χ^2	P
Diet	13·87	0·0010
Bone defects	2·30	0·3245
Pharyngeal conditions	3·39	0·1889
Dental decay	4·81	0·0922
Squint	1·21	0·5564
Anaemia	9·01	0·0111
Diarrhoea	5·97	0·0508
Bronchitis	1·70	0·4395
Otorrhoea	2·88	0·2405

From Table XIII it appears that maternal health has very little effect upon the incidence of the factors examined in relation to it. There is an exception in the case of diet, where the proportion of children fed in an unsatisfactory manner is higher among unhealthy mothers; and also in the case of anaemia, where the incidence is greater among the children of mothers whose state of health is not satisfactory.

The estimate of the state of health of the mother is in the nature of a generalisation being taken from the data recorded upon their record cards by the Health Visitors.

None of the correlations attains anything approaching the magnitude of those already found between diet and those abnormal conditions of the growing child which are recorded upon the schedule cards.

The figures in Table XIII justify the disregard of maternal health, or ill health, as a factor of importance in the incidence of certain physical conditions in the children.

(*f*) *Influence of maternal efficiency.*

The mothers were classified as to efficiency in three groups: (*a*) those of whom a special note was made that they were good or very good mothers, (*b*) those specifically noted as bad or inefficient, and (*c*) an intermediate category where nothing noteworthy was mentioned in respect of efficiency.

Table XIV.

	χ^2	*P*
Diet	71·40	0·0000
Bone defects	11·32	0·0036
Pharyngeal conditions	5·15	0·0772
Dental decay	20·14	0·0000
Squint	14·80	0·0006
Anaemia	29·01	0·0000
Diarrhoea	2·31	0·3230
Bronchitis	12·33	0·0022
Otorrhoea	1·22	0·5540

As will be seen from Table XIV, the efficiency of the mother correlates to a slightly greater extent than does maternal health with the incidence of defects, though here again few of the correlations attain a high numerical value.

Efficiency of the mother and the proper method of feeding go hand in hand to some extent. For example, the proportion of children fed in an unsatisfactory manner is, among efficient mothers 20·9 per cent., among moderately good mothers 46·4 per cent., and among inefficient mothers 80·0 per cent. Whether in actual fact these two variables are substantially correlated (and, *a priori*, the finding appears very reasonable), or whether this is an example of what might result from individual preconceptions as to what constitutes efficiency, is a little difficult to confirm.

The main point, however, for the purposes of the present enquiry, is that the magnitude of the association between maternal efficiency and abnormal conditions, with the exceptions of diarrhoea and bronchitis, is of a definitely lower order than that found with reference to diet, and that the slighter correlations shown in Table XIV between maternal efficiency and physical defects in the child might well be the indirect result of the relation found between diet and efficiency.

(*g*) *Summary.*

It does seem clear from the above series of results that of the factors examined in their relation to rickets, etc., the only one of substantial importance is differences in the manner of feeding. The absence of definite association with overcrowding is, certainly, surprising, in spite of the fact that we realise how crude is the measure of this factor which we have had to adopt. If, as we suggest, the personal factor is not a very serious one, the above findings afford at least *prima facie* evidence of the truth of the assertions made previously, and

are certainly sufficient to warrant the prosecution of further field enquiries, on this line, but having greater regard to the obtaining of the necessary information in a form more suitable for detailed analysis.

VII. RELATION BETWEEN INFANT WEIGHT AND CERTAIN FACTORS.

In the preceding section, an attempt has been made to determine which of several possible causes have the greatest association with the presence or absence of certain kinds of deviations from the physical normal. Records of the weights of each of these infants being available, we considered it would be of value in addition to relate these variations of infant weight to differences in dietetic and other factors, to show the inter-relations, if any, which these have one with another.

(*a*) *Diet.*

The weights of children in the two groups previously made with respect to this factor, those fed in a satisfactory and those in an unsatisfactory manner, were contrasted. The average weights of children in each of the groups were calculated for each week of life up to the sixtieth. After that date the observations become so few that averages based on them fluctuate greatly and are, therefore, to some extent unreliable. The difficulties met with in this enquiry in the attempt to assess the effect of variations in diet in the sense here understood on any other condition have already been explained, and it will be realised that comparisons made in this case are also necessarily somewhat crude. The average weights of the two groups of children, males and females separately, are given in Table XV.

In the male sex, the weights of children in whom no deficiencies in the diet were recorded is, if anything, somewhat lower than those of the remaining group of children. It is only in a minority of these averages that a higher value is found for the first group and, although the differences are not very large, the conclusion seems justified that dietetic indiscretions (as here understood) do not affect adversely the weight of the male child. In females in the first six months of life there is very little difference in the average weights of the two groups compared. From that date onwards, however, the children whose feeding was considered satisfactory show somewhat higher averages. Although not consistently higher, and although the significance of the individual difference is doubtful, the majority of the average weights after the twenty-sixth week are above those of infants whose feeding was at some period and for some time unsatisfactory. In view of the finding as to the most frequent period for dietetic indiscretions to make their first appearance, the figures for females would suggest that this factor had some effect on the child's weight; but since the results for males give no support to, in fact contradict this suggestion, it seems more reasonable to conclude that there are no gross differences of weight between the two groups in respect of differences of diet.

Table XV. *Average weights of boys and girls classified according to differences in feeding.*

Age in weeks	Boys			Girls		
	Total	S.	N.S.	Total	S.	N.S.
2	8·17	8·42	8·08	7·44	7·65	7·08
3	8·26	7·94	8·53	7·84	7·63	7·99
4	8·50	8·52	8·49	8·08	7·98	8·21
5	9·23	9·09	9·38	8·34	8·16	8·60
6	9·51	9·62	9·41	8·83	8·89	8·74
7	10·13	10·16	10·11	9·01	8·89	9·21
8	9·87	9·63	10·21	9·59	9·63	9·53
9	10·31	9·90	10·69	9·65	9·73	9·53
10	10·80	10·57	11·03	9·87	9·90	9·83
11	10·88	10·83	10·94	10·12	9·96	10·37
12	11·15	11·16	11·15	10·45	10·49	10·41
13	11·55	11·19	11·92	10·66	10·25	11·18
14	11·65	11·75	11·54	11·10	11·13	11·06
15	12·49	12·15	12·84	11·15	10·89	11·56
16	12·51	12·49	12·53	11·72	11·53	11·98
17	12·74	12·57	12·91	11·75	11·62	11·93
18	13·09	12·63	13·63	12·31	12·29	12·33
19	13·50	13·38	13·64	12·56	12·47	12·72
20	13·69	13·47	13·94	12·83	12·64	13·13
21	14·06	13·84	14·28	13·21	13·04	13·48
22	14·17	13·82	14·60	13·21	13·15	13·29
23	14·55	14·25	14·89	13·81	13·83	13·78
24	14·70	14·55	14·89	14·23	14·26	14·19
25	15·18	14·94	15·45	14·24	14·46	13·93
26	15·31	15·34	15·27	14·68	14·86	14·44
27	15·58	15·22	16·07	15·06	15·14	14·90
28	15·84	15·72	15·98	15·02	15·31	14·65
29	16·23	16·03	16·49	15·45	15·61	15·25
30	16·13	15·91	16·39	15·32	15·42	15·16
31	16·62	16·51	16·78	16·11	16·24	15·95
32	16·96	16·59	17·48	15·58	15·73	15·39
33	17·17	16·60	17·92	16·47	16·55	16·31
34	16·95	16·94	16·97	16·50	16·66	16·26
35	17·50	17·48	17·52	16·86	16·93	16·75
36	17·77	17·62	18·02	16·64	16·93	16·13
37	17·56	17·51	17·62	17·34	17·27	17·46
38	17·86	17·30	18·45	17·27	17·40	17·01
39	18·58	18·54	18·61	17·68	17·94	17·38
40	18·41	17·85	19·06	17·70	18·00	17·10
41	18·92	18·54	19·25	18·55	18·79	18·19
42	18·90	18·92	18·86	17·90	18·36	17·21
43	19·10	18·42	20·01	18·08	18·33	17·78
44	18·79	18·79	18·79	18·29	18·86	17·64
45	19·29	19·02	19·54	18·12	18·34	17·75
46	19·43	19·28	19·56	18·51	18·76	18·28
47	20·14	19·82	20·54	18·49	18·74	18·06
48	19·66	19·56	19·76	18·68	18·87	18·42
49	20·28	20·25	20·32	18·69	19·28	17·99
50	20·29	20·27	20·31	19·18	19·92	18·14
51	19·86	19·79	19·96	19·03	19·50	18·59
52	20·20	19·92	20·53	19·76	20·23	19·04
53	20·84	21·07	20·55	19·58	19·84	19·27
54	20·74	20·38	21·12	19·39	20·09	18·48
55	21·16	21·03	21·36	19·68	20·40	18·81
56	20·51	20·23	20·87	19·46	20·29	18·72
57	21·93	21·78	22·11	20·33	20·62	19·84
58	21·19	21·06	21·33	20·04	20·32	19·71
59	21·08	20·84	21·28	20·09	21·06	19·08
60	22·02	21·87	22·23	20·05	20·13	19·93

(*b*) *Overcrowding.*

The average number of rooms per person is the only index of this factor which is available in these schedules, and the correlations between the weight of the infant at various periods during the first year of life and this index were calculated. The five periods taken were (*a*) under four weeks, (*b*) five to sixteen weeks, (*c*) seventeen to twenty-eight weeks, (*d*) twenty-nine to forty weeks, and (*e*) forty-one to fifty-two weeks. Where the infant had frequently been weighed, the weight taken for any one of these five periods was that recorded at the age in weeks nearest to the mid-point of the range for that group. In the first period there were few infants weighed before the third week of life, so that the average age of those included here lies probably between three and four weeks; but in each of the other four periods, although there is variation in the ages of the infants included in any one group, the average age will probably approximate to the mid-point of the class-interval chosen. The correlations found at each of these age periods of infant life and the index of overcrowding for each of the two sexes are given in Table XVI.

Table XVI. *Correlation between weight of infant and overcrowding (rooms per person).*

Age	Males	Females
Under 4 weeks	$0{\cdot}0424 \pm 0{\cdot}068$	$0{\cdot}0102 \pm 0{\cdot}066$
5–16 ,,	$0{\cdot}0166 \pm 0{\cdot}042$	$0{\cdot}0630 \pm 0{\cdot}042$
17–28 ,,	$0{\cdot}0681 \pm 0{\cdot}041$	$0{\cdot}0910 \pm 0{\cdot}042$
29–40 ,,	$0{\cdot}0770 \pm 0{\cdot}043$	$0{\cdot}1538 \pm 0{\cdot}043$
41–52 ,,	$0{\cdot}1436 \pm 0{\cdot}043$	$0{\cdot}2509 \pm 0{\cdot}042$

It will be observed that the coefficients of correlation are uniformly positive in sign, small in magnitude, but that in males only one, that found in the last three months of the first year, and in females two, those in the two last three-monthly periods of the first year, are statistically significant. In both sexes, but more especially in females, there is a tendency for the association to increase in magnitude as age advances, and suggests that the effect on infant weight of overcrowding only becomes appreciable towards the end of the first year of life, but that even then the correlations are not very high. The average weights of infants at the several age periods considered are shown grouped according to the number of rooms per person in Table XVII.

It is evident that there are no gross and consistent changes in weight in the case of males housed under varying conditions of overcrowding; but that in females in the fourth, and more especially in the fifth age group under review, there is a fairly wide divergence between those living in the most and least overcrowded homes. In the age group, 29–40 weeks, for example, the weights range from 16·4 lb. for infants in homes with less than 0·3 rooms per person, to 19·5 lb. for those in homes with 1·8 and under 2·1 rooms per person. At ages 41–52 weeks, the average weights range from 17·1 lb. in the worst homes to 21·0 lb. in the least overcrowded homes. It would appear then that overcrowding in the home is associated to some extent with a lower infant weight towards the end of the first year of life.

Table XVII. *Average weights in relation to air space at different periods in the first year of life.*

Rooms per person	Males Period					Females Period				
	1st	2nd	3rd	4th	5th	1st	2nd	3rd	4th	5th
Under 0·3	9·1	11·9	15·4	18·4	20·3	7·4	9·7	13·7	16·4	17·1
0·3–	8·4	11·1	14·5	17·1	19·2	8·2	10·4	13·6	16·6	18·3
0·6–	8·3	11·1	14·8	17·4	19·8	7·9	10·3	14·1	16·7	18·7
0·9–	8·0	11·2	14·8	18·3	20·1	8·5	10·8	13·9	17·0	19·0
1·2–	8·9	11·8	15·9	18·6	21·0	8·6	10·3	14·0	17·0	19·6
1·5–	8·8	10·5	14·3	16·9	20·1	7·5	10·7	14·3	17·4	19·6
1·8–	7·8	11·6	14·9	17·3	20·1	6·8	10·1	16·0	19·5	21·8
2·1–	—	—	—	—	—	7·2	10·7	14·5	18·5	21·0
General average	8·4	11·2	14·9	17·7	19·9	8·0	10·4	13·9	16·8	18·8

(*c*) *Size of family.*

The coefficients of correlation between weight and position of the infant in the family are shown in Table XVIII.

Table XVIII. *Correlation between weight of infant and size of family.*

Age	Males	Females
Under 4 weeks	0·1035 ± 0·066	−0·0335 ± 0·064
5–16 ,,	0·0856 ± 0·041	−0·0770 ± 0·040
17–28 ,,	−0·0739 ± 0·040	−0·0839 ± 0·040
29–40 ,,	−0·1358 ± 0·041	−0·0851 ± 0·042
41–52 ,,	−0·1406 ± 0·042	−0·1810 ± 0·042

Here again the size of the coefficients is small, and although the greater number are negative in sign, only three are statistically significant, those for the last two age groups in boys and that for the final age group in girls. The average weights of infants of different positions in the family are given in Table XIX.

Table XIX. *Average weights in relation to size of family in the first year of life.*

Size of family	Males Period					Females Period				
	1st	2nd	3rd	4th	5th	1st	2nd	3rd	4th	5th
1	7·8	10·8	14·9	17·7	20·2	7·8	10·5	14·3	17·0	19·4
2	8·3	11·2	14·9	17·9	20·3	7·7	10·4	13·8	16·8	19·2
3	8·7	11·6	15·4	18·2	20·1	8·3	10·5	14·0	17·1	18·2
4 and 5	9·1	11·8	14·9	17·3	19·2	8·9	10·9	14·4	17·2	19·1
6 and 7	8·0	10·7	14·3	17·2	19·2	7·2	9·6	13·3	15·8	17·3
8+	8·4	11·4	13·8	15·8	18·9	7·2	9·7	12·9	15·7	17·7
General average	8·4	11·2	14·9	17·7	20·0	8·0	10·4	14·0	16·8	18·9

There would appear to be a suggestion in the earliest age groups for the average weights to be lowest in first-born children, to increase to a maximum for fourth and fifth-born infants and for later-born children again to show a lower average weight. Towards the end of the first year of life, however, first-born have recovered from this initial deficiency, their weights being, if anything, over average; but those of infants born into larger families are still at this age under average.

(*d*) *Maternal health.*

Health of the mother was grouped into three categories—good, satisfactory, and unsatisfactory. The correlations found are shown in Table XX.

Table XX. *Correlation between weight of infant and maternal health.*

Age	Males	Females
Under 4 weeks	0·0237 ± 0·074	0·1588 ± 0·072
5–16 ,,	0·0896 ± 0·045	0·0825 ± 0·047
17–28 ,,	0·1413 ± 0·044	0·1210 ± 0·046
29–40 ,,	0·1386 ± 0·045	0·1613 ± 0·047
41–52 ,,	0·1562 ± 0·046	0·1080 ± 0·050

None of these is high, and there is not, as in the previous two factors considered, evidence of even the slightest tendency to change uniformly with age.

Inspection of Table XXI, in which are collected the average weights of infants of mothers grouped in the three categories with respect to health, will show that, except in the first age group, the weights of infants, the health of whose mothers was considered only as satisfactory, are higher than either of the other two groups, but that the weights of infants whose mothers were in unsatisfactory health are lower than those of infants from mothers in good health. The actual differences, however, are at no period very great.

Table XXI. *Average weights of infants and health of mother in first year of life.*

Health of mother	Males Period					Females Period				
	1st	2nd	3rd	4th	5th	1st	2nd	3rd	4th	5th
G.	8·5	11·1	14·7	17·7	20·0	8·0	10·5	14·1	17·0	19·1
S.	8·4	11·3	15·1	17·8	20·3	8·0	10·7	14·3	17·5	19·2
N.S.	8·4	10·9	14·1	16·9	19·2	8·0	10·3	13·6	16·4	18·5
General average	8·4	11·2	14·8	17·5	20·0	8·0	10·5	14·1	17·0	19·0

(*e*) *Maternal efficiency.*

The mothers were grouped as good, moderately good, and bad.

Table XXII. *Correlation between weight of infant and maternal efficiency.*

Age	Males	Females
Under 4 weeks	0·2162 ± 0·064	0·1682 ± 0·062
5–16 ,,	0·1079 ± 0·040	0·1423 ± 0·040
17–28 ,,	0·2029 ± 0·039	0·1825 ± 0·039
29–40 ,,	0·2275 ± 0·040	0·2047 ± 0·040
41–52 ,,	0·2087 ± 0·041	0·2480 ± 0·041

The correlations (Table XXII) are not very high in this case, but are on the whole greater than those found for any of the other factors studied here.

Table XXIII. *Average weights of infants and efficiency of mother in first year of life.*

Efficiency of mother	Males Period					Females Period				
	1st	2nd	3rd	4th	5th	1st	2nd	3rd	4th	5th
G.	8·9	11·2	16·2	18·2	20·4	8·5	11·2	14·7	17·6	20·3
M.	8·5	11·3	15·1	17·9	20·2	7·9	10·4	14·1	17·0	18·9
B.	8·0	10·7	13·9	16·4	18·7	8·3	10·1	13·0	15·7	17·6

Table XXIII shows the average weights of the babies in each of the three categories; and it will be observed that the efficiency of the mother does seem to have a definite influence on the weight of the infant, the average weights of those with inefficient mothers being almost consistently under average, those of good mothers equally consistently over average.

(*f*) *Summary.*

In this section the influence of five possible factors on the weight of the child has been considered. No one of these can be shown to be of outstanding importance in this respect; but the efficiency of the mother shows the highest and most consistent relationship. Health of mother and those variations of feeding which are considered here as indiscretions have no appreciable influence on infant weight, but the remaining two variables, overcrowding and position of the infant in the family, seem to influence the weight of the child. In the case of overcrowding, the effect is small and only becomes substantial towards the end of the first year. Position of the infant in family, likewise, is of little moment; first and latest-born infants initially seem to have lower than average weights, but towards the end of the first year of life the weights of first-born infants tend to be over average, while those of infants born into already large families still show evidence of inferiority.

The present report, it will be observed, has attempted on the basis of analysis of the ordinary routine records kept at a Welfare Centre, to approach some of the many problems of infant and child health. No suggestion of finality is claimed for any of the conclusions drawn from these data, but it will be admitted that the results found in Section VI (*c*) (see p. 477) are at least sufficiently suggestive to warrant further efforts in a similar direction. If, as was one of the motives for prosecuting these enquiries, other workers may be tempted to utilise existing or frame future schedules for an assessment of the utilities of welfare efforts or for inquiring on a large scale into some of the many unknown factors influencing the growth and nutrition of the child, our present efforts will not have been in vain.

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