"MALNUTRITION IN SCHOOL CHILDREN"

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Contents

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INTRODUCTION.

There can be no doubt that the general condition which the vague term "malnutrition" is used to connote forms one of the most important parts of the School Medical Officer's work, and its remedy quite the most important objective of the whole School administration. The subject received national recognition in the Reports of the Royal Commission on Physical Training (Scotland) 1903, (1) and in that of the Physical Deterioration Committee in England in 1904, (2). Since the introduction of School Medical Inspection in 1908, the Annual Reports of the Chief Medical Officer to the Board of Education in England have laid increasing emphasis on the subject; for example in the report for 1910 (3) Sir George Newman the Chief Medical Officer says "Defective nutrition stands in the forefront as the most important of all physical defects from which school children suffer".

To define when precisely a child is suffering from malnutrition is a matter of some little difficulty. The term is not meant to indicate merely deficiency from the normal in height or weight though such deficiency is a regular accompaniment. It includes such puniness of stature only when other evidences of ill health are present such as anaemia, dryness of skin and hair, dulness in the expression of the eye, mental apathy, and similar indications which point to poor physical condition, whether such condition can be attributed to any known active disease or not.

The diagnosis of malnutrition will thus obviously depend greatly on the personal equation of the examiner, and will vary greatly even with the same examiner according to the time and place of the examination. For example, with most

Examiners engaged at a School in the slums of a large town the standard will almost certainly be lower than in a better class school, while a child in the latter type of school will readily be classed as ill-nourished which would easily pass muster as normal in the former. That such variation does occur is shown by the returns published in the reports of the Medical Department of the Board of Education. In the annual Report for 1912 (4), that most recently issued, the percentage of children suffering from malnutrition varies in County areas from 2.2 to 18.6, while in Urban areas estimates of from .8 to 31.4 appear in not greatly dissimilar districts.

The following investigation was carried out in the County Borough of Bootle which adjoins and is continuous with the City of Liverpool. The population is 73,000 and is in the main industrial containing a large proportion of casual labourers engaged at the Liverpool docks. Racially the population is very mixed containing a high proportion of Irish people, very many Welsh, and amongst English towns it is shown by the Report on the Census of 1911 (5) to have the fourth highest percentage of persons of Scotch birth. Racial variations have not been considered in the present inquiry, nor do they appear to be of great importance as affecting the conclusions. In reference to the poor physique of children in poor schools, the Report of the Royal Commission on Physical training (Scotland) (1) states that "race fails to have any apparent bearing on the matter, judging by the cephalic index, one of the most abiding signs of race."

The conclusions are based on the Routine examination of over 4,000 children carried out in the latter months of 1912 and the whole of the year 1913. 3488 of these children were examined in 1913, and the results will have special reference to them. The examinations were in all cases conducted by myself. By "routine" examination is meant a general physical survey of presumably healthy children in regular attendance at school, and

it embraces the examination of the most important bodily systems. "Special" cases, that is children referred for examination either at school or at the school clinic for some known defect, are not included. The children selected for examination are mostly those at the extremes of school life, that is, those aged five and six years and those aged twelve and thirteen.

I. ANALYSIS OF CONDITIONS FOUND TO ACCOMPANY MALNUTRITION.

From the foregoing it will be seen that it is a matter of great importance to inquire on what conditions malnutrition depends.

The most usual and natural method to adopt in ascertaining this, is to inquire into the individual record of each child in an area found to be ill-nourished, and to find if there is any accompanying condition which appears to be the cause of such ill-nourishment. In Bootle over four per cent of children examined were recorded as suffering from malnutrition, and the following analysis of 118 consecutive cases will indicate the apparent causes.

In 28, that is 23.7% evidence of bad social conditions was found as the only probable potent cause, while in 14 others i.e. 11.8% there was evidence of bad social conditions together with disease which may or may not have been a result of these conditions. In 9 i.e. 7.6% Rickets appeared to be the only potent cause, while rickets was present in 8 others together with some other important condition i.e. in 6.7%. As rickets can now be assumed to be the result of ignorance or carelessness on the part of the parent, and as it almost invariably occurs in undesirable surroundings, evidence of such undesirable home conditions appears in 56 or 47%, while they appeared as the only potent cause in 41 or 34%.

In 9 children, 7.6%, adenoids appeared to be the cause, while 5 others were recorded as mouth-breathers, a total of 11.8%. In

4 more, adenoids were present together with another important condition. In 10 there were positive evidences of tuberculous mischief or such signs as indicated probable tuberculosis. In 8 there was evidence of disease in early life such as infantile paralysis, or a positive history from the parent of delicacy from birth.

Although the enormous majority of children are born healthy there is undoubtedly a small residue that present great difficulty in their upbringing, and it can reasonably be assumed that some of these at any rate are suffering from developmental defects.

Prematurity, multiple births, and other less defined causes probably account for their proportion, even though small, of cases of malnutrition in after life.

Of the remaining cases 11 showed some combination of the above apparent causes where it was difficult to decide which was the important element. The cases not included above were caused or accompanied by a variety of conditions, such as bronchitis, recent recovery from acute infectious diseases, cardiac disease, etc., etc.

In 18 no cause could be found, or only such conditions observed as were symptoms of malnutrition, such as anaemia.

Thus to recapitulate, apparent causes in these 118 cases are -

Social Conditions	28 - 23.7%	
Rickets	9 - 7.6%	34.7%
Rickets & Social conditions together	4 - 3.3%	
Adenoids in	9 - 7.6%	11.8%
Mouth-breathers	5 - 4.2%	
Tuberculosis actual or suspected	10 -	8.4%
Infantile Disease or Developmental Defect	8 -	6.0%
Combinations of above acting together	11 -	9.3%
No apparent cause in 18 -		15.2%
Miscellaneous causes in 16 -		13.5%

Undesirable home conditions were presumed to exist when the child in its person or clothing showed evidences of neglect.

In other areas similar analyses have been made and the above causes are found to figure in most, although the proportion attributed to each varies. In Middlesex (6) of 570 cases examined in 1910 30% are attributed to poverty, again in Middlesex (7) in 1911 23% of 167 cases are due to poverty while in London (8) in 1912 of 200 cases 37% are the result of "necessitous conditions". Many other Examiners without analysing the records of malnourished children in detail give their general impression that poverty accounts for a large proportion of malnutrition.

Rickets as a separate cause is generally given as producing its proportion of malnourished children, though the amount varies in different areas as the prevalence of the disease varies. Adenoids has been recognised as a definite cause (for example in Middlesex 1910 and 1911), while developmental causes have also been given varying prominence (London 1912) (8) The chief Medical Officer in his latest report (4) (1912) to the Board of Education has summarized the opinions expressed by Examiners all over England in which the following are said to be the causes -

"(i) Food - Insufficiency and unsuitability.

(ii) Bad home surroundings and neglect

(iii) Lack of fresh air and sunlight

(iv) Unsuitable sleeping arrangements

(v) Insufficient sleep

(vi) Employment out of school hours

(vii) Unhealthy school conditions

(ix) Congenital debility

(x) Disease (Mouth breathing, decayed teeth, adenoids, bronchitis, suspected tuberculosis, cardiac disease, rheumatism, post-exanthematous debility)

(xi) Unsuitable attendance of young children in rural areas".

Most of the above "causes" can be grouped generally under the heading of "bad social conditions" and it will be a matter of great difficulty to distinguish the results of any one particular factor.

To compare these opinions and results with the leading text-books, Cautley in "The Diseases of Infants and Children" (9) says that 20% of children are defective at birth, the result of heredity mainly acting through tuberculosis, syphilis, alcoholism, and neuroses. Unsuitable food, insufficient sleep, and general unhygienic conditions are also emphasised. Holt in "The Diseases of Infancy and Childhood" (10) makes special mention of children delicate from birth but without giving evidence of any definite disease. Tuberculosis, syphilis, alcoholism in parents, and general hygienic conditions including unsuitable food with resultant digestive disorders are all accounted as causes, while the too highly developed nervous organization and consequent physical deterioration of city children is given prominence.

Analyses similar to those given above are of doubtful value. The definition of malnutrition is so vague that the types of children included in different analyses will probably vary greatly, while the personal idiosyncracy of the Examiner often shows itself in the results; for example 15% of malnutrition attributed to intestinal parasites in one case and 50% to adenoids in another. The general absence of inherited syphilis as a cause accords with my own experience, which leads me to the belief that the extent and the effects of this condition have been greatly over-estimated.

For these reasons it appears desirable to attempt to find some factor which would be capable of precise measurement and which would at the same time reflect the condition of the children as regards nutrition. Comparisons of height and weight and of the relation of height to weight appear to offer

such a guide. Though misleading and erroneous as applied to individuals it appears to be a trustworthy indication when applied to groups of children of like age and sex. The differences in height and weight between Urban and Rural children, between slum, and suburban children, and between the high school as contrasted with the elementary school children are doubtless a real indication of their respective "nutrition" and general well-being.

The number of grammes weight per centimetre of height is much used as an indication of physical condition, while a much more elaborate method in use on the continent is referred to in the report of the School Medical Officer of the London County Council for 1910 (11). This is that the Nutritional Index = $\frac{100 \sqrt[3]{\text{weight}}}{\text{Stature}}$ and the index is said to be constant between 2.3 and 2.4 at all ordinary school ages. It appears to be much too complicated for ordinary use.

The device of the index number suggested by Greenwood in "The Health and Physique of School children (12) has the advantage of simplicity and appears reliable. If the heights or weights of children in the whole country or in a whole district be represented by 100, the heights and weights of any particular group in the country or district may be compared with the whole and the result shown by the corresponding index number. Further, age and sex groups may be combined, provided that the groups included are fair samples. This method of comparison will be mostly used throughout the paper.

Practically all heights and weights were taken by myself and as nearly as possible under the same conditions, that is without boots and in indoor clothing only. The measurements were taken according to the Metric system in centimetres and Kilograms, and since not the gross measurements but comparisons are to be considered, these have not been converted into British measure.

If we now compare by means of height and weight all children suffering from those conditions, which appear from our original analysis or from other reports, to be causes of malnutrition with all children of the Borough, we may be able to measure in some degree the effect of each.

II. EFFECTS OF BAD SOCIAL CONDITIONS.

A child was assumed to be the victim of bad social conditions, whether from poverty or other cause, on whose appearance from dirt or neglect or from poor or insufficient clothing or footwear any adverse note had been made. 489 such children were found representing approximately 13% of the number examined. To decide when a child shows evidence of neglect may also be a matter for difference of opinion, but taking clothes and boots into consideration probably more unanimity will be arrived at than in the original question of malnutrition. The standard adopted in Bootle was intentionally low, and when it is remembered that the parents are advised beforehand of the time of the examination and the children are consequently burnished up for the occasion, this number will not be regarded as an overestimate. All the schools in the Borough were examined, including similar age-groups in each better class and poor school alike. These 489 children have been divided up into age and sex groups and their heights and weights compared with those of all children of the Borough the latter group including the former.

The results show that the "poor" children are deficient in height at every age and in both sexes as will be seen from the accompanying Table (Table I). The table also shows the heights represented by an index number, the height of all Bootle children being taken as 100. If the ages five to six, twelve to thirteen are selected in which the numbers

are greatest - 156 in the former group and 180 in the latter - it will be seen that the deficiency is more marked at the earlier ages than at the later ones.

Comparing similarly the weights, corresponding deficiencies appear at five, six and twelve years, and again the early ages suffer most. A most surprising result appears at age thirteen where in each sex the 'poor' children have the advantage in weight, although the advantage is fractional in both cases.

This anomalous result appears to arise not so much from the improvement in the 'poor' children as from the depression of the standard. When one compares the weights of all Bootle children with those of all England at age 13 the latter being taken as 100, the index number for Bootle is in the case of boys 91 and in the case of girls 96.9, both these numbers being the lowest touched by either sex at any age. The standard for England is taken from Greenwood "Health and Physique of School children" (12) where the averages are based on the weight records of over 800,000 children. In passing it may be mentioned that children aged twelve examined the previous year (1912) showed a similar striking deficiency, which would point to the possibility of the children born in a particular year, in this case 1899, being distinctly below average in later years. This subject will be referred to later.

The table will show the results in detail.

TABLE I.

TABLE SHOWING EFFECTS OF BAD SOCIAL CONDITIONS

	Boys						Girls					
	All children of Borough		Poor Children		Index numbers of Poor Children		All children of Borough		Poor Children		Index numbers of Poor Children	
Age	Height	Weight	Height	Weight	Height	Weight	Height	Weight	Height	Weight	Height	Weight
5	103·6	17·7	99·7	17·0	96·2	96·0	102·4	17·1	100·	16·7	97·6	97·6
6	108·	19·	104·8	18·4	97·0	96·8	107·1	18·5	104·4	17·9	97·4	96·7
7	112·7	20·4	106·6	19·0	94·5	93·2	113·9	20·8	110·0	20·1	96·6	96·6
8	119·3	22·8	117·5	22·8	98·4	100·	117·4	22·3	117·3	21·6	99·9	96·8
9	122·6	23·9	121·0	23·0	98·7	96·2	121·7	23·8	120·3	24·2	98·8	101·6
10	128·4	26·4	126·4	26·6	98·4	101·0	127·9	26·4	122·8	24·7	96·0	93·5
11	131·2	28·3	130·2	28·0	99·1	98·9	131·3	29·2	131·0	28·4	99·7	97·2
12	136·1	31·1	134·0	30·5	98·4	98·0	138·0	32·5	132·6	29·7	96·0	91·3
13	139·9	31·9	137·7	32·2	98·4	100·9	142·4	35·3	141·2	35·5	99·1	100·5

If we take ages five to thirteen inclusive and compare the physique of 'poor' children with those of all children in Bootle the result may again be shown by means of index numbers.

'Poor' boys as a whole show a deficiency of 2.4% in height and 2.2% in weight, their index numbers being 97.6 and 97.8 respectively, while 'poor' girls are 2.1% deficient in height and 3.2% in weight, the index numbers being 97.9 and 96.8 contrasted with 100 for all girls.

INDEX NUMBERS FOR 'POOR' CHILDREN

	Boys		Girls	
Ages	Height	Weight	Height	Weight
5-13	97.6	97.8	97.9	96.8

Pursuing this subject further the three best schools in Bootle were compared with the three worst, the selection

being based on the percentage with insufficient clothing in attendance at each school and on the conditions known to obtain. The two classes of school are situated in the most prosperous and in the poorest districts of the town respectively.

The good class schools are taken as 100 the poorer schools being represented by the corresponding index number. The ages selected are five and six which are grouped together and for boys ages twelve and thirteen also grouped together, but age twelve only for girls. The age thirteen girls are omitted because of the smallness of the number examined at two of the poorer schools. The results are set out below (Table II)

T A B L E II.

COMPARISON OF 'GOOD' SCHOOLS WITH 'POOR' SCHOOLS

	Boys					Girls			
	Height		Weight			Height		Weight	
Age	Good	Poor	Good	Poor	Age	Good	Poor	Good	Poor
5 & 16	100	96.4	100	95.6	5 & 6	100	96.7	100	95.2
12 & 13	100	98.7	100	97.4	12	100	97.5	100	97.2

The results correspond with those found in the comparison of individual children. The poor schools show at distinct disadvantage and the deficiency is more marked at the earlier ages. The sexes appear to suffer almost equally at both groups of ages.

Taking the results of the enquiry as a whole, one cannot fail to conclude that bad social environment must be a powerful factor in the production of malnutrition. The results also agree with what one would naturally expect. It must be remembered that the comparisons are not made between two extremes of the social scale. All the children attend the

ordinary elementary schools and practically all are in very modest circumstances. The Anthropometric Committee of the British Association (13) demonstrated a similar improvement in physiques as you progress upwards through the social scale.

The second conclusion suggested both by the result of the examination of individual children and by schools is that the 'poor' children relatively improve, or, perhaps more accurately, that the more prosperous decline. Comparing Bootle children by the standard for all England supplied by Greenwood (12), there appears to be a steady deterioration throughout school life, similar results being obtained in Bootle during the last three years. From this it is evident that the improvement in the 'poor' children is more apparent than real. Dr. Arkle (14) in a comparison of different schools in Liverpool appeared to find that the deterioration of the poorer schools was progressive with advancing years, and a similar conclusion has been arrived at by Greenwood in the records of weights of Poor children at the Leeds Holiday camp.

Contrary results have been found by other school Medical Officers, for example in Nottingham (12) If the better class children are generally found to lose their advantage, it is possible that confinement in school, being inferior to their early home care and circumstances, acts prejudicially and equalizes their condition to that of the poor children with whom the reverse is the case.

Granted that 'poor' children are physically inferior to those more fortunately situated, it becomes necessary to inquire which are the elements in their condition which contribute to the result.

Taking, first, disease conditions, the past history of all children with respect to the common infectious diseases is known, and if we presume the great debilitating effect of such

diseases as measles and whooping cough it would be interesting to compare their frequency in the group of 489 'poor' children with that amongst all Bootle children. It is found to be practically the same in both groups. Measles shows a higher incidence and whooping cough a lower one amongst the poor children,but the differences are small and probably accidental. A comparison of the number with adenoids shows the 'poor' children to advantage. The condition of the teeth of poor and better class children has given rise to controversy. Comparing again 'poor' children with all Bootle children and dividing them into groups with good teeth and those with four or more bad teeth,'poor' children again show to advantage in both aspects.

In passing it may be mentioned that the number of mentally backward children was much greater amongst the 'poor' than amongst the other children. It is thus evident that none of the factors here noted contribute in any degree to the deficiencies of the 'poor' children, which undoubtedly depend on the broader question of home conditions, principally food and housing.

Dr. Larkins (15) in Surrey adduced evidence that poverty per se was the explanation. He found that children of the same age decreased in weight pro rata with the earning of the parent.

Professor Hay and Dr. Leslie MacKenzie in their special report to the Royal Commission on Physical Culture (Scotland) (1) both emphasized the effect of bad housing. No statistics are available for comparison of the children in Bootle on the basis of the number of rooms in the houses from which they come, nor does the English housing system lend itself so readily to such a comparison as does the Scotch. A comparison on such a basis has been made in Glasgow by MacKenzie and

Foster (16) showing that the weight of boys increases with the number of rooms in the houses from which they come. The value of any such comparison is doubtful, as the children from the bigger houses are the children of the more prosperous parents whose food in quality and quantity will be on a much higher standard and on whom home care will be lavished in a much greater degree. Apart from any statistics however, it will readily be admitted that the close overcrowded homes of the poor must be a considerable factor in the production of the malnutrition which is found to characterize their children.

III. FEEDING OF SCHOOL CHILDREN

The effects of insufficient or unsuitable food on the physique of school children are capable of more accurate determination, and the whole subject of the feeding of school children has now assumed a position of very great importance. The latest returns (4) show that 137 out of a total of 322 Local Education Authorities in England and Wales now make some provision for the feeding of children in attendance at the Elementary Schools. With the object of ascertaining how far the effect of such meals could be measured the weight records of two groups of children in Bootle were kept over an extended period. The first group embraced 19 children attending the Day Industrial School. The weights in these cases were taken by the teacher and great care was exercised to preserve the same conditions throughout, the children being without boots the boys in shirts and trousers and the girls in light underclothing only. The records were kept from January till September 1913. The children are provided with three meals daily at the school. They attend school from 8.30 a.m. till 5 p.m. but outside these hours they are at home and subject to outside

influences.

Over the whole period the weights of the children, subject to minor fluctuations, showed a steady increase. Taking however two similar periods, May to July and July till September, the latter period embracing the school holiday of five weeks, two sets of figures are available for comparison. During the first period of full school attendance with full meals no child lost weight, though the weights of two remained stationary. At the end of the second period, the weights being taken soon after the holiday, six of the nineteen showed an actual loss in weight, while six others showed a relative loss, in that the rate of increase was diminished. Four of the children showed a slight relative improvement, but each of the four had shown a regular increase in weight during the school term. All the children come from the poorest homes and the majority are 'voluntary', poverty being the sole cause of their admission. Since home conditions regarding sleeping accommodation etc. are acting throughout, it is difficult to avoid the conclusion that losses of weight are the direct result of the loss of regular healthy nutriment.

The second group of children whose weights were recorded were in attendance at the ordinary elementary schools. Here breakfasts are provided for necessitous children, and in the case of some of the poorest some sort of mid-day meal is also provided. The teachers make the selection of children for breakfast, the selection being on a strict poverty basis depending on the wages of the household and the numbers dependent on them. That this broadly meets the requirements of the case is shown by the fact that the children receiving the meals are on the average lighter than other children of the same age who do not receive them. The meals are supplied during the winter months only. In order to determine if the

effect of the meals might be reflected in the weights of the children, the weights of a large number of children in receipt of meals and a similar number not receiving them were taken regularly by the teachers from October 1913 till March 1914. The control children were not specially selected on account of good physique or otherwise, but were mainly of the poorer class. Unfortunately many of the records had to be rejected because of some doubt as to the manner of taking the weights, but the weights of 38 children in receipt of breakfasts remain for comparison against those of 40 not receiving them. While it would be injudicious to draw any definite conclusions from the results, these results are nevertheless interesting. The breakfast children are found to show a higher percentage increase in weight than do the controls, namely 5.8% against 5.4%. In May 1914, six weeks after the cessation of the meals, the children were again weighed. The gross weights in both groups however remained practically constant.

At the end of the period under review the breakfast children were still the inferiors of the controls, but as indicated their deficiency had been reduced, and one may hope that the provision of meals contributed to the result. Too many sources of error enter into the calculation to deduce that this effect was caused by the meals supplied. The increases of weight in boys varies at different periods of the year. The maximum rate of increase is from August to December from which time until April is a period of average growth. From April till July is a period of minimal increase in weight. From other sources ample corroborative evidence is to be found of the beneficial effects of school meals.

A recent (May 1914) brochure by M. E. Buckley "The Feeding of School children " (17) contains ample evidence of these good effects.

At Bradford in 1907, Dr. Crowley (18) demonstrated the loss of weight of children during holiday times when meals ceased, while similar results have been found by other Examiners. How delicately the weights of children reflect changed conditions of food and environment is shown by Greenwood from observations made at the Leeds Poor Children's Holiday Camp where, over a large number of observations, children after a fortnight's residence showed an increase of weight equivalent to about six month's normal growth.

A further factor which appears to be insufficiently realised is the educational value of school meals. To teach the children the kind of food to eat and its method of preparation is bound to have a great future value when one appreciates the extravagant and useless methods of living at present employed by the poorer people. In this educational aspect lies not the least important feature of the whole School Medical service

Most authorities give only one meal per day and some difference of opinion exists as to which meal should be given. The Board of Education recommends that arrangements should be made to provide dinner as being the principal meal of the day. From extensive inquiry amongst parents and children I am of opinion that breakfast as at present provided by probably most authorities is the better arrangement. The children at present, it would appear, do get something resembling an orthodox dinner, but time and again one finds that the home breakfast is at fault, and still more frequently that the children are unable to take such as is provided, either from the fact that sleeping overnight in ill-ventilated rooms leaves them little appetite, or from nervousness and excitement in getting to school.

IV. THE EMPLOYMENT OF SCHOOL CHILDREN

Another cause which is said to militate strongly against

the proper nutrition of school children is employment out of school hours.

With the object of finding out how far this view can be substantiated all boys so employed were examined during the year 1913. The question may be dealt with in several aspects -

(1) Extent of such employment. It may be said to begin at the age of nine years, the numbers employed being about 3% of the numbers in attendance at that age. There appears, however, to be no regular market for boy labour at nine years, and the numbers employed are found to vary greatly in different schools. From ten years up to the end of school life, that is at the end of the thirteenth year, employment out of school hours becomes a regular feature of boy life, the numbers increasing in each school at each succeeding year. Thus at ten years over 3%, at eleven years 10%, at twelve years 20%, and at thirteen years 25% of the boys at these ages are employed out of school hours.

(2) Hours of Employment. That this employment is no casual running of occasional errands will be seen from an analysis of the hours during which the boys are engaged. Details were obtained of just over 200 cases and it is discovered that (a) 43 work more than 30 hours a week, the average being 33 hours, whilst a maximum of just over 40 hours was attained by two boys, both milk boys; (b) 76 are engaged between 20 and 30 hours a week, the average number of hours worked being 24; (c) 83 are employed between 10 and 20 hours a week the average being just over 13 hours. Many of the boys are employed in contravention of the Employment of Children Act, which prohibits child labour between 9 p.m. and 6 a.m.

(3) Nature of Employment. A total of 273 boy workers were examined, of whom 112 were engaged to run errands for the

various shop-keepers, 46 were engaged on a milk round, 36 delivering newspapers, while the remainder were engaged selling newspapers in the streets, as Barbers' boy, and other miscellaneous occupations.

(4) Reasons for employment. There can be no doubt that the economic factor plays the chief part in causing the entry of these boys into the labour market. Schools which are attended by the children of the poorer classes have the greatest number of employed children, while the children of the more comfortably situated in each school do not seek employment. In this connection it is interesting to inquire what the earnings are, and here further surprising evidence is forthcoming of the established place of this form of boy labour in our social system, in that the wages paid maintain a fairly uniform standard rate of one penny per hour. Those employed for the longer hours that is 30 - 40 hours per week receive a fraction less than this rate namely 2/6 per week, the 20 - 30 hour group almost exactly coincide with the standard, and since there is a minimum which must be reached, the short time boys, 10 - 20 hours, receive a little more namely 1/3 per week. Besides the question of wages, it must be remembered that many parents express the view that this employment is a benefit to the boys physically by keeping them in the open air, and that the training is of advantage in inculcating habits of economy. While recognising that these views were evidently honestly held, it would appear that the receipt of the small wages must have a considerable effect.

(5) Effects of Employment. Enough has been said in the preceding paragraphs regarding the extent of this employment to show that there is distinctly a case for inquiry as to what may be its effects on the physical condition of the children. Again taking height and weight as the basis of comparison it

is found that the workers have the advantage of the Non-workers in both height and weight at all ages. At ages nine and ten this difference is more marked, but little importance should be attached to this circumstance since, as is pointed out above, the market for boy labour being restricted at the earlier age, only boys big for their years will be selected. At ages eleven, twelve, and thirteen however, the workers maintain their advantage in both height and weight, although at age thirteen the difference is small. Not only do the workers have the advantage in height and weight, but by comparison of the height-weight ratio, that is the number of grammes weight per centimetre of height, it will be seen that they are proportionately heavier. The results are set out in the subjoined table. (Table III) Only ages eleven, twelve, and thirteen are shown where the numbers examined are considerable.

T A B L E III.

Comparison of Heights and Weights in Workers & Non-Workers.

	Workers.				Non-Workers.			
Age	No. examined.	Height cm	Weight Kil	Ratio	No. Examined	Height cm	Weight kilo	Ratio
11	51	133.3	29.1	218	39	128	26.4	206
12	97	138.1	32.1	233	179	135.8	30.5	224
13	90	140.5	33.0	235	123	140.3	32.9	234

Average height in centimetres. Average weight in Kilograms.

Ratio = Grammes weight per centimetre of Height.

Such a comparison of workers and Non-workers is open to certain fallacies, the Chief being that (a) only big healthy boys will be selected for work and (b) puny delicate ones will not be allowed to work. The former consideration that only big healthy boys work is probably counterbalanced by the fact that the children of those parents who are more

comfortably placed socially are on the average the biggest and heaviest and they do not as a rule seek employment. The latter objection that small feeble boys do not work is in the main true, but not a few instances were found where boys were sent to work because they were failing, in the hope that they might benefit.

Further many Mothers claimed that their boys did actually improve after commencing work.

Before drawing any general conclusion from the above analysis it is advisable to compare workers when grouped according to the nature of the work done, to discover if possible whether any special kind of work might re-act unfavourably. Here the workers of each special group are contrasted with workers as a whole. The results now are not so uniform or perhaps so reliable, chiefly from the fact that as a result of the sub-division the numbers become smaller and more liable to fluctuation. To obviate this source of error I have again only considered boys from eleven years upwards and only in such groups as have the total numbers sufficient, namely - Errand-boys, Milk Boys, and Newspaper-Boys. Taking then Errand-Boys, it is found that they fairly maintain the standard in both height and weight, deficiencies where they occur being small and probably accidental. Also the height-weight ratio is more than maintained. Milk-boys are below the standard considerably at both twelve and thirteen years although at age eleven they are slightly above the standard weight. The height-weight ratio also shows marked deficiency at both the former ages. Newspaper-boys, that is those who deliver papers at the houses of customers, show a similar deficiency being below standard weight at all ages with a corresponding deficiency in the height-weight ratio. The

following table (Table IV) shows the results.

T A B L E IV.

Comparison of boys grouped according to occupation

Age	All workers			Errand Boys			Milk Boys			Newspaper boys		
	Height cm.	Weight kg.	Ratio	Height	Weight	Ratio	Height	Weight	Ratio	Height	Weight	Ratio
11	133·3	29.1	218	136·3	30.7	225	132.4	29.2	221	130.8	27.6	210
12	138·1	32.1	233	138.5	32.0	231	136.7	30.6	224	137.	30.8	225
13	140·5	33·0	235	139.6	32.9	238	140.3	32.4	231	141.	32.0	226

If the three ages be grouped together and the different types of workers be compared by means of index numbers the result will be more readily appreciated (Table V)

T A B L E V.

	Height	Weight
All workers	100	100
Errand boys	100.6	101.3
Milk boys	99.3	97.7
Paper boys	99.2	95.8

The numbers in these three groups - over 100 Errand boys, 41 Milk boys and 32 Newspaper boys - are sufficiently large to give them considerable value, and the failure of milk and paper boys to reach the standard is striking. Naturally the weight, a much more easily affected factor, shows a much greater deficiency than the height.

The nature of the employment is similar, and like results have been found by Dr. Brown (19) in the County of Surrey. Various reasons suggest themselves to account for this result. They frequently work long hours, but a more

potent cause would appear to be the hour of starting in the morning, which usually entails their rising before 6 a.m. This will interfere seriously with their sleep and will often deprive them of breakfast. A mitigating influence in favour of milk boys, that they are often given milk to drink and that they probably help themselves without permission, is not present in the case of paper boys, and may account for the fact that the latter groups show even worse results. I find no evidence that the weaker boys select these two particular occupations.

A further analysis was made according to the number of hours worked per week. The results would indicate that the number of hours is not so important a consideration as the time at which those hours are worked. The most noteworthy feature is the failure of boys aged thirteen, who work more than 30 hours a week, to reach the standard. This group comprises 33 boys. By means of index numbers the comparison may again be made (Table VI). Age eleven is omitted from the 30-hour group since it only comprised three boys, although they also were below standard.

T A B L E VI.

Comparison of Boys according to number of hours worked.

	No. Examined	Height	Weight
All workers	238	100	100
10-20 hours per week	83	100	100.3
20-30 " " "	76	100	100.1
over 30 " " "	40	99.8	99.1

The table shows that deviations from the standard are in no case as marked as in the previous classification, though a downward gradation appears progressing with the

number of hours worked. We can now view the results of the whole inquiry. The fact that in the first review the workers compare favourably with the non-workers lends no support to the frequently expressed opinion that every kind of employment out of school hours offers a menace to the physical well-being of the children so employed. Nor did the general impression left at the time of examination convey any adverse impression, indeed the workers as a whole presented if anything a brighter appearance.

That conditions attaching to certain occupations might react favourably was shown in Surrey by Dr. Brown (19) in the case of house-boys who were found to be superior to all other groups. These boys assist in boot cleaning etc. in large houses, getting certain meals in return together with wages. That there is little evidence that the workers are specially selected on account of physique has been already commented upon and this opinion is shared by Dr. Brown in Surrey and Dr. Parsons (20) in Northampton. It has also been noted that the difference in favour of the workers almost disappears at age thirteen, whence it might be urged that it is only after a lengthy period that the deleterious effect of out-of-school employment manifests itself. This does not appear to be a very weighty consideration, particularly as the slight difference is still in favour of the workers. It was also mentioned above that the age-thirteen children are a very deficient group when compared with the standard of all England. It should further be remembered that employment is not continuous, although inquiry indicates that in the main it is the same children who are employed throughout the latter years of school life. Deficiencies at age thirteen have been strongly emphasised in the 'half-time' towns particularly Bradford (Greenwood) (12), but

conditions of factory work in such towns have no parallel in Bootle.

To account for this apparent advantage in favour of the works several reasons suggest themselves. Frequently it is found that the earnings are regarded as peculiarly the boy's property to be devoted solely to his benefit so that he gets advantages at home in the way of food and clothing. The very fact itself that he is one of the wage-earners of the household will probably often ensure him greater attention. It is also common to find that in addition to his wages he gets food such as meat, milk,or vegetables from his employer. Further it may be said that the boys undoubtedly enjoy this kind of work, perhaps from a sense of their increased importance, and this might conceivably react to their advantage physically.

When the above considerations have been put forward, the failure of milk-boys and paper-boys previously emphasised will become relatively more important. Their inferiority cannot be regarded as a coincidence. The chief influence acting against them would appear to be the interference with sleep, though it should also be remembered that in some cases they work the longest hours.

The effect educationally has not been considered, but frequent complaints are heard from teachers of the difficulty of getting some of these boys to concentrate attention on their work during the forenoon, a difficulty not hard to understand when it is remembered that they have already done two or three hours work before arriving at school.

V. EFFECT OF ADENOIDS.

No condition has been given more prominence as causing serious results on the physique of school children than

adenoids. Most of the opinions are based on general impressions, but an investigation carried out in Surrey in 1911 (21) pointed to a progressive deterioration amongst children with adenoids, evidenced by deficiencies in height and weight more marked at the later years. With the object of measuring the effect of this condition the records of all children who appeared to be suffering from adenoids were extracted and classified.

The diagnosis from the circumstances of the examinations had to be made from general observation based on the facial expression, inability to breathe through the nose, nasal discharge etc. Only in exceptional cases could palpation or examination with a mirror be resorted to. The cases were divided into well-marked and slight or doubtful classes. The former group, embracing 77 cases of well marked adenoids and representing 2% of the children examined, is probably a conservative estimate of the prevalence of adenoids.

To divide such a small number into age and sex groups would render any subsequent deductions fallacious, but if the sexes are taken together and groups of ages combined some indication of the effect of adenoids can be ascertained. As mentioned above, most of the children examined were at the extremes of school life, that is aged five and six years and aged twelve and thirteen years, consequently most of the cases - 55 of the total of 77 - are embraced by these two groups. Further the individual groups of cases at these ages are composed of greater numbers of units and appear to be fair samples.

It is not desired to attach too much importance to the intermediate age-groups where the numbers are small and individual groups composed of few units.

At the earlier ages differences from standard are small and probably accidental. The adenoids-children although slightly below standard height have actually an advantage in weight. At the intermediate ages the loss in height is more marked, but a distinct loss in weight manifests itself. As mentioned above, the figures in this group are not insisted upon. In the twelve and thirteen-year-old group however there is a sufficiently marked result to warrant the deduction that the adenoids were the causative factor. The loss in height is relatively small but the loss of 6% in weight is striking. The accompanying table (Table VII) illustrates the results, the standards in height and weight, 100 in each case, being that of all Bootle children at like ages.

T A B L E VII.

RESULTS OF ADENOID GROWTHS

Ages	Height	Weight
5 and 6	99.7	100.7
7 - 10	97.7	96.6
12 and 13	97.9	94.0

Anyone examining large numbers of school children cannot fail to be struck with this result of the persistence of adenoid growths.

When it is further considered that the liability to errors of diagnosis is less grave in the case of the older children than in that of the younger, whose condition from lack of use of handkerchief or from 'habit' mouth breathing might mislead, the resultant malnutrition of the former group will be regarded as still more important. The effect of adenoids, shown in the shape of the chest, is probably exerted through interference with lung expansion and consequent impeding of

oxygenation and general circulation. In addition the deformed jaw with its irregular teeth so frequently seen, and the resultant decay and sepsis will doubtless aid in the process.

The question of the causation of adenoids has been much discussed. The frequency of its occurrence amongst the poor as compared with the more comfortably placed has given rise to some difference of opinion. The 'poor' children of Bootle show a less frequent incidence of adenoids than all children of the Borough, and the 'poor' schools appear to suffer no more than others. In the main this view is endorsed by examiners elsewhere. The alleged excessive prevalence in damp low-lying districts near rivers, on which evidence has been collected in Middlesex (6) is a subject on which more information is still required.

VI. TUBERCULOSIS AND OTHER DISEASE CONDITIONS

In our original analysis of cases of malnutrition Tuberculosis or suspected Tuberculosis ranks high as a cause. This is open to the primary fallacy that the malnutrition itself was often regarded as the principal even the only diagnostic sign of the disease. Cases of undoubted Tuberculosis of the lungs are in my experience extremely rare amongst children in attendance at schools, representing not more than .25% of all children. This figure, although below the average for the country, still leaves a generous margin when viewed in the light of the Registrar General's returns of deaths from phthisis, of children of school age. It will of course be expected that children, when a tuberculous focus has been properly established, will be too ill to attend school and will thus not be met with at Routine examinations, whilst the diagnosis of early cases is a matter of extreme difficulty. Sputum examinations have been found

to be useless in practice, positive results being obtained only in cases where the diagnosis could be easily effected by other means. The difficulty of obtaining satisfactory specimens for examination is often great. The tuberculo-cutaneous reactions appear too sensitive to be of practical utility and the wisdom of their wholesale application open to question. Further when a tentative diagnosis of tuberculosis has been made the child is usually excluded from school, when under more hygienic conditions and with added home care the improvement is frequently so marked as to cause one to doubt the correctness of the original diagnosis.

The whole question is one of the most difficult with which the School Medical Officer has to deal,but it would appear that returns of the prevalence of tuberculosis based on tuberculo-cutaneous reactions or on post-mortem results cannot be supported by evidence in the lungs capable of being detected with a stethoscope. How far tuberculosis is responsible for malnutrition will thus be a matter difficult of precise determination.

Teeth Conditions. Decayed teeth and oral sepsis have been given much prominence as a cause of defective nutrition.

To show records of height and weight of children with good teeth, as compared with those with bad teeth appears to me valueless from the entry of so many other factors. It has already been mentioned that the 489 'poor' children whose teeth conditions were inquired into show to advantage against all children of the Borough. A further inquiry was made into the condition of the teeth of children attending the three best schools as contrasted with that of those in attendance at the three poorest schools. The results are based on the records of examinations conducted in these schools during the past three years. Again the poor schools have the advantage.

A feature of the result is that the difference is more

marked amongst the infants, indicating that the poor children retain their temporary teeth in good condition for a longer period than do those more happily situated. This factor of social position alone would probably falsify any comparison of groups of children with good and bad teeth. Oral sepsis, though of necessity always present when decay of teeth takes place, is not in my experience often present to such a degree as to cause an immediately resulting malnutrition in the child. That is to say, that to find pus visibly exuding from the stumps of decayed teeth or gums is a comparatively rare condition and must rank low as a cause of malnutrition.

Other disease conditions, such as cardiac disease, operate in individual cases but the gross number of such cases is so small as to influence little the general question of malnutrition.

VII. PRE-NATAL AND INFANTILE CONDITIONS.

The effect of such conditions as Infantile paralysis on children in after years cannot be overlooked, but again the gross numbers so affected are small. Regarding other pre-natal and infantile conditions one enters into more speculative regions. The results of the methods of infant feeding as reflected in the after condition of school children was inquired into in Middlesex (1911) (7). In 700 cases no differences could be found in the condition of children who had been breast-fed as against that of those fed by other means. Other questions which have been raised are the effects of good or bad trade conditions, and of years of high or low infantile mortality in early life on the after condition of children. When records have been kept over sufficiently long periods it will be possible to follow children born in a particular year throughout their school life and so to

compare children born in any one year with those born in another year.

The suggestion has already been made by Dr. Kerr (22) in London County that there are what he has termed 'vintage' years for children. In Bootle there are only reliable figures of height and weight for the past three years which are insufficient for the purpose of comparison. Taking these figures, however, a somewhat remarkable coincidence is apparent. It was noticed that children aged thirteen examined during the year 1913 showed a striking percentage deficiency in weight from the standard of all England.

Both sexes showed a maximum deficiency at that age though boys appear to suffer more than girls. Following children born in that year, that is 1899, backwards for two years, those aged twelve in 1912 and those aged eleven in 1911, a corresponding maximum deficiency is still observable. The figures for 1912 can be taken as accurately representing the weights of the children of that year, because the numbers are sufficiently large, but the 1911 figures are based on much smaller numbers. On consulting the health reports it is found that the infantile mortality rate for the Borough reached its Maximum in the year 1899. This was also the year of the beginning of the Boer war, when trade was at a subnormal level. Whether such influences can affect future physical condition will remain for future elucidation.

VIII CONCLUSIONS

Any conclusions based on numerical data will have a value varying directly with the number of observations, consequently the returns for any single area will require further corroboration.

It is believed however, that the following conclusions are justified by sufficiently strong Evidence to warrant their acceptance.

(1) That what has been called the "Social" factor is the predominant element in the production of malnutrition.

(2) That insufficient or unsuitable food is the chief means by which this result is produced.

(3) That employment out of School hours is not a prolific cause of malnutrition, though certain phases of such employment, probably such as interfere with sleep, have evil effect.

(4) That adenoids after long persistence do cause distinct evil consequences in children in later years.

(5) That tuberculosis is a potent cause of malnutrition, but that the extent of this condition in children of School age is probably over-estimated.

(6) That the effect of decayed teeth per se (are) not at present capable of precise estimation.

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