control group, but the increase over their own initial haemoglobin values was not significant.

(*d*) An analysis of the haemoglobin figures of those children whose initial haemoglobin level was less than 80% showed that out of 26 in the control series 15 (57.7%) still had haemoglobin figures of less than 80% at the second examination; of those receiving ascorbic acid alone, 19 had haemoglobin levels below 80% at the first examination, and at the second examination 13 (68.4%) were still below 80%; while of those receiving iron and ascorbic acid 19 were below 80% at the first examination, but only 4 (21.1%) were below 80% at the second examination. The improvement noted in this last group is statistically significant.

School III

Only children whose original haemoglobin level was 80% or less were included in this experiment. (*a*) Control group. total 27. (*b*) Experimental group: total 27.

The children in the experimental group were given 25 mg. of ascorbic acid daily and 6 gr. of ferrous sulphate in tablet form daily for 5 days a week. It should be noted that the dosage of iron was double that given in Schools I and II, and the children were selected because clinical anaemia was present. Treatment was given for six months. Haemoglobin estimations were made at the outset of treatment and repeated at intervals of three and six months.

Conclusions

(*a*) *Control Group.*—A significant rise in haemoglobin levels was found at the second and third examinations as compared with the levels found at the first examination.

(*b*) *Experimental Group.*—This series also showed a significant rise in haemoglobin levels at the second and third examinations. The mean levels in this treated group were, however, significantly greater than those found in the control group at the second and third examinations.

Discussion

Investigations into the Hb levels of large numbers of persons in different areas of Great Britain, including Aberdeen (Davidson *et al.*, 1935) and Edinburgh (Davidson *et al.*, 1942), have clearly demonstrated the frequency with which anaemia occurs in infants, school-children, and women, both pregnant and non-pregnant. The anaemia is almost universally of the hypochromic type, which responds excellently to iron therapy. It leads to a feeling of fatigue and exhaustion, to a loss of appetite, and to a reduction in efficiency. In the case of the infants it has been shown to be associated with an increased liability to infection. The family doctor should constantly be on the watch for the development of anaemia in his patients. The improvement in their general well-being which will rapidly result from the administration of the ferrous salts of iron will amply reward him for the time spent on making the necessary examinations. For the prevention of anaemia, reliance should be placed primarily on securing an adequate intake of iron by instructing the patient to eat sufficient quantities of the foodstuffs which are particularly rich in the mineral. By so doing the intake of other important factors connected with haematopoiesis—e.g., protein and vitamins B and C—will be coincidently improved. In this connexion we wish to draw attention to the value of national wheatmeal bread made of 85% extraction flour. Its content of iron is 0.7 mg. per oz., compared with 0.3 mg. per oz. for white bread made from 70% extraction flour. On an average intake of 6 oz. of bread daily an addition of more than 2 mg. of iron daily is consumed. Investigations which will be published shortly suggest that this increment during the past eighteen months has already made a significant contribution to the reduction of anaemia in school-children. Nevertheless, under wartime conditions it may on occasion be necessary to supplement the diet with medicinal iron.

The investigations reported in this paper clearly indicate that the administration of iron in doses of approximately one-third of that usually prescribed for curative treatment can significantly improve the haemoglobin levels of school-children. The increases shown in the Table are admittedly small. It might accordingly be asked whether any significant improvement in health could be expected to result therefrom. It should be pointed out, however, that the figures given represent mean values. In the municipal-school children in Edinburgh the average haemoglobin figure was found to be 80%. Accordingly approximately half of the children had a haemoglobin level above this figure and half below it. It would be unreasonable to expect such small doses of iron to affect materially haemoglobin levels of normal or only slightly subnormal ranges. A study of individual cases showed this to be the case. It should be noted incidentally that when two tablets were given daily, as in School III, the mean haemoglobin was brought up to 93%. In the case of children whose haemoglobin was below 80%, and particularly when they were in the neighbourhood of 70%, a rise of 10 to 15% regularly followed the administration of one tablet of fersolate daily. It was due to these increments that the mean haemoglobin level was raised. Few would question the advantages to the health of school-children of such an increment.

It should be noted that the experiments recorded in this communication were essentially prophylactic in nature, and it must be clearly understood that in the treatment of individual cases of anaemia much larger doses of iron should be given.

Our knowledge of the aetiology, incidence, and treatment of iron-deficiency anaemia is now so complete that the medical profession must shoulder the responsibility if the necessary measures for its control are not widely adopted.

Summary

Experiments conducted over periods of three to six months indicate that a supplement of iron, even in such small amounts as 3 gr. of ferrous sulphate once daily for 5 days a week, can produce a significant rise in the haemoglobin levels of municipal-school children.

This suggests that the hypochromic anaemia of these children is mainly conditioned by an insufficiency of iron in the diet.

A supplement of 25 mg. of ascorbic acid daily had no effect in raising the haemoglobin levels.

We wish to express our thanks to Dr. Bradford Hill for his statistical help, and to Messrs. Glaxo Laboratories Ltd. and Roche Products Ltd. for their generosity in supplying free the supplements of iron and ascorbic acid respectively; and also to the Medical Officer of Health for Edinburgh and the staffs of the municipal schools, whose assistance was much appreciated.

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THE INFLUENCE OF SUPPLEMENTS OF VITAMINS A, B_1, B_2, C, AND D ON GROWTH, HEALTH, AND PHYSICAL FITNESS

BY

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This is a summary of a vitamin feeding test carried out in 1941–2 on approximately 1,400 school-children and adults. A full report of the test has been prepared, but it is too lengthy for publication.

Towards the end of 1940 the Ministry of Health accepted a gift of multi-vitamin capsules from a group of United States physicians to carry out a feeding test on suitable groups of people. The time was opportune, and the capsules were employed as test material to ascertain whether a supplement of synthetic vitamins to the ordinary diet would improve growth, health, and physical efficiency. Each capsule contained:

Vitamin A	4,000 i.u.	Ascorbic acid	1,000 i.u.
Thiamin	333 i.u.	Nicotinamide	20 mg.
Riboflavin	2 mg.	Vitamin D	600 i.u.

Three of the five tests carried out were done on school-children and two on factory workers. Four times during the tests the vitamin content of the capsules was checked and found up to specification by the Medical Research Council. The school tests were performed on elementary-school children in Ipswich, Glossop, and London. The number of children who completed the test was 1,242: Ipswich, 425 boys and girls aged 5 to 13; Glossop, 370 boys aged 9 to 13; London, 447 boys

aged 9 to 14. Of the London children 123 were boys aged 9 to 14 living in a camp school.

The tests began in Nov./Dec., 1941, and ended in July/Aug., 1942. The school-children were examined before, during, and after the period of feeding. They were divided at random into two equal groups according to school, age, and sex; one group received a vitamin capsule every school day, and the other a capsule containing a similar quantity of arachis oil, which is practically devoid of vitamins. Records were kept of all illnesses, of their nature and duration. The medical examination included examination of the teeth and gums by dentists—in London by T. S. Rodgers.

The factory tests were conducted at the zinc-smelting works at A and L, where the labour is extremely strenuous and exhausting. The men work in gangs of five or six, and the average output of zinc for each gang is weighed daily. In factory A 12, and in factory L 24, gangs of workers were divided at random into a vitamin and a control group. Each man received an appropriate capsule six days a week. The naked weight was taken monthly before the men began work. Haemoglobin and blood pressure were also measured at regular intervals, and the output of zinc and all absences due to illness were recorded.

The findings for the children were similar in all four places. During the period of observation the vitamins had no statistically significant effect on the rate of growth, nutritional status, muscular strength, condition of the teeth and gums, or absence from school on account of illness. Muscular strength was measured in London and Glossop by a dynamometer like that described by Hill, Magee, and Major (*Lancet*, 1937, **2**, 441); it was not done in Ipswich. In Glossop alone a special test of endurance by hanging on a bar was done. Both the controls and the vitamin children improved in endurance, and the improvement shown by the vitamin children was greater than that shown by the controls. In view of the relatively small number of Glossop children tested, we feel that this particular finding should be strictly limited in its application to that group of children. Similar findings would have to be obtained in other areas before any wider application of the Glossop results could be regarded as justifiable. Feeding tests with this object were started on several thousand children three months after the conclusion of the above tests, and are still in progress.

In the factory tests on 214 adult men, the results showed that the vitamin capsules had no significant effects on weight, haemoglobin, blood pressure, absence from illness, or output of material. The conditions of the test in the factories, however, were such that only relatively large differences in output would have been revealed.

Many people assisted us in conducting these feeding tests and analysing the results, but lack of space forbids individual acknowledgment of their help. A mass expression of thanks to all who co-operated is all we can make in this summary.

UMBILICAL HERNIA IN CHILDREN

WITH SPECIAL REFERENCE TO INJECTION TREATMENT

BY

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Umbilical hernia is classified into three types—congenital, infantile, and adult. There is no disagreement as to the treatment of the extremely rare congenital type, or exomphalos: all are agreed that it is only possible to save the infant from peritonitis by operating within a short period after birth. I have successfully operated on an infant within four hours of birth for an extensive exomphalos containing much large and small intestine: the defect in the abdominal wall was closed by the Mayo method, and it was surprising how the scar later contracted down and almost resembled a normal umbilical cicatrix.

The infantile and adult types are both of acquired origin, but they are regarded as being quite separate diseases. The general impression is that umbilical hernia rarely occurs in adolescence and early adult life. It is true that surgery is seldom requested for umbilical herniae at this period of life, because, if present, they are small and do not bother the patient much. Few mothers will fail to seek medical attention for a large umbilical hernia in a child. The adult patients one has to deal with are more commonly females than males, and the preponderance of females appears proportional to the greater incidence of adiposity in the female sex. Although the patients are over 40 years of age they usually state that they know the hernia has been present many years; but the onset is always vague and insidious. It is therefore impossible to establish any clear relation between the presence of an umbilical hernia in childhood and one in later life.

Clinical Features of Infantile Umbilical Hernia

The mother nearly always states that the hernia has dated from soon after birth, but occasionally a latent interval up to four months has been noticed. There is no history of any gross sepsis of the umbilical stump. The infant, either male or female, is often poorly developed, and is more likely to be suffering from rickets than the very rare condition of cretinism. It is important to keep in mind the possibility of increased intra-abdominal pressure due to ascites or intestinal obstruction, etc. The majority, however, have no obvious predisposing cause, but sometimes inguinal hernia is also present: adiposity apparently is not associated with infantile umbilical hernia. The infants are presented at a surgical out-patient department from 8 weeks old upwards, but the majority are about 18 months old when they arrive, having failed to respond to treatment by strapping.

Treatment

Paterson and Gray (Barrington-Ward, 1937) found that out of 214 cases at the Hospital for Sick Children, Great Ormond Street, 101 disappeared without operation, but all writers say that the longer the hernia has been present and the larger the neck, the less likely will it be cured without operation. Few spontaneous cures occur after the age of 3 with support. As spontaneous cure with support occurs in nearly half the cases I thought injections would increase the proportion of, and hasten, cure in selected cases with small necks. My results seem to show that injections can cure umbilical hernia in such cases. The advantage of the treatment is that it may avoid operation and admission to hospital, and can therefore be advised for debilitated infants and children with small herniae. I think the main disadvantage is that the temperament of young children is rather unsuited to repeated injections if one is insufficient. There appears to be no risk of injecting into the peritoneal cavity.

Injection treatment of inguinal hernia was first practised by George Heaton (1877) of Boston, Mass., about a hundred years ago, but was later perfected by Ignatz Mayer of Detroit. Delisle Gray (1932), who advocated Mayer's technique, brought the method and the results before the medical profession in England. So far as I can ascertain from literature and hearsay evidence there have been few cases of umbilical hernia treated in this way. Burdick and Coley (1937), out of a total of 92 cases, treated only one umbilical hernia by injection, and the result of this was not stated. Wyss (1929), Larson (1934), and Quillin (1934) reported favourably on the result of injecting umbilical herniae, but they were all mainly concerned with adult inguinal hernia. Bratrud (1937) illustrated his technique of injections for umbilical hernia, and stated that by this method they were more favourable than even in indirect inguinal hernia. Personally, I have not yet tried injections for inguinal hernia because the many attendances for injections at an out-patient department would entail as much lost work as with operative treatment, and if the patient was not cured at the end of the time both patient and employer would be dissatisfied. With regard to inguinal hernia in children, the operative treatment is so safe, with recurrence and sepsis almost unknown, that I have not yet been tempted to try injection treatment. There is no doubt that even inguinal hernia can sometimes be cured by a truss in childhood—e.g., the famous case of Sir Astley Cooper (Murray, 1910), which was verified at his necropsy, when only a minute sinus canal was found extending to the tunica vaginalis. In spite of this, operative treatment is indicated because of the rarity of spontaneous cure.

It is the accepted view that umbilical hernia in children is nearly always curable with a support, but the cases seen