5½ years. Of 118 cases of gastric ulcer, 90 were on the lesser curvature, the age being 32½ years and duration 6 years 1 month; and 28 at the pylorus, the age being 29½ and duration 5½ years.

Men suffering from peptic ulcer are not suitable for Army life under present conditions.

Men suffering from non-organic dyspepsia can in many cases make useful soldiers provided they are not detained too long in hospital. Cure of symptoms should not be attempted. An excess of medical attention and investigation results in exaggeration of symptoms and repeated admission to hospital.

Complications are rare in the Army compared with the incidence among admissions of the same age-and-sex groups in civilian hospitals, but the rarity is more apparent than real. It is probable that the incidence in the Army is a truer reflex of the incidence in the population than is afforded by civilian hospital admissions.

The low mortality from perforation and haemorrhage is similar to that in civilian males under 40 years of age.

The comparative incidence of dyspepsia between the two sexes in the Army is similar to that among civilians.

I am indebted to Lieut.-Gen. Sir A. Hood, K.C.B., Director-General of Army Medical Services, for permission to make use of Army statistics, and to Major C. Cassidy, R.A.M.C., and Sergeant Stalbow, R.A.M.C., of the Army Medical Statistical Department, for much assistance with the records.

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LEVELS OF VITAMIN A AND C NUTRITION IN GLOSSOP SCHOOL-CHILDREN AND EFFECT OF DEFICIENCIES ON THEIR PHYSICAL CONDITION. (PRELIMINARY COMMUNICATION)

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During the period Oct., 1941, to July, 1942 (37 weeks), the effects on the physical condition of feeding supplementary vitamin preparations to the school-children of Glossop had been investigated under a scheme devised by the Ministry of Health, and consequently we took the opportunity of using these same children in order to estimate the state of their vitamin A and C nutrition and the effects of any deficiencies on their physical condition. About 400 children, aged 9 to 14 years, were involved—200 having the vitamin capsules, and 200 not receiving supplementary vitamins acting as controls; the former group (hereafter called the "vitamin group") received daily doses of 4,000 I.U. of vitamin A, 350 I.U. of vitamin B complex, 1,000 I.U. of vitamin C, 600 I.U. of vitamin D, 2 mg. of riboflavin, and 20 mg. of nicotinamide five times weekly; the latter group (hereafter called the "control group") received capsules not containing any vitamins. The present report is a preliminary consideration of the period 1941-2.

I. LEVEL OF VITAMIN C IN GLOSSOP SCHOOL-CHILDREN

Methods Employed

(a) *The saturation test* employed follows the method of Harris and Abbasy (1937). Test doses of 11 mg. per kg. of body weight were given in the morning, and the urine was collected during the fifth and sixth hours, acidified, and titrated against dichlorophenolindophenol. The advantage of this method is its

simplicity, especially if one is concerned with school-children, as in our case. Harris (1942) has dealt extensively with the criticisms of this method.

(b) *Estimation of the Vitamin in Blood.*—As a supplementary to the saturation test and as an essential to Part III of this paper, blood vitamin C estimations were regarded as necessary. The analysis was done on whole blood, following the method of v. Eekelen (1937) with the use of mercury acetate and hydrogen sulphide. Our findings are in agreement with those of Heinemann (1941), who discussed the value of this method fully. We do not consider it to be less informative than the method employed by Butler and Cushman (1940), who determined the ascorbic acid content of whole blood colorimetrically. In our opinion these methods are the most reliable indication of the vitamin C level in an individual. Measurable amounts of ascorbic acid are found in whole blood after the plasma level has become zero, and the fluctuation of the plasma values also influences considerably the reading in normal and saturated persons (Portnoy and Wilkinson, 1938). Analysis of the white-cell and platelet layer was carried out when severe deficiency was suspected, since the white-cell layer provides evidence of deficiency only and not of good nutrition. In the case of a deficiency, however, it has the advantage over whole-blood estimations that the results are independent of the plasma fluctuations, and the ascorbic acid appears to be retained longer in that layer than in other blood constituents. In following this routine, when sufficient blood was available, we estimated the content of the white-cell layer in cases of severe deficiency as indicated by a blood vitamin C estimation below 0.3 mg./100 ml.

(c) *Inquiry into the Dietary Intake.*—A comprehensive dietary survey covering a period of three weeks was made on the families whose children were concerned in this study. The parents kept an accurate daily record, on printed forms, of all the food used during this period, both purchased and grown in their own allotments. They were interviewed by us at the beginning and end of this period, so that the reports obtained may be regarded as reliable. We also estimated the amount of ascorbic acid and calculated the nutrients contained in the school meals during this time, thus obtaining a very detailed evidence of the dietary intake of the children. Under this heading our findings are given with regard to the vitamin C intake.

Procedure and Results

Since the combined investigations carried out on the school-children by the Ministry of Health and ourselves were of a very complex nature, and the tests were not allowed to interfere with each other, we had to choose what, in our opinion, were the most suitable methods available. Therefore, in Jan.-Feb., 1942 (three months after the beginning of the test period), all the 400 children were given two test doses of ascorbic acid and no more. This enabled us to assess the amount of non-saturation present at that time. The children in the vitamin group (200) had by then received 3,000 mg. each on an average. They were all found to be saturated, as indicated by an urinary excretion of 0.8 mg. or over per kg. of body weight.

The control group (200) showed non-saturation in 72% of cases (145). Half of this number (71; 35%) showed no increase whatsoever, whereas the remaining 37% (74) excreted 0.3 to 0.7 mg. per kg. during the test period. The tests were continued in June, 1942 (at the end of the test period), with the object of ascertaining the severity of the deficiency. We assumed that those who in January and February had responded to the test doses with either saturation or increased excretion were not likely to be severely deficient in June. We therefore continued the tests with only the 35% of the boys who had shown no increased excretion at all. Samples of their blood were examined, and they were given test doses until full saturation was achieved. Out of these 71 boys 58 were found to be in a very deficient state—i.e., 36 having a blood value below 0.3 mg./100 ml. and requiring 5 to 7 test doses before saturation was attained, the remaining 22 a value between 0.3 and 0.5 mg./100 ml. and requiring 4 to 6 test doses for saturation. There is admittedly a good chance that some of the remaining subjects who were not investigated in June had become deficient, but their deficiency is not likely to be as

high as that of those examined. We analysed the white-cell layer in 11 cases of severe deficiency; the results obtained ranged from 3.5 to 11.3 mg./100 ml.

The dietary intake of vitamin C was calculated. Only 25% of the cases investigated showed a daily intake of over 30 mg.; 35% showed between 15 and 30 mg., and the remaining 40% under 15 mg. It must be emphasized that these figures are concerned with the period April-July only, but certainly this represents an extremely low intake.

Summary of Results

The extent of non-saturation was 72% in the control group. In the vitamin group all subjects were found to be saturated three months after the beginning of the test period. The most severe cases (58 in all) out of a group of 200 showed the following: 36 below 0.3 mg./100 ml. blood and requiring 5 to 7 test doses for saturation, 22 between 0.3 and 0.5 mg./100 ml., and requiring 4 to 6 test doses for saturation. For reasons explained in the text, it will be seen that the latter figure of 22 is probably higher. The vitamin C intake in the diet from April to June was under 15 mg. daily in 40% and between 15 and 30 mg. in 35% of all cases.

Although the level of vitamin C nutrition varied on the whole according to the social standard, there was a relatively large amount of severe deficiency present. Glossop children compared very badly with some school-children in other areas in which similar investigations have been carried out.

II. LEVEL OF VITAMIN A NUTRITION

The purpose of this part of the investigation was, first, to obtain some more evidence about the value of the dark-adaptation test; secondly, to discover if there was any correlation between the dark-adaptation test and the dietary intake; and, finally, to determine the incidence and degree of vitamin A deficiency in Glossop.

Methods and Procedure

(a) *The Dark-adaptation Test.*—The apparatus used was that described by Yudkin (1941a). As test object horizontal and vertical devices only were used, which were considered sufficient to exclude "guessing." When using these lines rather than the direction of arrows we obtained more constant and somewhat lower thresholds. We chose for our readings two parts of the curve—i.e., the final rod threshold and a field in the macular part of the curve. The former was determined after the subjects had been in complete darkness for at least 30 minutes. The latter we obtained by measuring the time required to attain a value of 6.5 μl (logarithm of the threshold intensities expressed in micro-microlamberts) after an illumination of two minutes. As Dow and Steven (1941) have pointed out, this "recovery-time" test has many disadvantages as compared with the determination of the rod plateau; therefore reliance was placed only on "significant" changes in the cone values if they agreed with corresponding final rod changes. Although this occurred in over half of the cases, we are not of the opinion that any accuracy is gained by employing cone readings.

Our criterion of vitamin A deficiency, as indicated by the dark-adaptation test, was a vitamin A lability of the final rod plateau, as proposed by Steven and Wald (1941). The "control range" was determined in over 900 school-children after adequate supplementation with vitamin A. In 98% of cases the values obtained ranged from 2.8 to 3.4 log units. The remaining 2%, above 3.4 log units, were found to show a gradual slope when the percentage was plotted against the final threshold. The term "normal range," which appears so many times in the literature, has in most cases been employed incorrectly, and, in any case, is rather confusing. The process of dark-adaptation depends on many subjective factors, in connexion with perception and interpretation of visual stimuli, besides the various factors influencing light transmission. An assessment, therefore, of a borderline between "normal" and "subnormal" is futile unless limited to the object for which the test is being used. Since the determination of "normal" and "subnormal" thresholds is of no advantage for the purpose of testing for vitamin A deficiency, no attempt has been made to define these values. All that is required is to determine the individual variation and the "control" range, with special regard to its lower values. These findings will indicate the number of subjects within the lower limits of the control range who are not likely to improve above the individual variation

and therefore can be eliminated from further tests. All the other subjects must be given vitamin A treatment if deficient cases are not to be missed.

The variation of an individual was found to be 0.1 to 0.2 log unit during the same day and 0.1 to 0.4 unit over a period of 14 days. The latter high variation—values of 0.4 occurring in 20 out of 900 cases—must be taken into consideration when vitamin A therapy is given over a period of several days and when the significance of changes due to this therapy is being assessed. In the light of these variations all the subjects found to have initial rod plateaux of 3.1 μl or over were subjected to vitamin A therapy after having had three tests in all.

Following the recommendation of Yudkin (1941b) the tested subjects were given at least 1,000,000 I.U. of vitamin A before the final tests were carried out, and the latter were performed 24 hours after a dose of 100,000 I.U. so that at least transient improvement would occur. The same conditions obtained in the determination of the "control range."

(b) *Calculation of the Dietary Intake.*—As part of our food survey the vitamin A intake of the test subjects was calculated. The method of this investigation is described elsewhere.

It should be added that the estimation of vitamin A in blood could not be made. Although our experiments did not show that the concentration of vitamin A in blood could be indicative of vitamin A deficiency, the comparison of the blood values with the results found by means of the dark-adaptation test and the dietary intake would have been of great value. However, taking blood from 400 children was impracticable.

Results

Adaptometer Readings.—(a) Comparison of adaptometer readings between the vitamin group and the control group before vitamin A therapy showed that the mean rod plateau was slightly but not significantly higher in the "control" group. (b) The following decreases in threshold were found after vitamin A therapy:

	0.5 Log Unit or Over	0.4 Log Unit	0.3 Log Unit
Vitamin group (200) ..	0 (0%)	3 (1.5%)	22 (11%)
Control group (200) ..	33 (16%)	14 (7%)	28 (15%)

Dietary Intake.—The intake was calculated in I.U. per kg. of body weight, and is given in percentages of the test population:

I.U. per kg.	%
Less than 20 ..	7
20 - 30 ..	20
30 - 40 ..	16
40 - 50 ..	12
Over 50 ..	45

Correlation of the Dark-adaptation Test and Dietary Intake.—The only definite correlation observed was that the subjects with a threshold lability of 0.5 log unit or over were in all but three cases found to have an intake of less than 30 I.U. per kg. The exceptions had an intake of 33, 48, and 60 I.U. per kg. respectively. Various subjects with a threshold lability of 0.4 log unit and many subjects with a lability of 0.3 log unit showed a really high intake. Also many cases with a very low dietary intake showed a vitamin-A-stable threshold.

Conclusions

The following conclusions may be drawn from our experiments:

1. *Criticism of the Dark-adaptation Test.*—Certain weaknesses are apparent: (i) A test based upon subjective evidence is not very satisfactory. (ii) The test is cumbersome: in order not to miss deficient cases it is necessary to administer over 1,000,000 I.U. of vitamin A to a large proportion of subjects. (iii) Vitamin-A-labile values of the order of 0.3 and 0.4 log unit can be interpreted either as being the range of individual variation or as being due to a vitamin A deficiency. Since the amount of vitamin A lability is not related to the severity of the deficiency, this is a serious disadvantage. On the other hand, a vitamin A lability of 0.5 log unit or over seems to be a definite indication of a vitamin A deficiency. In spite of the above-mentioned weaknesses, therefore, we regard the criterion of threshold lability as the best test now available for the detection of vitamin A deficiency, with the understanding that a positive result only is reliable and that various readings may be of doubtful diagnostic significance.

Concluding from our results regarding the individual variations and the correlation of the dark-adaptation test and the dietary intake, we regard a threshold lability of 0.5 log unit or over as indicative of vitamin A deficiency, of 0.4 log unit as a probable case of deficiency, and of 0.3 log unit as a possible deficiency.

2. *Incidence and Degree of Vitamin A Deficiency in Glossop.*—By means of the dark-adaptation test we found 16% deficient, 7% probably deficient, and 15% possibly deficient. The dietary intake was less than 20 I.U. per kg. in 7%, 20–30 I.U. per kg. in 20%, and over 30 I.U. per kg. in nearly half the cases.

3. *Vitamin A Requirement.*—A dietary intake of 30 I.U. per kg. and over can perhaps be described as the minimal daily requirement in children aged 9 to 14 to prevent impairment of night vision (as indicated by a threshold lability of 0.5 or over). This does not imply that an intake of less than 30 I.U. necessarily brings on an impaired night vision.

III. EFFECTS OF VITAMIN A AND C DEFICIENCIES ON THE PHYSICAL CONDITION OF THE SCHOOL-CHILDREN

In order to determine the effects of vitamin deficiencies on the physical condition of these children evidence was collected with reference to rate of growth (weight and height), strength, endurance, medical defects, incidence of gingivitis, serum complement titre, incidence of infection, and phosphatase content of plasma. For this purpose the following groups were compared:

Group A.—19–30 boys from the control group with vitamin A deficiency. All the subjects had a threshold lability of 0.5 log unit or over, and their dietary intake was in each case under 30 I.U. per kg.

Group C.—24–36 boys from the control group with severe vitamin C deficiency. All these boys had blood values below 0.3 mg. per 100 ml. and required 5 to 7 test doses for saturation. In 11 cases the vitamin C concentration in the white-cell layer was estimated; the values ranged between 3.5 and 11.3 mg. per 100 ml. Their dietary intake was under 20 mg. in all cases.

Group AC.—14 boys with combined vitamin A and C deficiencies.

Group O.—30–50 boys from the vitamin group. They were shown to be on an adequate vitamin A level and to be saturated with vitamin C. In comparing growth, strength, and endurance it was noticed that there was a difference in initial weight between the A and C groups. It was therefore considered advantageous to have two O groups—one of 36 boys and one of 50 boys, corresponding in weight to the A group and the C group respectively—so that there would be no significant difference in initial weight between the groups compared.

In assessing differences in this inquiry the following formula was used to obtain the statistical "T" figure:

$$T = \frac{\bar{x}_1 - \bar{x}_2 \times \sqrt{\frac{1}{N}}}{\sqrt{S(x_1^2) - \frac{[Sx_1]^2}{N_1} + S(x_2^2) - \frac{[Sx_2]^2}{N_2}}}$$

Where $\bar{x}_1 - \bar{x}_2$ = means; x_1 the one set of variables and x_2 the other set; N_1 = the number of one set of variables and N_2 = the number of the other; S = summation and $\sqrt{\frac{1}{N}}$ = value of $\sqrt{\frac{N_1 + N_2}{N_1 \times N_2 \times (N_1 + N_2 - 2)}}$, to be obtained from tables according to number of variables. (Mr. H. C. Stone, B.Sc., kindly helped to work out some of the data.)

Dietary Intake

Before these groups were compared it was important to calculate their intake of animal protein, vegetable protein, total protein, fat, and carbohydrates in order to discover if there was a significant difference in the dietary intake of the groups which might account for any difference found. This evidence was obtained from the family budgets plus the amount of food received by the children at school (milk and other school meals). It was considered best to calculate the heat value of the food as purchased for the individual families, to deduct 5% for waste in housekeeping, and to add to this amount the school meals, after which the intake per man-value was calculated. The physiologically utilizable portion of nutrients and calories was not calculated, since loss in absorption is equal in both groups. In working out the vitamin content of the diet we used the tables given by Fixsen and Roscoe (1937-8, 1939-40).

Results.—No significant differences were found between the mean values of the protein, carbohydrate, and fat intake in

the groups compared. It may be assumed, therefore, that the groups differ only with regard to their vitamin intake in that the vitamin group had the additional capsules whereas the control group lived on the basic diet. The full analysis of the family budgets will be given in a separate report.

Interval.—The interval was 36.7 ± 0.078 weeks.

Ages

Groups	Means	Standard Deviation
O (36)	10.680 $\pm$ 0.257	1.543
A (20)	10.970 $\pm$ 0.258	1.068
C (24)	11.159 $\pm$ 0.172	0.854
AC (14)	11.170 $\pm$ 0.358	1.342

There were no significant differences between the groups in age.

Growth

The growth was worked out as percentage gains in 36.7 weeks of the test:

1. Weight

Groups	Initial Mean Weight in lb.	S.D.	Percentage Mean Gains in lb.	S.D.
O (36)	67.35 $\pm$ 1.358	8.149	5.890 $\pm$ 0.550	3.300
A (20)	67.00 $\pm$ 2.464	10.750	4.427 $\pm$ 0.324	1.649
O (50)	73.68 $\pm$ 1.897	13.410	6.740 $\pm$ 0.574	3.760
C (24)	72.24 $\pm$ 4.680	12.040	6.676 $\pm$ 0.875	4.290
AC (14)	73.26 $\pm$ 4.820	18.060	5.500 $\pm$ 0.895	3.148

There was a significant difference (as indicated by the T figure being over 2) between O (36) and A (20)—in other words, there was a significant difference in percentage gains of weight between the group deficient in vitamin A and the saturated group, the A group gaining significantly less in weight than the O group. No other significant differences were found.

2. Height

Groups	Initial Height		Percentage Gains in Height	S.D.
	Initial Mean Height in Ins.	S.D.		
O (36)	53.43 $\pm$ 0.774	5.864	2.63 $\pm$ 0.134	0.807
C (24)	54.75 $\pm$ 0.878	4.304	2.65 $\pm$ 0.185	0.908
A (20)	54.65 $\pm$ 0.716	3.415	2.49 $\pm$ 0.171	0.773
AC (14)	55.50 $\pm$ 1.020	3.830	2.52 $\pm$ 0.303	1.135

There were no significant differences in percentage gains in height, the T figure being under 2.

Endurance (Fatigue-resistance Potential)

The endurance was tested in terms of the time in seconds that the test subjects could hold themselves suspended on a horizontal bar.* The following comparisons are made:

1. Comparison of Groups Individually at Beginning and End of Test; also Comparison among Groups at Beginning of Test

Groups	Performance in Seconds		Differences
	Beginning of Test	End of Test	
O (36)	116.50	116.2	0.30
O (50)	116.06	112.2	3.86
C (24)	116.60	92.7	23.90
A (19)	127.00	107.4	19.60
AC (14)	125.30	91.1	34.20

Result.—The performance of the C and AC groups was significantly worse at the end of the test after 36.7 weeks as compared with the beginning.

2. Comparison between Groups at End of Test

Groups Compared	Difference in Seconds on Bar	T Figure
O (36) + C (24)	23.50	3.80
O (50) + C (24)	23.20	2.22
O (36) + A (19)	19.25	1.79
O (50) + A (19)	15.50	1.70
O (36) + AC (14)	34.20	2.79
O (50) + AC (14)	30.30	2.65

There was no significant difference between the groups at the beginning of the test.

* The time represents the fatigue-resistance potential per lb. of body weight as per formula $\frac{1}{2}MV^2 \times t$, in which $\frac{1}{2}V^2$ is constant (see Milligan and Lewis-Fanning, 1942; Milligan, 1943).

Result.—At the end of the test there were significant differences between the O and C groups and also between the O and AC groups, the performance of the C and AC groups being significantly worse.

3. Comparison of the Total Fatigue-resistance Potentials between the Groups

(The F.R.P.-figure = $\frac{1}{2}MV^2 \times t$, and represents the total energy.)

Groups Compared	Differences in Average Percentage Gains of Losses	T Figure
O (36) + C (24)	27.89	3.13
O (50) + C (24)	24.28	2.70
O (36) + A (19)	23.00	2.15
O (36) + AC (14)	29.66	2.38
O (50) + AC (14)	26.10	2.24

Result.—All groups as compared with the O group showed a significant decrease in the total energy figures.

N.B.—With regard to the A group the low rate of gain in weight would partly be responsible for the low energy figure (see elsewhere in paper).

Strength

The strength was tested by pulling on a dynamometer, and the results were worked out as gross pull in pounds divided by body weight.

Result.—No significant differences in strength were found between any of the groups compared.

Effect of Massive Doses of Vitamin C on Physical Efficiency

In dealing with strength and endurance, in addition to the "long-term" effect of vitamin A, a test was made of its "short-term" effect. At the termination of the official test time, massive doses of vitamin C were given to the vitamin-deficient boys; the results were noted by examination before the doses were given and immediately after the children were found to be saturated with the vitamin.

1. Strength

	Mean Pull in lb. Before Saturation with Vitamin C	Mean Pull in lb. After Saturation with Vitamin C	T Figure
C cases ..	165.46	180	1.07
AC cases ..	169	172	0.19

2. Endurance

	Mean Time on Bar Before Saturation with Vitamin C (Seconds)	Mean Time on Bar After Saturation with Vitamin C (Seconds)	T Figure
C cases ..	88	99	0.88
AC cases ..	94	88	0.43

The massive doses of vitamin C to saturation produced no significant results either in strength or in endurance. The short-term effects of vitamin C appear to be different from the long-term effects.

Incidence of Gingivitis

Method of Examination.—Miss P. Nicholls, L.D.S., kindly compared 36 cases of the C group with 36 cases of the O group at the beginning and the end of the test. Data were taken from the upper and lower incisor regions only. The fact that temporary teeth were retained or premolars erupting in a large number of cases made it necessary to exclude the back portion of the mouth. A detailed statement of the oral condition was made on each examination. The location of the inflammation was noted, also prophylaxis, irregularities, delayed eruption of teeth, cavities, etc. The conditions were classified into acute, subacute, and chronic; and the gums were described as "clear" if no signs of hyperaemia or hyperplasia were observed.

Results

	Groups	Clear	Acute	Subacute	Chronic	Total
Beginning of test (Oct., 1941)	C	7	22	6	1	36
	O	8	20	6	2	36
End of test (July, 1942)	C	16	9	7	4	36
	O	18	13	2	3	36

There was no significant difference in the incidence of gingivitis between the two groups, but it will be noted that the occurrence of gingivitis decreased remarkably in both groups at the end of the test as compared with the beginning.

The Serum Complement Titre

The serum complement has been shown to consist of many fractions, but it is nevertheless interesting to find that it has been reported to have very low values in scurvy. The purpose of this investigation was to discover if there was any decrease in the complement titre in subscorbutic cases.

The estimation of complement is difficult, but one of the best methods is that of Ecker *et al.* (1938), in which the end-point is taken when haemolysis first begins. Dr. F. Stratton kindly estimated these, employing essentially Ecker's method.

The serum complement of the C and O groups (each group consisting of 30 children) was estimated. No significant differences were observed between the two groups, and no substantially low values were found in the deficient group. In view of the immunological importance attached to the complementary property of serum, and the few conditions in which it has been shown to be diminished in titre, these observations indicate that complete exhaustion of the vitamin may be necessary, as in scorbutic conditions, before complement titre is significantly reduced. This should not, however, be taken to indicate that additional therapy with vitamin C is unnecessary in deficient cases, as these observations show nothing concerning the continued sustenance of a high-titre complementary property under continuing unfavourable dietetic conditions and a supervision of infection.

Incidence of Infection

A survey has been made with regard to the incidence of infection in each of the groups. Twenty-five subjects of groups O, A, and C were compared. A list was first obtained of all the boys who had been absent from school for more than two days. Subsequently the children's parents were interviewed and an allowance was made for non-relevant factors such as broken legs, etc.

Results

Groups	Mean Absences	S.D.
O	1.68 ± 1.110	5.550
A	5.96 ± 0.990	4.990
C	4.76 ± 1.265	6.318

A significant difference was found in the incidence of infection both between O and A groups (T=3.14) and between O and C groups (T=2.40).

Medical Defects

The assessment of physical defects is not an easy undertaking and allowance must be made for errors, so that it must be frankly said that great accuracy is not possible. There were, however, certain conditions that could be assessed with more confidence than others, such as various skin conditions (acne, boils, other sepsis, chilblains), glands (enlarged tonsillar glands), lungs (cough and rales), and cheilosis. Only these conditions were assessed.

Results.—(1) Examination at beginning of test (Oct., 1941): No significant differences existed between any of the groups compared. (2) Examination in March, 1942: Significantly more defects were found in the A and AC groups as compared with the O group. (3) Examination at end of test (July, 1942): No significant differences were found between any of the groups. Our impression, however, during the examinations in March and July was that the skins of the O group were clearer, smoother, and sleeker than in the other groups. Similar observations were made by Wilkins and Rollason (1937).

Phosphatase Content of Plasma

When taking blood samples of the O and C groups for the determination of the vitamin C content and the complement titre, the estimation of the phosphatase content in the plasma was carried out with a view to detecting early bone changes in cases of avitaminosis. We employed the micromethod described by King *et al.* (1937), which measures the amount of phenol liberated from phenylphosphate when incubated at 37° C.

Result.—There was no significant difference between the two groups, and no substantial increases were noted in the C group.

We wish to thank the head teachers and staff of the Glossop schools, the parents of children, the Health Department staff, and various voluntary technicians for their co-operation, which made this investigation possible. We also are indebted to Messrs. Organon Laboratories, Messrs. Roche Products Ltd., and Messrs. Glaxo Ltd. for generous supplies of the vitamins.

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AGE INCIDENCE AND PROGNOSIS OF EPILEPSY

BY

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In the course of some 20 years' experience of epilepsy in hospital and private practice I have been impressed by the number of cases of epilepsy of unknown origin beginning in middle and later life. While all writers recognize that idiopathic epilepsy may arise at any age, an onset in later life is generally thought to be rare. Organic disease of the brain which may cause epilepsy is commoner in later life, and therefore epilepsy in such patients is more likely to be a symptom of progressive intracranial disease than in children or adolescents. A statement such as the following, taken from the latest edition of Osler's *Medicine* (Christian, 1942), is typical: "It is well always to be suspicious of 'epilepsy' beginning in adult life, for in a majority of such cases the disease is not epilepsy" (italics mine).

Some statements, however, are much more dogmatic. For example, Penfield and Erickson (1941), in their recent book, *Epilepsy*, which is a very fine study of the surgical aspects of the problem, lay great stress on the age of onset of fits as a factor in diagnosis, though they are careful to state that idiopathic epilepsy may occur at any age. They say:

"In cases of onset of seizures between 35 and 55, the most frequent cause is cerebral neoplasm" (italics mine). "After 55 years the various cerebral lesions produced by abnormality of the cerebral blood vessels become more frequent, though the strong probability of neoplasm must still be remembered." And lastly: "Idiopathic epilepsy comes on in youth, not in early infancy, and not in middle age or old age."

Age of Onset

As such statements did not correspond with my experience, I instituted, with the aid of Flight Lieut. H. G. Miller, formerly medical registrar, and Dr. Frank Robertson, first assistant, an inquiry into the age of onset in my cases, and, secondly, into the cause of attacks in the later age groups.

TABLE I.—Age of Onset of Epilepsy: Present Investigation

Age (Years)	Private	Hospital	Total
0-10	50 (22%)	83 (22%)	133 (22%)
11-20	63 (28%)	122 (33%)	185 (31%)
21-30	49 (21%)	82 (22%)	131 (22%)
31-40	28 (12%)	44 (12%)	72 (12%)
Over 40	41 (17%)	40 (11%)	81 (13%)
Total	231	371	602

The cases number 602. The private cases cover a period of 18 years, hospital cases 12 years; hospital out-patient records before this time were removed for salvage without my know-

ledge. No cases seen during the past two years have been included, as insufficient time has elapsed to judge of their outcome. A study of the figures will reveal that there is a general correspondence between the private and hospital groups, and that of the whole series 25% showed the first evidences of epilepsy after the age of 30 and 13% after the age of 40. The group of 81 patients with onset of attacks over the age of 40 were chosen for special follow-up.

Table II shows a comparison with previous records of the age of onset of epilepsy. While all the records show the

TABLE II.—Age of Onset of Epilepsy: Comparison with Previous Records

Age (Years)	Gowers (1,450 Cases)	Turner (1,000 Cases)	Nattrass (602 Cases)
0-10	29%	31.3%	22%
11-20	46%	46.7%	31%
21-30	15.7%	12.2%	22%
31-40	6%	5.8%	12%
Over 40	3.3%	4.0%	13%

highest incidence in the second decade, the figures of these eminent observers (Gowers, 1901; Turner, 1907) indicate only 9 to 10% of patients in whom the first fits occurred after the age of 30, as compared with 25% in my series.

Results of a Follow-up

Table III summarizes the results of a follow-up of the 81 patients who developed attacks diagnosed as epilepsy with onset after the age of 40, and in whom at the time of initial examination no cause could be found for the attacks.

TABLE III.—81 Cases diagnosed Epilepsy of Unknown Origin with the First Attack after the Age of 40

Untraced	24
Deaths	16
Tumour proved 5, probable 2	7
G.P.I.	1
Cerebral arteriosclerosis	1
Heart failure	2
Air raid	1
Pancreatic tumour, ? hypoglycaemia	1
Unknown	3
Living and traced	41

The number of untraced patients (24) is perhaps not surprising considering the years involved in the inquiry. The 41 patients living and traced were nearly all re-examined; of the few who could not attend adequate information was obtained. The present condition of these 41 patients is indicated in Table IV.

TABLE IV.—Present Condition of 41 Traced Patients of the Series in Table III

3 patients have had only 1 fit:	
11 years ago, at age 53	
7	55
6	43
1 patient had 2 fits at age 47; now aged 54	
6 others have had no fits for the past 9 years (2 cases), 8 years (1 case), 5 years (1 case), 2 years (2 cases)	
The remainder continue to have fits at very variable intervals	

In some cases the frequency of fits remains unchanged, but on the whole there seems a tendency to diminution in the frequency and severity of attacks with the passing years. None of these patients shows any symptom or sign of intracranial tumour. Their general condition on the whole is good; most of them are living almost normal lives and are at work. For example, one patient is the manager of a large branch of an insurance company though he is the subject of major seizures and has very severe myoclonic twitching from time to time between attacks. Another patient had 7 major nocturnal attacks between the ages of 67 and 77, when they ceased. He is now aged 83, and is exceptionally well.

With regard to evidence of cerebral arteriosclerosis, a moderate degree of hypertension is found in a proportion of cases (Table V).

TABLE V.—Incidence of Hypertension (41 Cases re-examined)

B.P. in one patient	= 210/120
B.P. " " "	= 190/130
B.P. " " "	= 190/100
B.P. " " "	= 195/95
B.P. " " "	= 180/100 (Attacks ceased since 1935)

Hypertension seems to us to occur in no greater proportion in these patients than in non-epileptic subjects of the same age, and the height of the blood pressure has not been found to