

MILK CONSUMPTION AND THE GROWTH OF SCHOOL CHILDREN.

SECOND PRELIMINARY REPORT ON TESTS TO THE SCOTTISH BOARD OF HEALTH

BY

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THE preliminary report, by Dr. J. B. Orr, on the result of the 1926-27 investigation into the feeding of a large number of school children was published in the *British Medical Journal*, January 28th, 1928 (p. 140).

The conclusions which might be drawn from that work appeared to the committee in charge of the test to be so interesting and important that it was decided to continue the investigation over a further period of equal length. That has been done, and the present report* deals with this period of the repeated test—namely, November, 1927, to June, 1928.

The seven centres at which the investigation was carried out were Peterhead, Aberdeen, Dundee, Edinburgh, Glasgow, Greenock, and Belfast. The number of children involved was 1,425. At each place four groups of children were selected, and each group treated differently. One group received whole milk, another separated milk, a third a biscuit ration of the caloric value of the separated milk, while a fourth acted as controls, receiving nothing.

The children of 13 to 14 years received 1 pint of milk daily.
The children of 9 to 10 years received 1 pint of milk daily.
The children of 6 to 7 years received three-quarters of a pint of milk daily.

All the milk was given at the schools under supervision. The whole milk was pasteurized, except at Peterhead and Aberdeen, where it was "certified." The separated milk was machine-skimmed.

Samples of all the milk given were taken monthly and sent to the Rowett Research Institute, where they were analysed. These analyses show that the average fat percentage of the whole milk was 3.85, and that of the separated milk 0.33.

Measurements.

The measurements were all done by one of us (M. L. C.), and were done four times everywhere, except at Belfast, where they were done three times. As in the 1927 test the children were all weighed and measured in indoor garments and without shoes. This year the heights were recorded to the nearest eighth of an inch and the weights to the nearest quarter of a pound. To obtain a fairly accurate average increase in weight a careful record was made at each weighing of every article of clothing worn by the child, and from these records the average weight of clothing for boy or girl was calculated. The difference between the initial (winter) and final (summer) weight of clothing was then added to the final gross weight. In Belfast, in three schools, the children were weighed in one garment only, and the difference between winter and summer weights was, therefore, the exact increase made by the child.

To obviate fluctuations as far as possible the weights and heights were taken at the same hour of the day on each occasion, this being in the case of children receiving milk before the milk was drunk. As far as possible the

* Owing to the death of Dr. L. Cruickshank and to the absence of Dr. J. B. Orr abroad, it was decided to place the organization of the second investigation in the hands of Dr. Gerald Leighton, Medical Officer of Foods, Scottish Board of Health. This also enabled the Board's wide knowledge of the nutrition of school children and the implications of such in connexion with public health to be more readily utilized.

schools were visited in the same rotation in order that the period between initial and final weights and heights might be identical. On each visit an accurate record was obtained for each child of all absences and illnesses. Thus the exact amount of supplementary feeding was known. Any child who had missed 25 per cent. of feeds, or showed other abnormality, was excluded when calculating the results. The number so excluded was 268.

Special Conditions of the Investigation.

In considering the results of this investigation the following points should be borne in mind. The number of children involved was very large, no fewer than 1,157 being available for the measurements from which the tables are compiled. These children were divided among seven centres of population, in which the test was conducted simultaneously. Their ages ranged from 5 to 13 years, including the beginning, the middle, and the end of their ordinary school life. All the children in the six Scottish centres were living in the ordinary conditions of Scottish working-class homes, and received the ordinary diet of such homes. The milk and biscuit given to them at the schools were therefore in the nature of a *supplementary ration to their home food*. The results, consequently, must be regarded as the effect of the addition of definite quantities of milk to the average home diet of children of school age living in ordinary working-class conditions in industrial centres. It would appear to be justifiable to infer that the same results, whatever they may be, would apply to the whole school population living their ordinary life. Those conditions, from the standpoint of a nutritional investigation, are, of course, very complicated, but this test was so devised as to bring out any significant differences which might arise within the limits laid down.

The following three tables show the total results of the investigation.

TABLE I.—1928—Increase: Milk versus Non-milk Groups and Percentages.

	No. of Children.	Height Increase.	Weight Increase.
13-year Groups:			
Milk	137	1.4699 in.	5.6387 lb.
Non-milk	133	1.1908 "	4.2368 "
		= +0.2791 ins.	= +1.4019 lb.
		or 23.44%	or 33.09%
9-year Groups:			
Milk	188	1.3947 in.	3.4701 lb.
Non-milk	212	1.1068 "	2.0695 "
		= +0.2875 in.	= +1.3707 lb.
		or 25.98%	or 66.18%
6-year Groups:			
Milk	242	1.5021 in.	2.5331 lb.
Non-milk	245	1.2758 "	1.8531 "
		= +0.2263 in.	= +0.6800 lb.
		or 21.16%	or 36.70%
All Age Groups:			
Milk	567	1.4585 in.	3.5776 lb.
Non-milk	590	1.1810 "	2.4610 "
		= +0.2775 in.	= +1.1165 lb.
		or 23.50%	or 45.37%
1927 increases (Scotland—all ages):			
Milk	551	1.470 in.	3.617 lb.
Non-milk	731	1.212 "	2.94 "
		= +0.258 in.	= +0.643 lb.
		or 21.59%	or 21.62%

From this table it is seen that, taking all the ages combined of the 1,157 children and dividing them into milk-fed groups and non-milk-fed groups, there is an average increase in height of 23.5 per cent., and in weight of 45.37 per cent., in favour of the milk-fed groups over the non-milk-fed groups.

It is also seen that these increases are greater in this second and repeated test than they were in the first (1927) test.

TABLE II.—1928—Increases in Age Groups.

	No. of Children.	Height Increase.	Weight Increase.
13-year Groups:			
Whole milk	68	1.4540 in.	5.562 lb.
Separated milk	69	1.4855 "	5.7101 "
Biscuits	67	1.1194 "	4.4179 "
Controls	66	1.2533 "	4.0530 "
	270		
9-year Groups:			
Whole milk	105	1.4238 in.	3.5333 lb.
Separated milk	83	1.3569 "	3.2771 "
Biscuits	101	1.1077 "	2.0396 "
Controls	111	1.1059 "	2.0586 "
	400		
6-year Groups:			
Whole milk	121	1.5789 in.	2.7107 lb.
Separated milk	121	1.4452 "	2.3554 "
Biscuits	115	1.2424 "	2.1009 "
Controls	130	1.2375 "	1.5808 "
	487		
Total number ...	1157		

This table shows the increase in height and weight in all the age groups, with the number of children in each group. In every case the milk-fed children are ahead of the "biscuit" and "control" groups. The greatest increase in height is in the 6-year-old milk-fed group. The greatest increase in weight is in the 13-year-old separated milk group. The difference between the "biscuit" group and the "controls" is but slight, except that the 13-year-old controls did better in height but not so well in weight.

In the 6-year-old group the "biscuit" group is better in weight than the "controls."

Those familiar with the manner in which statistics of this kind are worked out will be aware that, in order that the difference between two groups and figures may be regarded as "significant," that difference must be at least three times as great as the "probable error." The results in this table are calculated on that basis.

In Table III there is set forth the mean increase in pounds and inches (that is, for weight and height) in each group at each age, together with the probable error involved and the significance or otherwise of the differences.

Other Observations.

In addition to the foregoing statistical observations, two other lines were adopted which cannot be stated in figures.

Dr. C. A. Douglas examined all the children clinically when they were measured. Her report states that "in practically every case it was noted that the children receiving milk showed, even where there was obviously poor maternal care, that sleekness peculiar to a well-nourished animal. Their hair had a glossy and bright appearance. Their nails were smooth, resilient, and looked as if polished. General alertness was common to all the children fed on milk. No difference could be detected with regard to these points between the children receiving milk irrespective of the kind of milk. It was gathered from teachers and janitors that the children receiving milk were much more alert and very much more boisterous and difficult to control than the others. This latter fact was only too evident when they were waiting in small groups to be weighed."

TABLE III.—1928 Nutrition Test.
A.—13 Years: Weights (Increases in Pounds).

	Increase I.	Increase II.	Difference.	Probable Error.	Result.	Remarks.
Whole milk (68) v. Separated milk (69) ...	5.5662	5.7101	-0.1439	0.2979	-0.483	Insignificant.
v. Biscuits (67) ...	"	4.4179	+1.1483	0.3080	+3.728	Significantly better.
v. Controls (65) ...	"	4.0530	+1.5132	0.2816	+5.374	" "
Separated milk (69) v. Biscuits (67) ...	5.7101	4.4179	+1.2922	0.3400	+3.801	" "
v. Controls (66) ...	"	4.0530	+1.6571	0.3163	+5.239	" "
Biscuits (67) v. Controls (66) ...	4.4179	"	+0.3649	0.3258	+1.120	Insignificant.

B.—Heights (Increases in Inches).

	Increase I.	Increase II.	Difference.	Probable Error.	Result.	Remarks.
Whole milk (68) v. Separated milk (69) ...	1.4540	1.4855	-0.0315	0.0424	-0.743	Insignificant.
v. Biscuits (67) ...	"	1.1194	+0.3346	0.0431	+7.763	Significantly better.
v. Controls (65) ...	"	1.2533	+0.1907	0.0444	+4.295	" "
Separated milk (69) v. Biscuits (67) ...	1.4855	1.1194	+0.3661	0.0453	+8.031	" "
v. Controls (66) ...	"	1.2633	+0.2222	0.0466	+4.768	" "
Biscuits (67) v. Controls (66) ...	1.1194	"	-0.1439	0.0472	-3.049	Significantly worse.

C.—9 Years: Weights (Increases in Pounds).

	Increase I.	Increase II.	Difference.	Probable Error.	Result.	Remarks.
Whole milk (105) v. Separated milk (83) ...	3.5333	3.2771	+0.2562	0.1468	+1.745	Insignificant.
v. Biscuits (101) ...	"	2.0396	+1.4937	0.1314	+11.114	Significantly better.
v. Controls (111) ...	"	2.0586	+1.4747	0.1360	+1.843	" "
Separated milk (83) v. Biscuits (101) ...	3.2771	2.0396	+1.2375	0.1403	+8.820	" "
v. Controls (111) ...	"	2.0586	+1.2185	0.1419	+8.587	" "
Biscuits (101) v. Controls (111) ...	2.0396	"	-0.0190	0.1290	-0.147	Insignificant.

D.—Heights (Increases in Inches).

	Increase I.	Increase II.	Difference.	Probable Error.	Result.	Remarks.
Whole milk (105) v. Separated milk (83) ...	1.4238	1.3669	+0.0669	0.0261	+2.563	Not quite significant.
v. Biscuits (101) ...	"	1.1077	+0.3161	0.0281	+1.249	Significantly better.
v. Controls (111) ...	"	1.1059	+0.3179	0.0263	+12.047	" "
Separated milk (83) v. Biscuits (101) ...	1.3569	1.1077	+0.2492	0.0237	+10.515	" "
v. Controls (111) ...	"	1.1059	+0.2510	0.0215	+11.674	" "
Biscuits (101) v. Controls (111) ...	1.1077	"	+0.0318	0.0239	+0.075	Insignificant.

E.—6 Years: Weights (Increases in Pounds).

	Increase I.	Increase II.	Difference.	Probable Error.	Result.	Remarks.
Whole milk (121) v. Separated milk (121) ...	2.7107	2.3554	+0.3553	0.1112	+3.195	Significantly better.
v. Biscuits (115) ...	"	2.1609	+0.5498	0.1020	+5.390	" "
v. Controls (130) ...	"	1.5808	+1.1299	0.0331	+10.959	" "
Separated milk (121) v. Biscuits (115) ...	2.3554	2.1609	+0.1945	0.1055	+1.844	Insignificant.
v. Controls (130) ...	"	1.5808	+0.7746	0.1066	+7.265	Significantly better.
Biscuits (115) v. Controls (130) ...	2.1009	"	+0.5801	0.0969	+5.987	" "

F.—Heights (Increases in Inches).

	Increase I.	Increase II.	Difference.	Probable Error.	Result.	Remarks.
Whole milk (121) v. Separated milk (121) ...	1.5589	1.4452	+0.1137	0.0250	+4.578	Significantly better.
v. Biscuits (115) ...	"	1.2424	+0.3165	0.0243	+13.025	" "
v. Controls (130) ...	"	1.2375	+0.3214	0.0250	+12.856	" "
Separated milk (121) v. Biscuits (115) ...	1.4452	1.2424	+0.2028	0.0221	+9.76	" "
v. Controls (130) ...	"	1.2375	+0.2077	0.028	+9.110	" "
Biscuits (115) v. Controls (130) ...	1.2424	"	+0.0049	0.0221	+0.222	Insignificant.

Dr. G. W. Simpson made a different observation. He asked the headmasters to parade the children in their respective groups, he himself being unaware which group was milk-fed or otherwise. From this general survey he placed the groups in order of apparent standard of nutrition. Of five examinations thus made he found that first places of nutritional standard were accorded to three whole milk and two separated milk groups. Second places were accorded to two whole milk and three separated milk groups. Third places were accorded to all five biscuit groups, and fourth places to all five control groups. "The difference in nutrition between groups receiving milk and not receiving milk was plainly evident. No great difference was noticed between the whole milk and separated milk groups." A sixth examination did not correspond with the other five, but in this case the best nourished children had been selected as controls, while those apparently needing the milk most were put into the milk groups. The desired conditions for observation were thus not fulfilled.

A Test Reversed.

One very interesting result came out in this repeated investigation. In order to ascertain what would occur two of the previous feeding groups were reversed. A group which in the first investigation received separated milk now received biscuit. Another group which in the first investigation were "controls" now received whole milk. The general result in both cases was that they changed places, the former milk group now receiving biscuit fell to biscuit standard, while the former "control" group now receiving milk rose to the milk standard. Table IV shows the detailed results of this reversed test.

TABLE IV.—Groups Reversed.

	Average Increase in Height (inches).		Average Increase in Weight (lb.).	
	1927.	1928.	1927.	1928.
GLASGOW.				
5-year-old children:				
Separated milk 1927; biscuits, 1928	1.500	1.351	2.407	2.212
Biscuits, 1927; separated milk, 1928	1.101	1.454	2.234	2.237
8-year-old children:				
Separated milk, 1927; biscuits, 1928	1.297	1.213	3.471	2.063
Biscuits, 1927; separated milk, 1928	1.089	1.335	2.266	3.207
GREENOCK.				
5-year-old children:				
Whole milk 1927; controls, 1928	1.543	1.163	1.994	1.875
Controls, 1927; whole milk, 1928	1.470	1.479	1.595	2.639

The following table shows similar details for the other areas (groups not reversed).

TABLE IVA.—Groups Continued.

	Average Increase in Height (inches).		Average Increase in Weight (lb.).	
	1927.	1928.	1927.	1928.
PETERHEAD.				
5-year-old children:				
Whole milk	1.550	1.384	2.741	2.569
Separated milk	1.568	1.356	2.983	2.576
Biscuits	1.392	1.270	1.973	2.188
Controls	1.425	1.311	1.773	2.048
DUNDEE.				
8-year-old children:				
Whole milk	1.105	1.197	2.556	3.205
Separated milk	1.209	1.347	2.659	3.070
Biscuits	0.931	1.054	2.404	2.738
Controls	0.972	1.156	2.433	1.911
EDINBURGH.				
8-year-old children:				
Whole milk	1.483	1.429	3.330	4.057
Separated milk	1.457	1.383	3.238	3.531
Biscuits	1.285	1.031	2.972	1.650
Controls	1.224	1.100	2.132	2.438
GREENOCK.				
5-year-old children:				
Separated milk	1.625	1.443	1.969	2.243
Biscuits	1.455	1.131	1.200	2.050

Conclusions.

As the result of this repeated investigation (1927-28), it may be said at once that the tentative conclusions drawn by Dr. J. B. Orr from the first investigation were more than justified.

The great value of an additional milk ration to that already taken at home is clearly demonstrated for all ages of school children.

In the repeated test the average increase in height in the milk-fed groups in all ages combined is actually 1.21 per cent. more than in the first test. The average increase in weight in the milk-fed groups in all ages combined is no less than 3.75 per cent. more than in the first test. Not only have the same milk-fed children benefited again, but they have done so to a greater extent than before. Their initial improvement has continued over the second year.

Once more the value of separated milk for children of school age is shown. In most groups the difference in height and weight between the whole milk and separated milk groups is not "significant," but in the six-year-old group whole milk is "significantly" better than separated for both weight and height. In every case the whole milk and separated milk groups are better than the "biscuit" or the "controls." In this repeated test the difference between the "biscuit" and the "controls" is usually "insignificant"; the effect of the extra biscuit appears almost negligible. The improvement of the milk-fed groups in general health and appearance is clearly brought out in the reports of Dr. C. A. Douglas and Dr. G. W. Simpson. Many of the teachers have recorded similar opinions.

When these results are considered, along with those published by Dr. Corry Mann in this country and those of observers in other countries, the only conclusion possible is that they have a wide public health significance, especially with the nutrition of school children.

"In 1903, when the Royal Commission on Physical Training (Scotland) issued their report, two things became clear: first, that medical examination and superintendence were essential conditions of any system of physical education; second, that in the end the fundamental problem is one of nutrition. . . . When every preventable ailment is prevented, and every serious disease treated to its finish, the new battalions of children coming forward have to be superintended from the nutritional standpoint." (Sir Leslie Mackenzie.) The two reports of this investigation fully substantiate these views.

Committee of Investigation.

The investigation was conducted under the direction of a committee appointed by the Scottish Board of Health with Sir Leslie Mackenzie as chairman. The members consisted of the school medical officers for the cities and towns where the work was carried out.

We desire to thank Dr. J. F. Tocher, Aberdeen, and Mr. J. S. Thomson, Rowett Research Institute, for advice and help on the statistical side of this investigation.

The results of the investigation have also been submitted from time to time to Professor A. P. Cathcart, chairman of the Nutrition Committee of the Medical Research Council.

The cost of the investigation was defrayed by a grant made by the Empire Marketing Board to the Rowett Research Institute, Aberdeen.

THE seventh issue of the *Medical and Scientific Archives of the Adelaide Hospital* contains records of various cases of general interest, and a tabulation of certain lesions found during the course of 1,000 necropsies performed between 1920 and 1925. In this survey the conditions dealt with include diseases of the vascular system, the digestive system, the female generative tract, and the ductless glands; in the *Archives* of the previous year data were given for all neoplasms. The hope is expressed that the material thus tabulated will prove of value to those engaged in research work who require references to the occurrence of peculiar lesions. Any particular case can be followed up, fuller details being obtainable on application to the registrars at the Adelaide Hospital. It is suggested that unexpected associations between various lesions may be brought out in this way, and that if similar statistics were to be made at large hospitals throughout the world, a very important mass of information would be made available.