Dietary survey methods: a comparison of the calorie and protein contents of some rural Jamaican diets

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SUMMARY

The food intakes of nine subjects were weighed for seven days and the calorie and protein intakes calculated from food tables. At the same time, identical portions were taken and the actual calorie and protein compositions were determined by chemical analysis.

Food tables tended to underestimate both calories and protein when compared with the chemical analysis. The majority (79%) of the calculated values were within 20% of the true calorie and protein composition, but only 23% came within 10% of the actual composition.

Considerable doubt was cast on the accuracy and usefulness of the "recall" survey method in which subjects merely describe their intakes. Investigators wishing an accuracy greater than 20% are recommended to weigh ingredients throughout the preparation period and not just at meal times.

Dietary surveys are frequently used in assessing the nutritional status of individuals and families, and a variety of methods are employed. The accuracy of such surveys depends largely on the degree of complexity involved, but many investigators tend to state their results with absolute precisión and exactness regardless of the method employed. This paper reports the findings of a small scale survey where calorie and protein intakes were calculated using food tables and the

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results compared to the actual composition obtained by chemical analysis. The extent of the errors found in Jamaica may be helpful to survey teams who propose to rely solely on food tables for their analysis and are working in similar countries where not all food items are to be found in tables and consequently approximations have to be made.

MATERIAL AND METHODS

The subjects, four male and five female aged 16-21 years, were from poor families living in a rural Jamaican community. The individual food items which they consumed at each meal were weighed for seven days and the calorie and protein intakes were calculated from food tables. The tables of McCance and Widdowson (1) were used for the most part, together with the INCAP & ICNND table for use in Latin America (2), Handbook No. 8 of the United States Department of Agriculture (3) and local food tables of Fox (4). An approximation was made of the composition of fifteen composite dishes not appearing in any food table. None of the households used either recipes or measures in the making of these dishes so that the composition was likely to vary from day to day and from house to house. The estimate of the composition, however, was kept constant.

At the same time as the food items were weighed, identical portions were taken and placed in a polythene bag, one bag being used per day for each subject. These replicate meals were deep frozen and subsequently freeze-dried and made into a fine powder by passing through a hammer mill. The calorie composition was determined in triplicate with a ballistic bomb calorimeter, and the nitrogen content was measured in duplicate by the micro-Kjeldahl method. The protein content was calculated by multiplying the N content by 6.25.

RESULTS

The dietary patterns of the subjects were basically very similar and fairly simple. Breakfast consisted largely of bread or crackers and margarine, with perhaps an egg, banana or salted codfish. Fried dumplings, Johnny cakes (another fried

doughy mixture) or codfish fritters were alternatives. A hot drink was customary — coffee or tea with condensed milk or a chocolate drink made by boiling grated parched cocoa beans with coconut milk.

Lunch was a light meal, cornmeal porridge with condensed milk and sugar being popular as was soup — either packaged chicken noodle or home made red pea (*Phaseolus vulgaris*) or congo pea (*Cajanus indicus*) with added green banana, dumplings, yam or sweet potato. Items from the village shop such as meat patties (highly seasoned meat inside pastry), raisin bun and bulla (a spiced bun) were frequent alternatives. Often lunch was simply bread with a little sardine, corn beef or cheese.

The evening meal was the largest meal of the day, comprising yam, rice, or rice and red peas, green banana, breadfruit, dasheen (*Colocasia esculenta*), sweet or irish potato or dumpling. Two or three of these items were eaten at the evening meal with a small portion of stewed beef, liver or corned beef, or with mackerel, salted codfish, or codfish with ackee (*Blighia sapida*) or with stewed red peas and pig's tail.

A comparison of the estimated and actual compositions of the individual diets is given in Table 1. The maximum difference among triplicate calorie determinations averaged 4.0% whilst the difference between duplicate nitrogen determinations was 1.9%. The calorie and protein contents calculated from food tables were expressed as a percentage of the actual composition found by analysis and the results are shown as histograms, fig. 1. The calorie values based on food tables ranged from 66% to 126% of the analytical figures, whilst the protein values ranged from 66% to 141%.

Nearly all the calorie values (59 out of 63) were within 20% of the analytical figure and more than half (38) were within 10%. The protein values showed somewhat less uniformity with 53 falling within 20% of the analytical figure and half (32) being within 10%. Fifty of the calculated values had both calories and protein to within 20% of the analytical figure, but only 23 had both factors to within 10%. Of the 63 calculated values, 40 were below the analytical value so the tendency was for the food tables to underestimate rather than to over estimate the actual composition and the tendency applied equally to calories and protein.

TABLE 1

A COMPARISON BETWEEN THE ESTIMATED AND ACTUAL COMPOSITIONS OF THE 63 DIETS

No.	CALORIES		PROTEIN (g)	
	Estimated	Analysed	Estimated	Analysed
1	826	1140	23.2	28.4
2	858	817	17.1	18.9
3	978	1031	24.3	27.0
4	988	989	29.1	30.9
5	994	1186	24.6	24.7
6	1005	1056	37.1	38.2
7	1073	1088	37.7	46.8
8	1086	1356	42.6	44.5
9	1087	1076	15.7	13.9
10	1110	1034	22.0	26.2
11	1129	1030	46.7	36.7
12	1165	1318	40.5	44.5
13	1173	1773	64.1	61.4
14	1209	1331	36.5	38.6
15	1247	1260	44.3	44.9
16	1261	1305	28.0	32.3
17	1286	1496	34.7	36.9
18	1309	1481	25.9	31.2
19	1327	1294	30.4	29.0
20	1333	1754	42.5	51.1
21	1339	1129	37.0	26.4
22	1340	1427	45.3	42.1
23	1343	1306	30.6	27.1
24	1389	1695	40.0	56.9
25	1409	1449	28.1	27.9
26	1420	1659	52.7	37.3
27	1431	1511	52.1	49.9
28	1435	1411	41.6	35.7
29	1458	1611	39.7	42.8
30	1469	1362	29.2	36.3
31	1470	1174	26.5	20.6
32	1491	1619	57.0	63.2

TABLE 1 (Continuation)

A COMPARISON BETWEEN THE ESTIMATED AND ACTUAL COMPOSITIONS OF THE 63 DIETS

No.	CALORIES		PROTEIN (g)	
	Estimated	Analysed	Estimated	Analysed
33	1493	1725	27.2	30.6
34	1500	1871	62.8	75.8
35	1510	1558	45.5	43.9
36	1565	1810	50.9	52.1
37	1566	1810	46.1	48.4
38	1574	1688	53.2	45.3
39	1586	1699	63.2	60.1
40	1591	1948	45.7	53.3
41	1603	1587	46.2	42.6
42	1632	1478	60.8	54.2
43	1664	1499	52.0	47.6
44	1675	1999	39.0	48.4
45	1675	1949	51.2	65.4
46	1746	2027	69.3	73.1
47	1839	1993	52.3	67.1
48	1848	2252	44.7	57.2
49	1873	1776	48.9	41.9
50	1891	1855	35.2	40.4
51	1918	1901	42.5	45.4
52	1922	1905	62.4	58.4
53	1935	1796	45.3	54.4
54	1942	1995	49.2	64.2
55	2020	2060	50.8	56.2
56	2023	2037	52.8	47.9
57	2040	1928	50.1	53.5
58	2184	2045	66.1	69.2
59	2394	2158	55.4	51.9
60	2521	2524	81.5	75.4
61	2527	2234	51.1	61.6
62	2663	2922	48.1	73.2
63	2788	2977	81.3	82.6

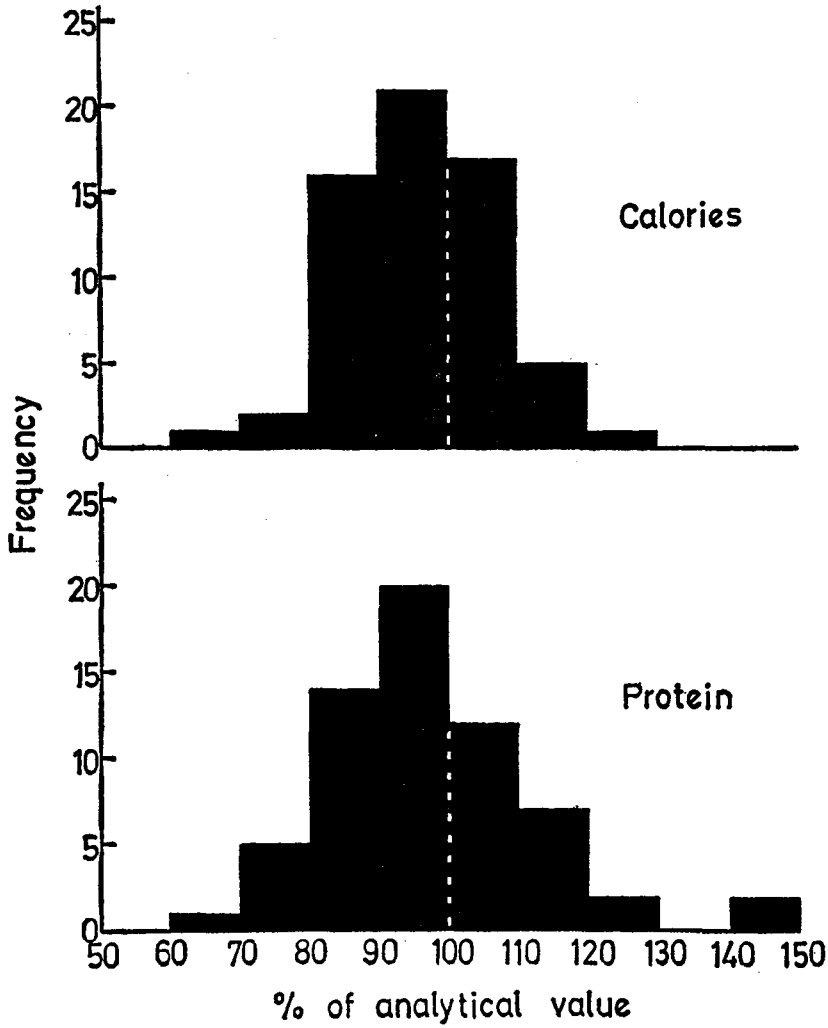

Fig. 1.—Frequency distribution of the calorie and protein contents of 63 meals calculated from food tables and expressed as a percentage of the actual composition found by chemical analysis.

It was thought likely that the largest deviations from the true composition would be due either to (a) a particular composite dish having a composition difficult to standardise, notably ackee and codfish, soups and codfish fritters, or to (b) a bad approximation having been made. The first possibility would explain two overestimates of protein content (141% and 127% of the analytical value), one involving codfish fritters and the second involving red pea soup, and three underestimates of protein content (66% and 78%) involving dumpling. No single explanation was found to account for the deviations in calorie value.

DISCUSSION

Chemical analysis of replicate meals is probably the most accurate method for assessing dietary intakes but it is not applicable in normal survey work and is only used under research conditions. Weighing the various food items eaten and calculating their composition from tables is a convenient and orthodox dietary survey method and a comparison of the two techniques has shown that for diets which were simple but did contain some composite dishes, the majority of the calorie and protein intakes calculated from tables were within 20% of the actual value. Deviations as great as 40%, however, were found and the tendency was to underestimate rather than to overestimate. It is important to note that the greatest discrepancies in relation to protein content were attributed to composite dishes, so that in this type of survey, in which no quantitative estimations of the ingredients of composite dishes are made, relatively large additional errors can be incurred compared with surveys in which weighing during preparation is performed.

The probability that one is likely to have errors of up to 20% even when objective measurements are employed must throw considerable doubt on the accuracy and usefulness of those dietary surveys which involve subjects describing their intakes from memory and expressing the amounts in terms of household measures. Such methods were found by Thomson (5) to underestimate the quantities by an average of 17% with a considerable number being at least 30% too low. To this may be added a further possible error of 20% for the

difference between the value calculated from food tables and the actual composition.

In conclusion one perhaps cannot emphasize too strongly that when undertaking dietary surveys the limitations of the various methods must be clearly appreciated and that this awareness should be evident both at the design stage and in the evaluation of results. There seems to be little alternative for investigators demanding an accuracy better than 20% but to undertake the time-consuming and laborious procedure of weighing ingredients during preparation, weighing the completed dish before and after cooking and then relating the portion eaten back to the raw ingredients.

RESUMEN

Métodos de encuestas: una comparación del contenido de calorías y proteínas en dietas rurales de Jamaica determinado por el uso de tablas de composición de alimentos y por análisis químico

Se estudió durante una semana el consumo de alimentos de nueve personas pesando los alimentos consumidos y calculando su contenido calórico y proteico a base de los datos de tablas de composición de alimentos. Al mismo tiempo se recolectaron porciones idénticas y se estableció el contenido calórico y proteico por análisis químico.

Los valores estimados a base de las tablas de composición de alimentos eran generalmente bajos, tanto en calorías como en proteínas, al compararlos con los resultados analíticos. La mayoría de los valores calculados (el 79%) estaban dentro del límite de 20% de los valores verdaderos en composición calórica y proteica, pero solamente el 23% variaba no más que 10% del valor verdadero correspondiente.

Los resultados de la investigación suscitaron gran duda sobre el valor del método de interrogatorio, en el cual los sujetos simplemente describen las cantidades de los alimentos consumidos. Se recomienda para el logro de una exactitud mayor que el 20%, pesar los alimentos durante la preparación y no simplemente a la hora del consumo.

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