

# INTAKE OF FOODS CONTAINING PROTEINS OF HIGH BIOLOGICAL VALUE IN FAMILIES OF LOW INCOME GROUPS IN SINGAPORE

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## INTRODUCTION

The importance of an adequate intake of protein is universally acknowledged. Recommended allowances of dietary protein are to be found in all textbooks on Nutrition. Although much has been recorded in many countries about levels of protein intake very little description has been given of patterns of protein intake. This is the case in Singapore. A great deal is assumed and loosely accepted about dietary patterns. Singapore presents singular attributes by virtue of its multi-racial population, and yet no records of patterns of intake of protein-rich foods by different ethnic groups seem to have been made.

The main purpose of the study reported here was:

- (i) to obtain information about the patterns of intake of proteins of high biological value by Chinese, Indian and Malay families of lower income levels, experiencing similar living conditions in a common area, and
- (ii) to assess the adequacy or otherwise of such intakes.

## METHODS AND MATERIALS

143 families of Malay, Chinese and Indian ethnic origin in Singapore formed the basis of the survey. These families resided in a slum area in Havelock Road, approximately 200,000 square feet, within the city limits, about a mile and a half from the General Post Office. The occupation of homes was such that all the Malays and all but one of the Indian families lived in the P.W.D. quarters situated towards the North East, while the Chinese families were scattered throughout the remaining area with very few residing in the P.W.D. quarters.

Three experienced field nutritionists in the Department of Social Medicine and Public Health of the University of Singapore conducted a house to house survey of this area, interviewing mothers with a prepared questionnaire. The

questionnaire was a very simple one, designed to elicit basic information about ethnic group, religion, age, sex and income. The questionnaire also listed twelve foods rich in proteins of high biological value. These foods are indicated in Table III. Questions asked by the field investigators brought out directly and indirectly answers of what was eaten in terms of the foods listed and how much was spent on these foods daily, weekly or periodically as the case may have been.

All the families living in the area were included in the survey.

The survey was carried out from 18 March 1968 to 21 March 1968.

## CHARACTERISTICS OF THE SAMPLE

The 143 families surveyed were made up of 896 persons of Indian, Chinese and Malay origin. Chinese families formed 81.8% of the families, the Indians 12.6% and the Malays 5.6%.

Table I gives the Sampling Proportions of the families and persons surveyed by ethnic group.

TABLE I  
FAMILIES AND PERSONS BY ETHNIC GROUP

Ethnic Group	Families	Sampling Proportions	Persons	Sampling Proportions
Chinese	117	81.8	726	81.0
Indian	18	12.6	108	11.8
Malay	8	5.6	64	7.2
TOTAL	143	100.0	896	100.0

From the questionnaire, the average income per family was obtained by dividing the total income of families in each ethnic group by the number of families in each group. The statements obtained on income are subject to indivi-

dual over- or understatement particularly when incomes are irregular or dependent on individual enterprise. The tendency to understatement would probably be present to a fair extent as generally interviewees are apt to feel that some financial aid may be the outcome of such surveys.

TABLE II  
AVERAGE INCOME AND FAMILY SIZE  
BY ETHNIC GROUP

Ethnic Group	Average Income	Family Size
Chinese	\$190.16	6.2
Indian	\$148.33	5.9
Malay	\$247.00	8.0

The average income for Malay families was higher than the Chinese mainly because in 6 of the 8 Malay families there was more than one wage earner, and in 2 families there were 3 wage earners.

## RESULTS

### I. Intake of Proteins

There was considerable difference in the kinds of protein-rich foods stated to be eaten by the three different groups. Sources of protein intake among Chinese showed the greatest variety, this ethnic group consuming all items tabled in the questionnaire. The Indians came next, some families consuming up to 10 of the 12 types of foods. The protein-rich foods not consumed by Indians were blood and kidney. The Malays showed least variation in intake of protein-rich foods, confining themselves to 6 of the 12 items listed.

#### *Histograms A, B, C. Mention Index of Proteins of High Biological Value by Ethnic Groups.*

Histograms A, B and C (Fig. 1) immediately give you the pattern of protein intake for the three ethnic groups, as it relates to the proteins listed in the questionnaire.

*Pork* ranked high with the Chinese, low with the Indians and on religious grounds was not eaten at all by the Malays. *Mutton* on the other hand was mentioned by all Indian families, and ranked 4th with the Malays with a 75% mention index and 9th with the Chinese with only a 4.3 mention index.

*Beef* showed some features worthy of note, with a mention index of 50 in Malay families, 11.1 in Indian families and 1.7 in Chinese. It is generally said that Chinese do not like beef and mutton, and the finding of 1.7% Chinese families consuming beef was consistent with this ob-

ervation. Low mention indices, 1.7 for beef and 4.3 for mutton in the Chinese were probably not due to cost, because pork is more expensive than either beef or mutton, and it seems likely that the Chinese in this study did not consume beef and mutton for some other reasons.

Attention must also be drawn to the low ranking of beef with Indians. This was probably due to the fact that 78% of the Indian families in this study were Hindus, to whom the cow is sacred and the consumption of beef prohibited on religious grounds.

The consumption of *duck* was mainly by the Chinese, and though this food is slightly cheaper than chicken, it costs about the same as mutton and beef, which were favoured by Indians and Malays. It would appear then, that Indians and Malays do not like ducks, again on some other grounds than that of cost.

The present enquiry did not give any indication as to the frequency of intake, the quantities of the different foods consumed, nor the distribution within the family. Although there was a high mention index for a number of foods which varied with ethnic groups, the number of protein-rich foods of high biological value consumed *daily* was confined to 4 in Chinese families, 3 in Indian families, and to 2 in the Malay families. This is shown in Table IV.

TABLE IV  
FOODS RICH IN PROTEINS OF HIGH  
BIOLOGICAL VALUE CONSUMED  
DAILY\* BY ETHNIC GROUPS

Protein Foods	Ethnic Group	Families Consuming these Foods Daily††		
		Chinese %	Indian %	Malay %
Fish		76.9	50.2	87.5
Milk		60.7	72.2	100.0
Eggs		15.4	16.7	—
Pork		46.2	—	—

\* Daily=7 days per week.

†† It is important to differentiate between "mention index" and daily. The mention index only states whether or not a protein is consumed. It does not indicate frequency of intake.

From Table IV, it can be seen that, *fish* in this sample was the main source of protein of high biological value consumed by all three ethnic groups. It is likely, considering the average incomes of the three groups that this food was favoured most because it is fairly cheap. There are variations in the price of fish, but small, nu-

TABLE III  
INTAKE OF PROTEINS OF HIGH BIOLOGICAL VALUE BY ETHNIC GROUP

Protein Foods	Ethnic Group	Chinese Total No. of Families 117			Indian Total No. of Families 18			Malay Total No. of Families 8		
		Families Consuming Proteins	Mention Index†	Ranking*	Families Consuming Proteins	Mention Index†	Ranking*	Families Consuming Proteins	Mention Index†	Ranking*
Pork		115	98.3	2	1	5.6	7	—	—	—
Beef		2	1.7	11	2	11.1	6	4	50	3
Mutton		5	4.3	9	18	100.0	1	6	75	2
Chicken		105	89.7	3	15	83.3	3	6	75	2
Duck		97	82.9	5	1	5.6	7	—	—	—
Fish		117	100.0	1	18	100.0	1	8	100.0	1
Milk		72	61.5	6	13	72.2	4	8	100.0	1
Eggs		101	86.3	4	16	88.9	2	1	12.5	4
Liver		37	31.6	8	5	27.8	5	—	—	—
Kidney		2	1.7	11	—	—	—	—	—	—
Brain		4	3.4	10	1	5.6	7	—	—	—
Blood		50	42.7	7	—	—	—	—	—	—

†The proportions of families mentioning each food as being consumed can be expressed as a "mention index" of that food.  
\* Ranking gives the "mention index" in descending order.

TABLE V  
PROTEIN-RICH FOODS CONSUMED  
"OFTEN"\*\*\*

Protein Foods	Ethnic Group	% of Families Consuming the Foods "Often"***		
		Chinese	Indian	Malay
Pork		13.7	—	—
Chicken		1.0	—	—
Fish		10.3	22.2	—
Milk		—	—	—
Eggs		9.4	—	—
Blood		1.7	—	—

\*\* Often = 4-6 times per week.

tritionally valuable fish can be obtained for as little as 30 cents a kati (equivalent to 1.33 lbs.).

Eggs were used daily only by a small proportion of the Chinese and Indian families, and the reason for this can be attributed to the relatively high cost of eggs to people of low incomes.

Milk was consumed daily by a large proportion of the families in all ethnic groups; it was probably mainly used for infants and toddlers, adults were consuming minimal amounts in tea or coffee. Sweetened condensed milk was used by 90.3% of all families consuming milk. 50% of Malay families who were consuming milk used full cream powdered milk, while only 5.6% of Chinese families and 8.5% of Indian families

who were consuming milk used full cream powdered milk.

Pork was a favourite meat with the Chinese with a mention index of 98.3 but it was eaten daily by only 47%. This was probably due to its expense.

Foods rich in proteins of high biological value taken "often" (defined as 4-6 times a week) are given in Table V.

From Table V, it can be seen that the Chinese were the only group which consumed a fairly wide variety of protein-rich foods often, and this added substantially to their protein intake taken "daily".

Chicken though eaten by all ethnic groups, and was mentioned by 89.7% Chinese families, 83.3% Indian families and 75% Malay families was eaten only sometimes† and rarely†† by all ethnic groups. The reason for the low consumption was probably due to the high cost of this food.

TABLE VI  
INTAKE OF CHICKEN BY ETHNIC GROUP AND FREQUENCY OF CONSUMPTION

Ethnic Group	Mention Index	Daily %	Often %	Sometimes %	Rarely %
Chinese	89.7	—	0.8	2.6	86.3
Indian	83.3	—	—	5.5	77.8
Malay	75.0	—	—	—	75.0

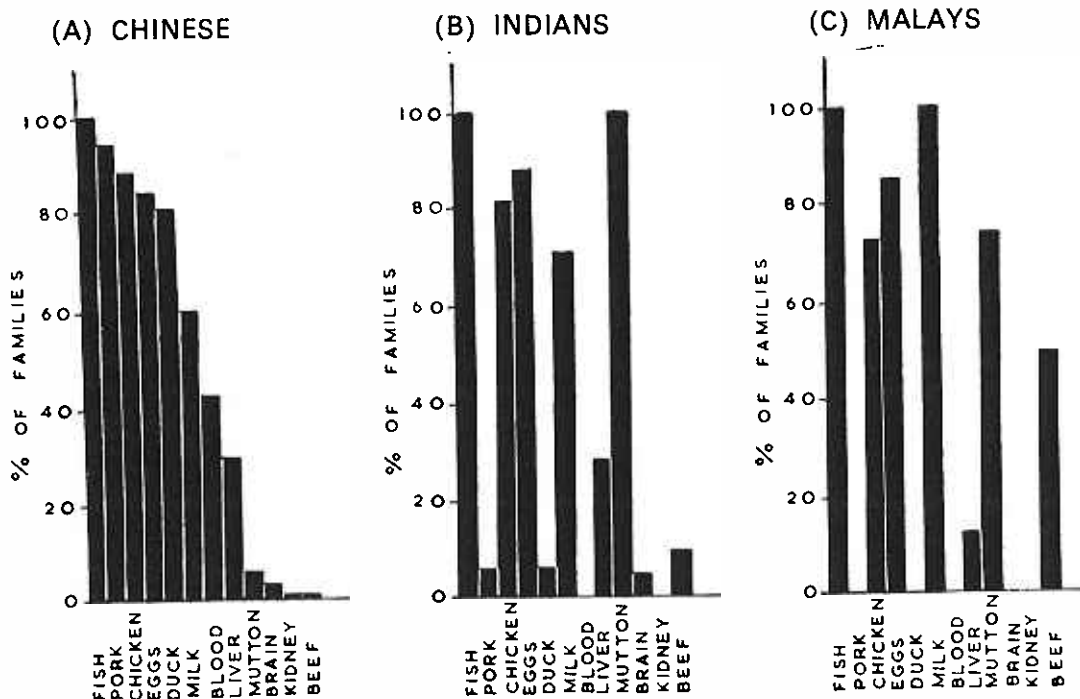


Fig. 1.

† Sometimes = 1-3 times per week.

†† Rarely = less than once a week.

*Liver* though mentioned by all three ethnic groups was consumed only rarely. *Kidney and Brain* were not consumed at all by the Malays. Brain was not consumed by the Indians, and kidney by only one Indian family in the "rarely" category. This applied also to both kidney and brain for the Chinese, and it is possible that the cost of these foods had a part to play in their low consumption by the Chinese families.

*Coagulated blood* is said to be commonly consumed by Chinese; it had a mention index of 42.7% in the Chinese families in this study. In fact it was not eaten very much with only 2 families or 4% eating it often, 6 families or 12% eating it sometimes, and 42 or 84% eating it rarely. It is not an expensive item, a pound costing about 20 cents. It would appear that the popular belief that blood is widely consumed by the Chinese is not substantiated by the present observations.

## II. Purchase of Protein-Rich Foods

From the questionnaires the following information was obtained on the amount of money spent per family per day on the main foods which were being studied. This is given in Table VII.

TABLE VII  
THE AVERAGE AMOUNT SPENT DAILY ON PROTEIN-RICH FOODS BY FAMILIES OF DIFFERENT ETHNIC GROUP

Food	Ethnic Group		
	Chinese	Indian	Malay
	cents	cents	cents
Fish	44.3	42.6	72.3
Pork	43.4	—	—
Milk	28.2	24.7	20.4
Eggs	20.7	17.0	15.3
Beef	—	—	10.3
Mutton	—	27.7	30.3
Duck	4.5	—	—
Chicken	6.8	24.1	23.3*
TOTAL	\$1:47.9 cts.	\$1:36.1 cts.	\$1:71.9 cts.

\*The wide variation in amounts spent on chicken by the Malays and Indians as compared with the Chinese requires clarification. Although most of the chicken eaten by the three groups was in the "rarely" category (see Table VI) with the Malays and Indians "rarely" was twice a month or approximately 24 times a year as salaries were received by P.W.D. employees fortnightly. With the Chinese families whose incomes may not have been so regular chicken was eaten mainly at festivals and this amounted to 3-4 times a year. Besides this, families in this group were vague about the consumption of chicken. The Malays and Indians on the other hand were quite definite about how much they ate.

The other foods listed were eaten so rarely, that it was not possible to calculate an average amount spent on them per family per day, and these items have been excluded from the calculation. Current market prices were used to calculate quantities of the protein-rich foods purchased and these are given in Table VIII.

TABLE VIII  
THE CURRENT AVERAGE COST OF FOODS LISTED IN TABLE VII

Protein Foods	Average Cost/Kati
	\$ cts.
Fish	.60
Pork	2.50
Beef	2.00
Mutton	1.90
Chicken	1.50 (unplucked)
Eggs	.10 each
Duck	1.30 (unplucked)
Milk (S.C.M.)	.50 (per tin—14 ozs.)

Note (i) Food costs vary from market to market. Food in rural markets generally costs less than that in urban markets. Small markets are usually cheaper than large ones.

(ii) The prices given above are averages. There is fairly wide range in some foods, e.g. a fish which can cost as little as 30 cents a kati and as much as \$1.60 (and even more) a kati.

### *Calculation of Intake of Proteins of High Biological Value.*

From the amount spent by each family on each of the foods listed in Table VII the weight of each bought daily was calculated. The amount of protein in each food was then estimated. This was done by using table on food values compiled by the Department of Social Medicine and Public Health. The values of proteins thus obtained was then divided by the average family size in each group to give the average intake per head

per day. It is important here to emphasise that this calculation is an approximation, and does not take into consideration variation in individual consumption nor does it consider variations that are present because of age and sex. As an approximation of average intake it allows a comparison to be made with values calculated on recommended dietary allowances, vide Table X infra, for the families in this study, taking into consideration age and sex, and then arriving at an average figure. This was done by ethnic group and the results are given in Table IX.

TABLE IX  
INTAKE OF PROTEIN-RICH FOODS PER FAMILY AND PER HEAD PER DAY BY ETHNIC GROUP

Protein Foods	Ethnic Group	Chinese	Indian	Malay
		grams	grams	grams
Fish		34.1	32.8	55.7
Pork		15.6	—	—
Milk		15.3	13.4	11.1
Eggs		15.0	12.3	11.1
Beef		—	—	5.1
Mutton		—	10.0	10.9
Duck		3.4	—	—
Chicken		5.0	12.2	11.8
		88.4	80.7	105.7
Average Family Size		6.2	5.9	8.0
Average Intake per head per day		13.1	13.7	13.2

It is possible that amounts were either overstated or understated, as does occur in surveys of this kind. The amount of fish eaten was likely to have been underestimated as the average price used in the calculation was 60 cents, and it is probable that cheaper fish was in fact purchased.

Applying the Institute of Medical Research (Kuala Lumpur) Tables on Recommended Dietary Allowances†, the protein allowances for each family was calculated taking into considera-

tion the age-sex structure. This was then divided by the average family size, and the average recommended allowances were then obtained per head per day and was compared with the intake of protein from the foods listed in the questionnaire given in Table IX. The results are given in Table X.

TABLE X  
A COMPARISON OF RECOMMENDED PROTEIN ALLOWANCES (I.M.R.) AND ACTUAL INTAKE

	Chinese	Malay	Indian
	grams	grams	grams
Recommended Protein Allowances per head per day (I.M.R. K.L.)	59.4	59.1	58.8
Intake of Protein from foods listed	13.1	13.7	13.2

#### Discussion on Intake of Protein of High Biological Value.

The protein intake given here does not represent either total protein intake or total intake of protein of high biological value, because there were, doubtless, a large number of foods containing proteins of high biological value not listed in the questionnaire; and estimations of total protein intake would have to take into consideration the protein content of cereals, legumes and vegetables. The present results show however that probably between  $\frac{1}{5}$ - $\frac{1}{4}$  of the daily intake of protein consisted of protein of high biological value; and the total intake of this class of protein would have been higher if more protein-rich foods had been listed.

Much work has been done in recent years on protein requirement in human diets and there is a considerable amount of evidence to show that adults can be maintained in nitrogen balance and in health on about 30-40 grams a day (e.g. Hegsted *et al*, 1946). Some authorities state that the critical level of protein intake is 0.35 G/kg. body weight per day (Brock, 1961; Yoshimura, 1960) and that below this, signs of protein deficiency appear. Hegsted (1946) also stated that the hu-

† These tables give Recommended Daily Allowances, based on the U.S. National Research Council's recommendations, adjusted for people living in this region.

man can exist in perfectly good health on intakes of 45-50% of Recommended Allowances and if this is applied to the Recommended Allowances used in Table X, the protein requirements for each group in the study will be as shown in Table XI.

Hegsted *et al* (1946) have also shown that the total amount of protein intake can be further reduced from 30-40 grams by 17% to 25-35 grams per day if  $\frac{1}{3}$  of the intake contains proteins of high biological value.

In this study, taking 50% of Recommended Allowances of protein, the intake of proteins of high biological value was 44.1%, 46.3% and 44.9% for the Chinese, Indians and Malays respectively and this is more than the 33.3% advocated by Hegsted for proteins of high biological value.

DISCUSSION

This study dealt with low income families of Chinese, Malay and Indian ethnic origin. It listed 12 foods rich in protein of high biological value which are in common use in Singapore. It was not an exhaustive list, for there are many other foods containing protein of high biological value that were omitted. Then too, certain items related particularly to one ethnic group, for example the blood of pigs and poultry is peculiar to Chinese diets and pork commonly seen at Chinese tables, is taboo to the Malays on religious grounds. Similarly while Indians do eat beef, it is prohibited to Hindus. Religious taboos, though not a specific area of the inquiry accounted for some of the differences in the intake patterns of the groups surveyed.

It is apparent that because of income, fish, being the cheapest source of protein, was most

commonly eaten daily by the three groups. It was probable that higher intake of protein-rich foods like chicken and eggs was limited by cost.

It would appear, using more recent pronouncements on protein intake, that in the families studied there was sufficient protein intake of high biological value. As stated earlier it is likely that, because the list of protein-rich foods in the questionnaire was not complete, the actual intake of proteins of high biological value could in fact have been higher.

It must also be remembered that the average cost of fish was taken to be 60 cents but it is more than likely that cheaper fish and therefore more fish for money actually spent, was consumed than estimated.

This study made no attempt to discover whether total protein intakes were adequate. Observations were made of patterns of intake of certain protein-rich foods and the results suggest that these intakes on a family basis appeared to be within the limits of those most recently advocated by nutritionists.

SUMMARY

A study of patterns of intake of foods containing proteins of high biological value by 143 low-income families of Chinese, Indian and Malay origin, in a slum area in Singapore showed that the Chinese consumed the largest variety of such foods, and Malays the smallest.

Differences in the kinds of the foods eaten was clearly seen in the three groups and while fish was the commonest one consumed by all groups, the Chinese did not show any particular liking for beef and mutton as compared with the Malay (both) and Indians (mutton only) and this was

TABLE XI  
COMPARISON OF 50% RECOMMENDED ALLOWANCES WITH ACTUAL INTAKE OF PROTEIN FROM FOODS LISTED

	Chinese	Indian	Malay
	grams	grams	grams
Recommended Allowances (I.M.R.)	59.4	59.1	58.8
50% Recommended Allowances (Hegsted Harvard 1946)	29.7	29.6	29.4
Actual Intake	13.1	13.7	13.2
Actual Intake of Protein of High Biological Value as % of 50% Recommended Allowances	44.1	46.3	44.9

possibly due to some factors other than cost. A common belief that coagulated blood is widely consumed by Chinese was not sustained by the results of this study. Duck was eaten mainly by the Chinese, the Malays not consuming it at all, and only one Indian family consuming it rarely. Malays showed a preference for full cream powdered milk while both Chinese and Indians appeared to prefer sweetened condensed milk.

Cost may have played a part in the low consumption of many of the protein-rich foods in this study.

Approximate calculations showed that average intake of proteins of high biological value per family, appeared to be within the limits of more recent recommendations on protein intake.

#### ACKNOWLEDGEMENTS

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