



2.4. DAILY DIETARY INTAKE

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Introduction

The knowledge of the daily dietary intake pattern of a population group living in a region is important from the viewpoint of strengthening national and regional radiation protection programmes. Information is required on different dietary components such as principal nutrients (carbohydrates, proteins, energy), micro nutrients (including trace elemental intake) and intakes of different items of diet such as, cereals, pulses, vegetables, flesh foods, fruits, etc. These data are required in radiation protection in the event of an accidental or planned release of radioactivity (nuclear waste disposal) during different nuclear operations when ingestion as well as inhalation could become a source of radioactivity exposure. In such circumstances, there is a need to identify the potential radioactivity carriers, in order to make relevant decisions for controlling radioactive exposure to humans through food.

The dietary data on the intake of important trace elements such as Cs, I, H, Th, U, etc. along with their tissue concentrations could provide valuable information on relevant metabolic parameters such as the biological half-life ($t_{b1/2}$), gut absorption factor (f_1) and tissue retention factors (f_2) which are important in internal dose assessment.

As part of study on "Reference Asian Man" to strengthen radiation protection, the data on the dietary consumption patterns of the Asian region were collected. Eight provided dietary data - Bangladesh, China, India, Indonesia, Japan, Pakistan, Philippines, and Viet Nam. Whereas the dietary data from Bangladesh, Indonesia, Pakistan and Viet Nam are preliminary in nature, the dietary information from China, India, Japan and Philippines, on the other hand, is quite substantial. The population of the countries from which sufficient dietary data are available represents more than 2/3 of the population of the Asian region. The details of the individual data available on dietary parameters from different Asian countries are listed below.

Bangladesh

The daily dietary consumption of different kinds of food stuff such as cereals, pulses, vegetables, fruits, flesh food and milk, etc. have been reported for different age groups of the Bangladesh population. The age groups covered are 0, 1, 5, 10, 15y and adult. Among the adult population, two different age groups, 20-50y and above 50y, are included in the study. Until 10 years of age, only the combined population has been considered, whereas for 15y and adult age groups, both male and female populations are included in the dietary study. The daily dietary elemental intake is also estimated for different age groups through the determination of the concentration of trace elements in 10 different food items of daily consumption.

The daily dietary consumption of individual food items such as cereals, pulses (legumes), potatoes (starch), sugars, fat and oil, fruits, flesh foods, milk and water for different age groups are presented in the country report. As to be expected, for the newborns, the only intake is about 400 ml of milk and 15 g of sugar. Milk consumption declines steadily with increasing age, whereas the consumption of cereals, pulses, vegetables and flesh foods increases with increasing age. Except for the newborns, the main source of energy (Calories) for the Bangladesh population is the cereals diet.

The daily intake of seven elements (K, Ca, Mn, Fe, Cu, Zn and Sr) is estimated through the determination of their concentrations in different food items including cereal, pulses, vegetables, milk, flesh food, etc. The highest concentrations for most of the elements is in pulses and the minimum is in drinking water. The daily intake of all 7 elements shows a steady increase with age. The intake by the female population is consistently lower in all three age groups for which data are available.

China

A substantial amount of data are reported from China on different dietary parameters including: (1) the daily dietary consumption of different kinds of food stuff by Chinese population groups from different regions and belonging to different age groups; (2) intake of principal nutrients such as carbohydrate, protein, fat, alcohol, etc. along with the energy provided by these sources; (3) daily elemental intake by the adult Chinese population; (4) data on the daily dietary intake of 17 radionuclides. A comparison of the daily intake of important dietary components in two different periods (1982 and 1990) is also reported for Chinese population. Most of the reported data are for adults, however, some data from 1982 on the consumption of different foods are also reported for three groups of younger Chinese population.

A notable feature of the daily consumption of different food stuffs is the substantial consumption of vegetables and fruits and extremely low consumption of milk by the Chinese adults. It is clear that, in place of the consumption of potatoes as the starch source, the Chinese consume large quantities of yams. As compared to the consumption of flesh foods by other Asian countries like India, Bangladesh and Pakistan, the consumption of flesh foods by the Chinese population is much higher. The main source of energy for the Chinese is also the cereal diet. Along with rice the Chinese population consumes an equal amount of wheat.

The daily dietary intake of major (C, H, O, N, S) and other elements has been reported. A comparison of the dietary intake of 30 elements as estimated in various surveys conducted during the years 1982, 1985, 1986 and 1990 is also presented. When the dietary elemental intake by the Chinese (1990 survey) population is compared with the ICRP data, a significant difference in the intake of most of the elements is observed.

The intake of 17 radionuclides by Chinese adults and the percentage contribution of different food items and water to the intake of these radionuclides by the Chinese population is also presented.

In summary, cereals and vegetables were the main food and sources of energy for the Chinese. The daily intake of radionuclides is reported only for the Chinese population among the Asian countries.

India

The daily intake of principal nutrients for the rural and urban Indian population and weighted mean national consumption values have been determined. The data are reported in consumption unit (CU), which is the coefficient for computing the calorie requirement for different groups of population indulging in sedentary, moderate or heavy work. CU value for sedentary male workers is taken as 1.0 and that for moderate and heavy workers is 1.2 and 1.6, respectively.

The daily intakes of various food components such as cereals, pulses, vegetables, fruits, flesh foods and milk, etc. are reported for rural and populations urban as well as the national average consumption.

The per capita protein and energy intake for the age groups 1, 2, 5 and 12 y are reported for the combined (male and female) population groups whereas for the population in 13-16y, 16-18 y and adult age groups, the data are reported for both male and female subjects. The average consumption of various food items by the Indian population in the age groups 1, 2, 5, 12 and 15 y shows that the consumption of various food items increases with age. The energy supply received by the Indian population in different age groups from different food items indicates that the major supply of energy (85-92%) is received from the consumption of cereals, pulses and milk.

The average intake of 14 minor and trace elements by the Indian population in the age groups 2, 5, 12, 15 and adult was estimated by the elemental analysis of the individual food items using the technique of neutron activation analysis (NAA) and atomic absorption spectrophotometry (AAS). The elemental concentrations of the individual food items along with the average quantity of food items consumed by the different age groups of the population were used to arrive at the daily elemental intake. The elemental intakes increase with age. However, intakes at 15 y are quite similar to intakes by the adult population.

The intakes of a few more elements were also determined through the analysis of the duplicate diet. The intakes of these elements, namely, Th, U and I, were obtained only for the adult population.

Indonesia

From Indonesia, very limited data, based on an equally smaller size survey, has been reported on the dietary intakes of the Indonesian population for the age groups 1-3, 4-6, 7-9, 10-12, 20-39, 40-59 y and >60 y. It is clear that the consumption patterns are quite different in the three regions reported in the study. The elemental concentrations for eight elements in the common food stuffs consumed in Indonesia are also presented. Since the data available from Indonesia is limited and based on a smaller survey size, it could well be termed as preliminary in nature and could be only of information value.

Japan

The daily dietary intake of principal nutrients such as energy, protein, fat and the micro nutrients (trace elements) along with the daily consumption pattern of different food items is reported from Japan. The daily dietary intake of 15 minor and trace elements is also reported for the adult Japanese population. The average intake of different food items consumed by the Japanese population, on a per capita basis between the years 1975 and 1985, is presented. It is interesting to note that the average consumption of fruits and vegetables is quite high and so is the case with the consumption of flesh foods.

The daily average intakes of some of the principal nutrients per capita for the 12y period between 1973 to 1984 are reported for carbohydrate, protein (both animal and total), fat and oil, energy and a few vitamins and mineral elements. The breakdown of the contributions of different food items to the total energy supply to the Japanese population shows that about 50% of the total energy is derived from cereals and a significant amount of energy is also contributed by the flesh foods and sugar.

The intake of 15 elements for the adult Japanese population has been measured. The highest daily dietary intake is of sodium (Na), an essential element for humans and the lowest for yttrium (Y), which is non-essential and therefore non-consequential to the human system. A comparison between the Japanese and ICRP data clearly shows the elemental intake for Japanese is in general lower than that for ICRP Reference Man.

Detailed information is available on most of the dietary aspects of the Japanese population, including the daily intake of food items, the intake of principal nutrients, the main sources of energy available from diet and also the average elemental intakes.

Pakistan

Data are reported from the Pakistan population on the different kinds of food items consumed daily by the Pakistan population and the percentage of calories provided by the consumption of each of these food items. The average daily intake of the different food items by the rural and urban national average along with the typical food intake in two cosmopolitan big cities of Pakistan are also reported. The calories provided by the consumption of individual food items in different regions of Pakistan are reported along with the other data.

99% of the adult population consumes cereals whereas only 61% of the children in 2-5y age group consume cereals. Only about 40% of the population in different age groups consumes milk. Similar data on consumption of pulses, meats, eggs, fish, oil, vegetables, etc. are presented.

The average regional consumption of different food items by the adult Pakistani population has been measured. The 150 g of the daily consumption of tea seems to be high. The consumption of cereals by the inhabitants of the bigger cities is much lower than that of the rural population. The maximum calories to the daily energy intake are provided by cereals followed by those through oil, sugar and milk.

The calorie intake in Pakistan by the male, female and other age groups of the Pakistan population indicates that the actual intake is marginally lower than the recommended values, with the exception of adult females and 1-2y age group, where the calorie intake is commensurate with the requirements.

Philippines

The dietary data based on a small but systematic survey is reported on the Filipino population from Philippines. The results are reported for the daily dietary intake of food items and the daily elemental intake for both the male and female populations of Philippines. Daily dietary intakes of food items such as cereals, pulses, nuts, potatoes, fat and oil, fruits, etc. are reported both for the male and female population. A noteworthy feature of the report is a very low daily energy consumption of 1614 Kcal by the Filipino population.

The daily dietary intake of 10 elements by the adult male and female Filipino population has been measured. The average elemental intake of the female population is in general lower than that for the male population. An interesting feature of the data is the very low consumption of Cu and I by the Filipino population.

Viet Nam

The daily intake of different food items by the adult Viet Nameese population living in different regions of urban and rural areas of Viet Nam, along with the country averages, are reported from Viet Nam. The average contribution of energy provided by different food items to the daily calorie intake are also reported.

The average food consumption data for presented Viet Nam (1990-1991) includes the intake of rice, potatoes, sugar, oils, vegetables, fruits, flesh foods, etc. The consumption of oil seeds by the Viet Nameese is quite low. The staple food of the population is rice.

Measurement of the average daily intake of principal nutrients such as energy, protein, fat, carbohydrate, minerals along with the percentage contributed by the individual food

material to the daily energy intake shows that the main contribution of energy, as usual, comes from glucids (carbohydrates), followed by that from protein.

GENERAL DIETARY INTAKE PATTERNS

Intake of principal nutrients

The principal nutrients include carbohydrates, protein, fat and total energy. The intake pattern of principal nutrients reported from China, India, Japan, Philippines and Viet Nam is summarized in Table 1. The intake of carbohydrates ranges between 320-405 g, whereas that by protein is in the range of 54.5-87 g.d⁻¹. There is large variation in the intakes of fat, being lowest at 15.8 g for Viet Nam and highest for Japan 56.2 g. The variation is by a factor of about 3.5. The energy intake varies from 1614 to 2739 kcal, whereas that of Ca and Fe is 400-582 mg and 9.8-22.7 g, respectively. In comparison to the ICRP data, the intake of carbohydrates and iron is comparable, whereas the intake of the other principal nutrients in the reporting Asian countries is lower. The comparison shown is for the male population only. The comparison for the female population groups with ICRP data shows similar patterns as in the case of the male population.

Intake of dietary food items

The data on intake of daily dietary food items such as cereals, pulses, milk, oils, fruits, vegetables, etc. are available from Bangladesh, India, China, Japan, Philippines, Pakistan and Viet Nam. For a few of these countries, the data are available for adult as well as younger groups of the population, whereas in other countries, the data are available only for the adult population. A comparison is shown in Table 2.

The comparison of the dietary patterns of the different Asian countries clearly shows that in spite of the close geographical proximity of the Asian countries, there are significant differences in the dietary patterns of the Asian population. Although the staple diet of the Asian population is rice, the population of countries like India, China and Pakistan consume significant amounts of wheat. There are very large variations in the consumption of flesh foods (range 12-172 g), milk (0.4-161 ml) and fruits (20-164.9 g) in different Asian countries. Again, in China, yam is consumed as an alternate to potatoes. The consumption of most of the food items is lower in Asian countries when compared with the intake for USA diets which are more representative of ICRP Reference Man. The consumption of milk is notably lower among different population groups in Asia.

Daily elemental intake

India, China, Japan, Bangladesh, and Philippines have provided data on the daily dietary intakes of a number of elements. A comparison of the estimates of dietary elemental intakes of elements by the adult populations in Table 3 shows significant variations in the elemental intakes by the population groups in different Asian countries. The variation at times is by a factor of more than two.

TABLE I. INTAKE OF PRINCIPAL NUTRIENTS BY ASIAN POPULATIONS

Country	Daily dietary intake					
	Carbohydrate (g)	Protein (g)	Fat (g)	Energy ^a (KCal)	Ca (g)	Fe (mg)
China ^b	366.	64.0	51.2	2203.	0.58	22.7
India ^b	405.	54.5	29.0	2040.	0.40	19.0
Japan ^c	320.	87.0	56.2	2739.	0.55	11.3
Philippines ^b	-	-	-	1614.	0.50	11.6
Viet Nam ^c	376.	59.7	15.8	1932.	0.55	9.8
Range	320. - 405.	54.5 - 87.7	15.8 - 56.2	1614. - 2739.	0.40 - 0.58	9.8 - 22.7
ICRP	390.	95.	120.	3000.	1.1	16.0

a. Indirectly determined based on assumed calorie content of food item intake

b. Daily intake values - per adult

c. Daily intake values - per Caput

TABLE II. DAILY DIETARY INTAKE OF SELECTED FOOD ITEMS

Food Item (g)	Bangladesh	China	India	Indonesia	Japan	Pakistan	Philippines	Viet Nam	Range	ICRP
Cereal	520.	461.	469.	171.	322.	502.	391.	462.	50.2 - 520.	207.
Pulses	120.	39.5	35.	114.	69.	43.	91.	-	35. - 114.	-
Flesh	54.	72.	12.	115.	161.	39.	172.	85.	12. - 172.	228.
Eggs	5.	11.	-	46.	41.	7.	31.	2.	2. - 46.	47.
Vegetables										
Total	150.	324.	65.	75.	260.	91.	143.	183.	65. - 324.	202.
Green	-	-	20.	-	59.	10.	59.	-	-	-
Other	-	-	-	-	-	-	105.	-	-	-
Fruits	20.	101.	20.	156.	165.	8.	113.	2.6	2.6 - 165.	184.
Milk	20.	11.	100.	147.	114.	161.	9.	-	9. - 147.	508.
Oil/Fat	6.	31.	15.	29.	18.	33.	22.	25.	6. - 33.	49.
Sugars	10.	3.	29.	36.	13.	39.	64.	1.	1. - 64.	
Basis for daily intake values	Per adult	Per adult	Per adult	Unspecified	Per Caput	Unspecified	Unspecified	Per Caput		
Sampling basis for values	National Diet sampling	National Food basket	National Food basket	Unspecified	National Diet sampling	Unspecified	Unspecified	National Food basket		

TABLE III. DAILY DIETARY ELEMENTAL INTAKE OF ASIAN POPULATIONS

Country	Daily Elemental Intake									
	K (g)	Na (g)	Ca (g)	Mg (g)	Fe (mg)	Zn (mg)	Cu (mg)	Mn (mg)	Cr (mg)	Sr (mg)
Bangladesh ^a	1.46	-	0.45	-	12.5	13.7	2.2	8.6	-	1.3
China ^a	1.12	3.75	0.58	0.28	22.7	9.8	4.8	5.9	0.48	1.5
India ^a	1.80	5.90	0.40	0.50	19.0	10.3	2.2	5.1	0.13	-
Japan ^c	2.00	4.70	0.58	0.21	12.0	7.7	1.3	4.0	0.18	2.3
Philippines ^b	0.82	1.57	0.50	0.31	11.6	10.9	0.6	3.7	-	-
Range	0.82 - 2.20	1.57- 5.90	0.40 - 0.58	0.21 - 0.50	11.6 - 22.7	7.7 - 13.7	0.6 - 4.8	3.7 - 8.6	0.13 - 0.48	1.3 - 2.3
ICRP	3.3	4.4	1.1	0.34	16.0	13.0	3.5	3.7	0.15	1.9

a. Daily intake values - per adult

b. Daily intake values - method unspecified

c. Daily intake values - per Caput

SUMMARY AND CONCLUSIONS

1. The dietary intake of principal nutrients such as carbohydrates, fat, protein, energy, along with the data on the daily intakes of different food items and the elemental intake, is available from Bangladesh, China, India, Indonesia, Japan, Philippines, Pakistan and Viet Nam.
2. Substantial dietary data are reported from China, Japan, India and Philippines. The limited data available from Bangladesh, Pakistan, Indonesia and Viet Nam provide useful information on the possible variations in the dietary intakes of food items among the Asian population belonging to different countries.
3. The dietary intake pattern of different Asian countries is quite different in certain respects in spite of the close geographical proximity of these countries. A typical example is of very low milk intake in China, Philippines and Viet Nam. On the other hand, the daily intake of flesh foods by the Indian population is very small.
4. The daily elemental intake by the population in different countries varies by a factor of more than two. In general, the elemental intake of the Asian population is lower than ICRP data. But for a few elements such as Fe, Sr, etc. the intake is comparable to the ICRP elemental intake data.

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