INTERIM* REPORT

Dietary Study of Australians Consuming Significant Quantities of Fish Products.

*Considered by EO/TA to be the final report.

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OF

DIETARY STUDY OF AUSTRALIAN CONSUMING SIGNIFICANT AMOUNTS OF FISH PRODUCTS

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The major objective of this study is to provide detailed dietary data on fish products* consumption by individuals eating significant quantities of these foods and to relate that consumption to levels of total mercury, estimated in hair and blood samples of the participant.

BACKGROUND

Mercury is one of the naturally occurring elements and since it is ubiquitous, it is to be expected that trace amounts can be found in all foods. In recent years two major sources of human intoxication with mercury have been reported - the consumption of seed grain, treated with organic mercury fungicides (1,2) and the consumption of fish and shell-fish from aquatic environments in Japan, contaminated with mercury from certain industrial operations (3,4). The primary form of mercury in the fish and shell-fish which were the principal factors in the cases of poisoning in Japan (Minamata disease) was methylmercury.

As a result of a number of major episodes of mercury poisoning, which led to deaths and disablement, many countries have carried out studies to monitor their own situations with respect to contamination of their food supply by mercury and the likely exposure of the population to this element. The Expert Consultation on the Joint FAO/WHO Food Contaminant Monitoring Program (5) in 1974, recommended that mercury in fish and other edible aquatic organisms be given priority in any evaluation program, together with other heavy metals, organochlorine compounds and mycotoxins. The study on which this interim report is based is part of a monitoring program to establish if Australians are at risk from methylmercury ingestion, resulting from the consumption of significant quantities of fish products.

Mercury in Food

For the great majority of the population, the most important site of entry of mercury compounds, particularly methylmercury, to the body is the alimentary tract. Exposure to elemental mercury and inorganic mercury through food is not as hazardous as exposure to organic mercurial compounds. Not more than 0.01 per cent of metallic mercury is absorbed by the alimentary tract, while inorganic salts are absorbed to a greater extent (about 15 per cent) (6). It has been estimated that, due to the low rate of absorption in the body, a daily intake of 1.0 mg of elemental mercury or inorganic salts of mercury appears safe (7). More than 99.9 per cent of ingested elemental mercury and about 85.97 per cent of ingested inorganic compounds of mercury are excreted within a few days, mainly in the faeces.

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* Fish products is the term used throughout this paper to refer to fresh water and seafish crustaceans and molluscs, whether they be used fresh or in frozen, canned, cured, smoked or otherwise prepared forms.

The absorption of organic mercury compounds is considered to be high, but quantitative data for humans is available only for methylmercury, which when given in small quantities is almost completely absorbed from the gastro-intestinal tract. Alkylmercury compounds are excreted slowly. Biologic half-life of methyl mercury has been estimated to range from 58-87 days in four subjects (8).

A number of countries have undertaken monitoring programs to determine levels of mercury in foods. In the United Kingdom, it was established that the mean level of mercury found in cereals, most fresh meat, fruits and preserves, green and root vegetables was 0.005 p.p.m. (fresh weight). Higher levels were found in canned fish e.g. in salmon, herrings, pilchards, sardines and mackerel, where the overall mean value was about 0.02 ppm; in pig's kidney and liver, for which means of 0.05 ppm and 0.03 ppm respectively were found in different types. Higher levels were found in canned tuna (0.07-0.44 ppm); in canned shellfish (0.01-0.29); and in the other fish (0.03-1.6 depending on the area from which the fish was taken and the species) (6).

Levels of total mercury in a range of Australian foods have been established in the yearly Market Basket Survey, which is conducted by the Commonwealth Department of Health to measure the level of contaminants in the food supply. The 1970 market basket survey (9) found that in no case did the mercury residue in any food groups from any city exceed 0.03 mg/kg during any season. Fish were included in a meat, fish and poultry group for analysis. The 1973 survey (10) reported that all fish samples contained more than 0.1 mg/kg, with two samples of a total of 24 being above 0.5 mg/kg. The greatest value found was 1.05 mg/kg. In other food groups examined, no samples exceeded 0.03 mg/kg. In the 1974 survey (11), the two groups analysed for mercury were fish and eggs and offal. Six of a total of 24 fish samples were above 0.5 mg/kg (greatest value 0.755 mg/kg). In the eggs and offal group none of the samples exceeded 0.03 mg/kg the greatest value being 0.005 mg/kg.

The 1975 survey (12), examined levels of total mercury (i.e. inorganic and organic forms) in fish and shellfish (oysters), four varieties of meat, eggs and lambs fry. The limit of detection for the results reported in Table 1 is 0.005 mg/kg.

TABLE 1 - Mercury in individual foods

Food	Number of samples	Mean(a) (mg/kg)	Range (mg/kg)
Fish	24	0.15	0.005 - 0.34
Shellfish	13(b)	0.03	0.005 - 0.11
Chicken	24	0.02	0.005 - 0.07
Mutton chops	24	0.01	0.005 - 0.08
Pork chops	23	0.03	0.005 - 0.20
Minced steak	24	0.01	0.005 - 0.06
Eggs	24	0.01	0.005 - 0.02
Lambs Fry	21	0.02	0.005 - 0.05

(a) 0.005 was taken to equal 0.0025 in calculating the mean.

(b) includes three samples of canned shellfish.

Analysis of variance shows the difference between foods to be highly significant, with the mean mercury level markedly higher in fish.

In the case of foods other than fish and shellfish, Table 2 shows the number of samples which exceeded 0.03 mg/kg.

TABLE 2 - Mercury Level in Foods (other than seafood) exceeding 0.03 mg/kg

Food	Number of samples $\geq$ 0.03	Total number of samples
Chicken	6	24
Mutton chops	2	24
Pork chops	5	23
Minced steak	2	24
Eggs	0	24
Lambs fry	4	21

The National Health and Medical Research Council in the Standard for Metals in Food (13) has recommended the following maximum levels:

Mercury in fish, crustaceans, molluscs, the fish content of fish products and the fish content of canned fish.	0.5 mg/kg (0.5 ppm)
Mercury in any other food	0.03 mg/kg (0.03 ppm)

In the case of meats it is apparent that in each case some samples were above the maximum recommended limit, up to a maximum of 25 per cent of chicken samples. The results for beef and mutton were comparable with the much larger Australian survey undertaken by the Department of Primary Industry (14). In this survey, 34 (9.9 per cent) of a total of 345 beef samples were above 0.03 mg/kg and 5 (6.4 per cent) of a total of 78 mutton samples were above the limit.

In the 1975 survey, the levels of mercury found in fish and shellfish were all below 0.5 mg/kg, in contrast to results reported in previous surveys.

A number of State Departments of Fisheries and Wildlife (15,15A) and the C.S.I.R.O. Division of Fisheries and Oceanography have carried out extensive analyses of mercury concentrations in various species of fish, crustaceans and molluscs. As to be expected, a wide range of values was recorded, depending on the species, length of fish and the area from which the fish was taken. Some of these reported values for mercury, especially in school shark, were far in excess of the limit that has now been set by the National Health and Medical Research Council.

It is now accepted, as a result of monitoring programs both in Australia and overseas countries, that fish products are the only foods likely to contribute significant quantities of mercury to the diet. In addition, it has been established that usually about 90 per cent of total mercury in fish is present in the methyl form. For shellfish, the proportion has been found to be variable, 40-90 per cent being present as methylmercury.

Selected Studies on Fish Intake and Mercury Toxicity

Besides establishing, the concentration of a contaminant in food, data is also required on the amount of a specific food or foods consumed by the population to quantify the intake of that contaminant for the population as a whole or for selected population groups within a country. Data on the mean consumption per head can be obtained from official statistics. The most recent figures available for annual fish consumption per head of population in Australia are given below in Table 3 (16).

TABLE 3 - Apparent Consumption of Fish Products
(kg per head per year)

	1974/75	1975/76
Fresh and frozen (edible weight)		
Fish		
Australian	1.2	1.8
Imported	1.6	1.7
Crustaceans and molluscs	0.6	1.0
Canned		
Australian	0.7	0.7
Imported	1.1	0.6
Cured (cured weight)	0.9	0.9
TOTAL:	6.1	6.7

These statistics indicate that 18.4 g fish products are available per head of population per day, corresponding to approximately one fish meal per person per week. The use of such statistics has appreciable deficiencies. For example, the mean consumption per head does not give any idea of variations in consumption in the population. Dietary studies have been carried out in a number of countries to establish more detailed data both on actual fish consumption of the general population or selected groups within that population. Details of a number of these studies are given below.

Sweden The most extensive investigations have been conducted in Sweden.

Tuolja (17) carried out two investigations of fish consumption in 16 families in the inland and mountain districts of Sweden who were supporting themselves by means of forestry with fishing and farming. They were families who could be expected to have a specially high consumption of fish. The amount of fish consumed was recorded for one year. On an average, fish was eaten 206 (90-341) days a year. Quantities were recorded as gutted fish. During the days that fish was consumed the mean amount was 0.31 per kg per head per day. Whitefish and char were the main species consumed. The author emphasises that the figures are higher than average for the population of the relevent areas. They show however, how large consumption can be in extreme cases.

The Swedish National Institute of Public Health (18) in 1967, carried out a survey by questionnaire, sent by mail on fish consumption habits. The investigation comprised (excluding non-response of about 20 per cent), 177 of the approximately 700 full-time fresh-water fishermen in Sweden, 179 saltwater fishermen and a random sample of 375 nationally representative males between the ages of 16 and 67 years.

The medium fish consumption among freshwater fisherman was about 15 kg per year - 23 per cent ate 36 kg or more per year. The medium consumption among salt water fishermen was about 30 kg per year, whereas 39 per cent ate more than 36 kg per year. In the national sample, consumption was 11-15 kg per year and 10 per cent ate more than about 23 kg per year. The questions were formulated in the questionnaire in such a way that answers were obtained concerning the frequency of consumption and size of the portions prepared. In the investigation, it was also asked where the fish most frequently eaten were caught.

One hundred and four men randomly selected from the investigated national sample were subsequently interviewed in their homes to furnish more reliable information on amounts of fish consumed, fish consumption pattern of the rest of the family, etc. In order to estimate the consumption of fish, models of fish were used. On account of the limited size of the random sample, great care should be taken when drawing conclusion with regard to the population as a whole. The median fish consumption was about 18 kg per year.

A market analysis was carried out in 1969 by Omnibus Research AB on behalf of the Swedish Fish Economic Association. The analysis comprised 2013 households representing about 2.7 million households. The non-response was 14 per cent. It was reported that:-

69% of households ate fish 1-2 times a week
26% of households ate fish 3-6 times a week.

In no case was daily consumption reported. In 9 per cent, a large part of the fish consumption was covered by the household's own fishing and in 3 per cent a very large part.

On the basis of the data obtained in the interviewing of 104 men selected from the national sample, in 1967, exposure to methylmercury was estimated. The consumption of fish was classified according to waters in which the fish had different degrees of mercury contamination. On the basis of the following factors:-

(1) consumed amount of flesh of different species of fish;

(2) the catch sites;

(3) the available data on the mercury level of the fish,

the exposure to mercury could be estimated for the persons investigated. Three persons were exposed to 8,400 µg per year or more. The medium dose per year was about 1600 µg mercury corresponding to 4-5 µg per day. Thus the mercury exposure due to fish alone was of about the same magnitude as the exposure from the rest of the diet.

Tejning (20) studied the mercury content of blood and hair of individuals consuming large quantities of fish, containing mostly 0.5 - 1.0 mg/kg mercury. The actual intake of fish was not accurately assessed, but even the consumption of three meals of fish per day produced no symptoms. The average consumption of fish was 3.1 ± 0.1 meals per week and the mean concentration of mercury in pike, the principal species was 0.87 ± 0.05 mg/kg, which was considered representative of the other species in the diet.

Tejning estimated the average meal of fish to be about 150 g, with an average mercury content of 0.13 mg, i.e. a weekly intake (3 meals) of mercury of 0.39 mg. This resulted in more than five-fold increase in the normal mercury content of blood and hair.

Skerfving (8) collected data on exposure, mercury levels in blood and hair and health status in exposed groups in Sweden. Two hundred and six subjects were studied between 1967-1972. Of these, 164 (age 3-86 years) ate fish that they or members of the family had caught themselves in different lakes or rivers or in coastal areas. Main interest was directed towards areas containing fish with methylmercury levels of 0.5-1 mg/kg. Considerable efforts were made to find exposed persons.

Contact was established through a variety of channels - local radio, local newspaper, local public health committees, inspectors of fisheries, local fishery advisers, fishermen's unions and sellers of fishing licenses. Special attention was paid to exposed children and young subjects. A total of 8 subjects made contact on their own initiative and volunteered for examination. Only two persons refused any examination when contacted and three refused re-examination.

The persons studied do not represent the total population in any region - the overwhelming majority of the population around mercury - contaminated water areas do not eat fish, or only rarely. In addition, eighteen subjects with high (4-10 meals per week) intakes of commercially available fish were studied. In most cases the examinations were performed at the local health centre. From each subject various blood samples were obtained for mercury determination

and from 60 persons also hair samples. In 71 subjects two or more blood samples were obtained at different occasions. Body weight was recorded. A nurse collected detailed information from each subject on fish intake habits. All subjects were asked about occupational or other possible exposure to mercury apart from fish consumption. They were also briefly interviewed as to major symptoms of methylmercury poisoning. In 86 persons another investigator performed a more detailed screening for symptoms and signs of methylmercury poisoning by means of a medical history and a physical examination.

Detailed information was recorded on the amounts of fish of different species consumed in different seasons. The amount of fish eaten at each meal was estimated by the use of models of five portions of fish of five different species. Also detailed information was obtained on the site of catch or place of purchase. Special attention was paid to consumption during the last year. From the records of fish-intake habits and data on levels of methylmercury in the different species of fish consumed, the average daily exposure of methylmercury per kg body weight per day was calculated for each month during the last year.

Mercury in fish from Swedish waters is present almost entirely as methylmercury. Published and unpublished survey data from various laboratories on levels of total mercury or methylmercury in fish were used as well as data obtained from analysis of methylmercury in samples of fish obtained from the subject under study. When two or more samples were obtained from a person at different occasions only the highest level was estimated. When no information was available on the level in a particular species consumed, the average ratios between levels in different species caught in the same water was used for an estimate of level. When fish had been purchased information about the site catch was obtained through the merchant or the wholesale dealer.

The estimate of exposure suffered several possible sources of error. the main ones being the uncertainty in calculating the intake of different species of fish and in estimating the levels of methylmercury in fish.

U.S.A. survey Market Facts Inc. Chicago carried out a 1 year survey of fish consumption patterns of 1,586 U.S. households and a total of 4,864 persons (21). The participants were selected at random from a large panel designed to par allel census data for U.S. with reference to population density and degree of urbanisation, geographic division, household income and age of panel members.

The head of each household completed a diary of fish purchases twice monthly for 12 months. These diaries reported purchases of fish and shell fish products by item, weight and cost, numbers of fish meals eaten away from

home by item and number of meals consumed at home from sport fish by species. Purchases of meat, meat products and meat substitute foods were recorded. This information provided a data base which listed for each family estimates of the total weights of each kind of fish consumed. Micro-nutrient levels were established for these fish species and the average daily micro-nutrient intake printed out for each family. The intake for each family was divided by number in family to give the individual daily intake levels.

Maximum intake of mercury was 31.7 µg/day and this level was reached by one family comprising four individuals, which was the only family whose intake exceeded 30 µg/day. Ninty-nine per cent of the group had intakes below 17 µg/day. The average intake was 2.48 µg/day.

Finland A study has been reported by Sumari et al (22) on the examination of over 1,000 individuals in Finland, covering a range of consumption of fish from zero to large quantities with high mercury levels (2-3 mg/kg). Only in one area where the highest mercury levels were present in fish was there a significant correlation between the amount of fish consumed and the concentration in blood and hair. In this area, with fish averaging 2-3 mg/kg mercury, the safety limits of 20 ng/g in blood and 6 ng/gm hair were exceeded for an average consumption of more than three meals of fish per week but no blood or hair concentrations approached the predicted effect level. In all other areas, where concentration of mercury in fish did not exceed an average of 1 mg/kg, the safety limits for blood and hair were rarely exceeded. These results suggest that even a regular consumption of fish, one meal daily, containing 1 mg/kg, will not normally result in mercury concentrations in blood or hair exceeding the defined safety limits and cannot approach the levels producing a toxic effect.

United Kingdom In the United Kingdom, although fish forms a minor component of the diet, it has been estimated that it could supply a greater proportion of the mercury intake of the population than any other single component. The average concentration in fish eaten is estimated to be only 0.08 mg/kg and the average daily intake of mercury to be probably in the area of 7-8 µg with the contribution from fish of 2.5 µg (6). The average consumption of fish is only about 24 g per day in the United Kingdom i.e. 168 g/week.

Australia A study was conducted in Melbourne in 1972 by Pennington et al (23) to ascertain whether significant exposure to methymercury had taken place in sections of the Victorian population. Attempts were made to identify groups of subjects with an unusually high fish intake and to study such individuals for evidence of mercury accumulation or toxicity. Information on fish consumption was obtained

through completion of dietary questionnaires at the time of sampling of blood or hair for mercury. Flake was found to be the most popular form of fish in the Victorians surveyed. High intakes of fish (more than 500 g per week) were found amongst 30 out of 310 selected subjects and the greatest number of these were amongst school children in inner Melbourne suburbs. The authors concluded that, whilst the group studied did not reflect consumption in the population at large, if the fish consumed by this group had contained greater than 0.5 ppm mercury, body content would have exceeded that regarded by WHO (24) as consistent with safety.

Recommendations of FAO/WHO re Mercury Intake

A joint Food and Agriculture Organisation/World Health Organisation Expert Committee (24) has established a provisional tolerable weekly intake for mercury from food. This is given as 0.3 mg per person per week, of which not more than 0.2 mg should be methylmercury, i.e. about 43 µg/day, of which not more than about 30 µg should be methylmercury. This is equivalent, for a 70 kg adult, to an intake of about 0.6 µg/kg/ body weight/day with not more than 0.4 µg/kg body weight/day in the methyl form. The WHO/FAO limit is about 70 times lower than the amount which could induce poisoning. In the Minimata episode, the intake of methylmercury probably averaged about 30 µg/kg body weight/day over several months.

The highest acceptable level of mercury in whole blood would be 0.02 µg/g, corresponding to about 0.04 µg/g in the blood cells and about 6 µg/g in the hair. Such levels could conceivably result from prolonged continuous exposure to the provisional tolerable weekly intake set by WHO/FAO.

Selenium - Antagonist of Mercury

It is generally accepted that many substances in particular nutrients, modify the effect of methylmercury ingestion. Selenium in particular, has been shown to be a powerful metabolic antagonist of mercury, including methylmercury (25). Methylmercury added to a tuna-corn-soya ration fed to Japanese quail was less toxic than an equivalent amount of this organic mercury added to the basal soya ration (26). It has also been reported that the addition of selenium to a casein ration containing methylmecuric chloride increased the survival rate in a colony of rats (25).

Analysis of tuna have shown an increase in selenium content paralleling increase in mercury concentration. The above work suggests a relationship between mercury and selenium through which toxicity of the mercury is decreased. Underwood (27) has suggested that since fish are normally rich in selenium as well as in mercury, it could be that a particular intake of methylmercury from fish would be less potentially toxic than a similar intake of methylmercury from other sources such as grain contaminated with such compounds.

DESIGN OF STUDY

The study* was carried out in co-operation with the Dietitians' Training Institutes at Deakin University (Geelong, Victoria), Flinders' University (Adelaide, South Australia) and Queensland Institute of Technology (Brisbane, Queensland) and the Community Health Service at Albany, Carnarvon, Mandurah and One-Arm Point (Western Australia). Basically, the study consisted of three phases:-

(1) Screening survey
(2) Dietary survey
(3) Collection of hair and blood samples.

The data were collected between October 1976 and June 1977.

Screening survey

The purpose of this phase was to identify individuals consuming significant quantities of fish products, who were willing to participate in the dietary survey and provide hair and possibly blood samples. Two screening questionnaires were used - one designed for adults and the other for children. Information was obtained on meat and chicken consumption as well as fish to avoid any undue bias or emphasis being placed on fish. The forms were distributed in the areas listed above to selected community groups, which included:-

Students in Primary and Secondary Schools.
Patients attending Health Centres and Hospitals
Staff of Health Centres and Hospitals.
Staff and Students at Tertiary Institutes of Education,
Customers of Fish Retail and Wholesale Establishments,
Leisure fishermen e.g Anglers' Clubs.

Copies of the two screening questionnaires together with the other forms used in the study - the seven-day food diary and interviewer's questionnaire - are given in Attachment I.

Selection of Subject

The main criteria for selection of people for participation in the dietary survey were frequency of fish consumption, type of fish consumed (fresh, canned, fried, shellfish etc.) and where bought. Two-thirds of the participants were to be having a high intake of fish i.e. four or more serving per week and the balance to be eating moderate quantities (about two servings of fish products per week).

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Dietary Survey

The selected participants were asked to complete a food diary, recording accurately the quantity of fish, meat, poultry and eggs eaten over the period of seven days. If possible, scales were to be used to record quantities of food eaten. Effort was made to visit participants during the diary week to check accuracy of recording.

After the collection of the diary, participants were asked to give details of usual fish consumption habits as a check that fish consumption during the survey week was representative of normal intake. Other data, such as height, weight, marital status, were obtained and recorded in the interviewers's questionnaire. Samples of fish, similar to those eaten during the survey week, were, in some cases, collected. These samples are being analysed for total mercury content and, if possible selenium by the Australian Government Analytical Laboratory, Hobart, Tasmania.

Collection of Hair and Blood Samples

A hair sample was obtained from all subjects, completing the seven-day food diary. The samples are being analysed for total mercury and in some cases, selenium content. Blood samples have been obtained from a small number of participants (approximately forty) comprising persons having a high intake of fish products and some having a moderate intake. These samples will be analysed for total mercury and selenium concentration. Analyses of hair and blood samples are being carried out at the CSIRO Division of Human Nutrition, Adelaide, South Australia.

Control Group

A small number of residents of the Australian Capital Territory, who rarely eat fish, were asked to provide a hair sample. Some of the group also provided blood samples for total mercury and selenium determinations. These participants will serve as a control both to the group having a high intake of fish and the group with a moderate fish-intake.

Pilot Study

The pilot study was conducted in Melbourne, Victoria during July, August 1976 by nutritionists of the Commonwealth Department of Health, Canberra. Dietary data and hair samples were collected from nineteen participants. The hair samples were analysed for total mercury by the Industrial Hygiene Laboratory of the Victorian Department of Health. A small number of fish samples similar to those eaten during the survey week were collected and analysed for total mercury content by the Australian Government Analytical Laboratory, Hobart.

RESULTS

Data processed at the 30th June 1977 is included in the results given in the Tables below. Included are the dietary data from:-

(1) The pilot study, conducted in Melbourne
(2) The Western Australian segment of the study
(3) The South Australian segment of the study
(4) The Queensland segment of the study.

Hair analyses for total mercury content are given for:-

(1) The pilot study, conducted in Melbourne
(2) The Western Australian segment of the study.

No analyses are given for the selenium content of hair and the total mercury and selenium content of whole blood, as only limited data is available. The total mercury values for blood (14 no) ranged from 0.002 ppm to 0.038 ppm.

The data provided in this interim report is given in the following Tables:-

Table 3	:	Participants for Whom Data Processed at 30.6.77
Table 4	:	Summarised Data on Participants with High Fish-Intake and Results of Hair Analyses.
Table 5	:	Summarised Data on Participants with Moderate Fish-Intake and Results of Hair Analyses.
Table 6	:	Summarised Data on Participants with High Fish-Intake without Results of Hair Analyses.
Table 7	:	Summarised Data on Participants with Moderate Fish-Intake without Results of Hair Analyses.
Table 8	:	Summarised Data on Participants with Insignificant Fish-Intake Without Results of Hair Analyses.

Discussion and Conclusions

It will be appreciated that due to the interim nature of this report and the incompleteness of the data detailed, these two areas cannot at this time be covered.

TABLE 3 : Participants for Whom Data Processed at 30.6.77

Total number = 115

State or Territory	High Fish Intake (more than 500 g/week)		Moderate Fish Intake (150- 480 g/week)		Insignificant food Intake (1 meal fish/month or less)	
	No	%	No	%	No	%
Western Australia	25	21.7	16	13.9	Nil	0
South Australia	13	11.3	6	5.2	Nil	0
Victoria	8	7.0	10	8.7	1	0.9
Queensland	18	15.7	4	3.5	Nil	0
A.C.T.	1	0.9	1	0.9	12	10.4
	65	56.5	37	32.18	13	11.31

TABLE 4 : Summarised Data on Participants with High Fish-Intake and Results of Hair Analyses

Participants Number	Weight of fish Consumed in diary week g	Times/week fish eaten No	Body Mass kg	Total Hg Content of hair p.p.m.
W.A.				
1	1675	8	52.0	3.00
2	1400	8	44.0	2.05
3	1245	7	48.0	1.88
4	2185	10	41.0	1.39
5	2680	13	41.0	1.27
6	2400	12	31.0	1.55
7	635	5	30.0	1.67
8	2165	12	27.5	1.84
9	1525	6	58.0	1.27
10	2460	12	107.0	2.00
11	1250	5	60.0	0.67
12	2295	12	87.0	0.59
13	2170	8	74.0	2.50
14	1590	7	63.0	1.38
15	600	2	95.0	2.13
16	600	3	70.0	2.10
17	880	7	82.0	1.87
18	780*	4*	60.5	1.86
19	2000	7	95.5	2.75
20	1000*	5*	63.5	1.49
21	750*	4*	25.0	2.00
22	720*	6*	73.0	2.70
23	540	5	65.0	3.04
24	960	7	73.0	0.49
25	880	4	44.0	2.87
VIC				
26	880	3	95.5	7.00
27	600	5	66.5	0.97
28	570	5	63.0	2.70
29	735	7	42.0	2.90
30	570	5	75.5	3.00

* Calculated from dietary history

Table 4(contd): - Summarised Data on Participants with High Fish-Intake and Results of Hair Analyses

Participants Number	Weight of fish Consumed in diary week g	Times/Week fish eaten No	Body Mass Kg	Total Hg Content of hair p.p.m.
Vic (contd)				
31	600*	3*	54.0	4.00
32	520*	4*	40.5	1.80
33	520	3	51.0	2.90
Mean	1223.6	6.5		2.18
Range	(520-2680)	(2 - 13)		(0.49 - 7.0)

* Calculated from dietary history

TABLE 5 Summarised Data on Participants with Moderate Fish-Intake and Results of Hair Analyses

Participants Number	Weight of fish Consumed in diary week g	Times/Week fish eaten No	Body Mass kg	Total Hg Content of hair p.p.m.
W.A.				
201	175	1	29.5	1.08
202	240*	2*	58	0.25
203	210	2	50	1.21
204	390	2	28	1.39
205	270	2	24	1.73
206	240*	2*	30	0.98
207	400	2	73	1.15
208	480	4	60.5	0.69
209	420*	3*	52	0.51
210	300	2	50	1 67
211	330	3	57.5	0.82
212	420	3	63.5	1.78
213	360*	3*	22	1.47
214	240	2	30	1.59
215	410	3	62	0.38
216	320	2	52.5	0.78
VIC				
217	150	2	29	1.80
218	360	2	77	1.40
219	360	4	70	1.70
220	450	4	82	0.03
221	400*	2*	40	1.40
222	200	1	33	1.30
223	280	3	80	1.40
224	400	2	70	1.90
225	240*	2*	54	0.33
226	360*	2*	33	0.03
Mean	323.3	2.4		1.11
Range	(150-480)	(1-4)		(0.03-1.9)

* Calculated from Dietary History

TABLE 6 : Summarised Data on Participants with High Fish-Intake without Results of Hair Analyses

Participants Number	Weight of fish Consumed in diary week g	Times/Week Fish eaten No	Body Mass kg
S.A.			
34	832	6	70.0
35	966	7	89.2
36	610*	3*	60.5
37	1575	8	95.5
38	540	4	89.5
39	825	3	70.0
40	600	2	47.5
41	695	5	70.0
42	600	4	74.5
43	600	5	60.5
44	600	5	67.0
45	750	3	69.0
46	650	7	63,5
QLD			
47	840	5	78.5
48	670	5	59.0
49	1020	6	54.0
50	960	5	48.0
51	920*	3*	50.0
52	780	8	53,5
53	510	5	65.0
54	1604	10	55.0
55	720	4	67.0
56	720	2	63.5
57	720	7	56.0
58	560	5	58.0
59	960	5	108.5
60	870	6	90.5
61	810	7	63.5

* Calculated from dietary history

Table 6 (contd): Summarised Data on Participants with High Fish-Intake Without Results of Hair Analyses

Participants Number	Weight of fish Consumed in diary week g	Times/Week No	Body Mass kg
62	600	5	52.0
63	600	4	43.5
64	780	5	70.0
A.C.T. 65	900	4	66.5
Mean	793.4	5.1	
Range	(510-1604)	(2-10)	

TABLE 7 : Summarised Data on Participants with Moderate Fish-Intake without Results of Hair Analyses

Participants Number	Weight of fish consumed on diary week g	Times/week fish eaten No	Body Mass kg
S.A.			
227	390	6	76.0
228	480*	4*	87.5
229	395	4	90.0
230	480	3	67.0
231	300	3	58.0
232	435*	3*	59.0
QLD			
233	180	2	90
234	440	5	76
235	300*	3*	51.0
236	420	5	63.5
A.C.T.			
237	390*	3*	56.0
Mean	382.73	3.7	
Range	(180-480)	(2 - 6)	

* Calculated from dietary history.

TABLE 8: Summarised Data on Participants with Insignificant Fish Intake Without Results of Hair Analyses

Participants Number	Frequency of Fish consumption for year	Body Mass kg	Total Hg Content of Hair p.p.m.
A.C.T			
301	4	63.5	
302	12	75.0	
303	2	60.5	
304	nil	68.0	
305	6	73.0	
306	4	51.0	
307	12	95.5	
308	12	49.0	
209	12	80.0	
310	12	65.0	
311	4	73.0	
312	9	61.5	
VIC			
313	12	36.0	0.22

TABLE 9: Average Values for Individual States and A.C.T.

AREA	Participants Having High Fish Intake				Particpants having Moderate Intake			
	No	Weight of fish Consumed in diary week g	Times/Week fish eaten No	Total Hg content of hair p.p.m.	No	Weight of fish Consumed in diary week g	Times/Week fish eaten No	Total Hg content of hair p.p.m.
Western Aust	25	1415	7.2	1.86	16	325	2.4	1.10
Victoria	8	624	4.4	3.16	10	320	2.4	1.13
South Aust	13	757	4.8		6	413	3.8	
Queen-sland	18	813	5.4		4	335	3.7	
A.C.T	1	900	4.0		1	390	3.0	

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ATTACHMENT 1

SURVEY ON FOOD HABITS OF AUSTRALIANS

This survey is being conducted for the Commonwealth Department of Health to determine the amounts of meat, fish, chicken and eggs that are being eaten by Australians. This information will make a valuable contribution to the knowledge of food habits in this country and your co-operation in filling in this form would be appreciated. All information given will be treated as confidential.

Guy Howells

Director-General of Health

PLEASE COMPLETE:

AGE: ..... years

SEX: please tick (✓)

☐ Male
☐ Female

MARITAL STATUS: please tick (✓)

☐ Single
☐ Married
☐ Widowed, separated, divorced

Country of Birth: .....

Occupation: .....

Please turn over

FOOD SURVEY

1. How many times <u>each week</u> do you <u>usually</u> eat the following foods?

Meat ..... times/week
Fish ..... times/week
Chicken ..... times/week
Eggs ..... times/week

2. Please tick (✓) the types of meat, fish and chicken you usually eat.

MEAT	FISH	CHICKEN
☐ lamb	☐ fresh	☐ fresh
☐ beef	☐ frozen	☐ frozen
☐ veal	☐ canned	☐ pre-cooked e.g. from take-away food shops
☐ pork	☐ shell-fish	
☐ canned or packaged meat	☐ fried fish and chips	

---

3. Please tick (✓) where you most frequently buy these foods:-

---

MEAT	FISH	CHICKEN
☐ butcher	☐ fish shop	☐ butcher
☐ meat market	☐ fish market	☐ poultry market
☐ supermarket	☐ supermarket	☐ supermarket
☐ take-away food shop	☐ take-away food shop	☐ take-away food shop
☐ restaurant or cafe	☐ restaurant or cafe	☐ restaurant or cafe
	☐ caught by yourself or friends	☐ farm

A further detailed survey will be conducted within one month The information obtained will assist Government authorities to set safety standards for Australian foods.

Your co-operation and assistance would be valuable. You would be asked to:-

1. Record accurately all the meat, fish, chicken and eggs you eat for a period of seven days.

2. Provide a small sample of hair so that food intake can be related to health.

If you are selected, would you be prepared to take part in this survey?

YES ☐

NO ☐

If yes, please complete the details on the back page so that an interviewer may contact you.

PLEASE NOTE: ALL information given on this form is for the use of the survey ONLY and will be treated as STRICTLY CONFIDENTIAL.

Please turn over

CONFIDENTIAL

Name .....

What is the most appropriate time and place to contact you?

Time	Day	Home or work
.....	.....	.....

Address:- (for interviewer to visit)

.....

.....

Telephone No:- .....

Signature .....

OFFICE USE:-

Collection point:-

In your State this survey is being conducted by:-

Mrs Yvonne Webb,
Department of Paramedical Studies,
Queensland Institute of Technology,
George Street,
BRISBANE QLD 4000

ATTACHMENT I

SURVEY ON FOOD HABITS OF AUSTRALIANS

This survey is being conducted for the Commonwealth Department of Health to determine the amounts of meat, fish, chicken and eggs that are being eaten by Australians. This information will make a valuable contribution to the knowledge of food habits in this country and your co-operation in filling in this form would be appreciated. All information given will be treated as confidential.

George Howells

Director-General of Health

PLEASE COMPLETE:

AGE:..... years

SEX: please tick (✓) ☐ Male ☐ Female

School grade: .....

Country of birth of:

myself .....

my mother .....

my father .....

Occupation of:

my mother .....

my father .....

Please turn over

FOOD SURVEY

1. How many times each week do you usually eat the following foods?

Meat ..... times/week
Fish ..... times/week
Chicken ..... times/week
Eggs ..... times/week

2. Please tick (✓) the types of meat, fish and chicken you usually eat.

MEAT	FISH	CHICKEN
☐ lamb	☐ fresh	☐ fresh
☐ beef	☐ frozen	☐ frozen
☐ veal	☐ canned	☐ pre-cooked e.g. from take-away food shops
☐ pork	☐ shell-fish	
☐ canned or packaged meat	☐ fried fish and chips	

3. Please tick (✓) where you or your parents most frequently buy these foods:-

MEAT	FISH	CHICKEN
☐ butcher	☐ fish shop	☐ butcher
☐ meat market	☐ fish market	☐ poultry market
☐ supermarket	☐ supermarket	☐ supermarket
☐ take-away food shop	☐ take-away food shop	☐ take-away food shop
☐ restaurant or cafe	☐ restaurant or cafe	☐ restaurant or cafe
	☐ caught by yourself or friends	☐ farm

A further detailed survey will be conducted within one month. The information obtained will assist Government authorities to set safety standards for Australian foods.

Your co-operation and assistance would be valuable. You would be asked to:-

1. Record accurately all the meat, fish, chicken and eggs you eat for a period of seven days.

2. Provide a small sample of hair so that food intake can be related to health.

If you are selected, would you be prepared to take part in this survey?

YES ☐

NO ☐

If yes, please ask your PARENTS or guardians to complete the details on the back page, so that an interviewer may contact you and your parents.

PLEASE NOTE: ALL information given on this form is for the use of the survey ONLY and will be treated as STRICTLY CONFIDENTIAL.

Please turn over

CONFIDENTIAL

Name .....

Please tick (✓)

☐ Mother
☐ Father
☐ Guardian

Child's Name.....

What is the most appropriate time and place to contact you?

Time	Day	Home or work
.....	.....	.....

Telephone No:- .....

Address:- .....

.....

Signature .....

OFFICE USE:-

Collection point:-

In your State this survey is being conducted by:-

Mrs Yvonne Webb,
Department of Paramedical Studies,
Queensland Institute of Technology,
George St.,
BRISBANE QLD 4000

ATTACHMENT 1

COMMONWEALTH DEPARTMENT OF HEALTH

FOOD SURVEY

DIARY FOR DIETARY RECORD

Identification No. | | | | |

This diary starts on Day.....

Date.....

Sample of hair to be taken on Date.....

INSTRUCTIONS

A. Please record all the meat, poultry, fish and eggs you eat EACH day for the next SEVEN days in the diary, using ONE page for EACH day.

MEAT - All foods which are:-

- Beef
- Lamb
- Mutton
- Pork
- Veal

and includes minced meat, liver, brains, kidney, sausages, processed sausage meats (e.g. salami, frankfurts, luncheon sausage) and bacon.

FISH - All foods which are:-

- salt-water fish
- fresh-water fish
- shell-fish (e.g. lobster, prawns, scallops)
- prepared fish products (e.g. fish fingers)

and includes all fresh, frozen, smoked or canned fish.

POULTRY - All foods which are:-

- Chicken
- Duck
- Turkey

EGGS - All eggs eaten whole or in an egg dish (omit eggs used in cooking, e.g. cakes, puddings, casseroles).

B. During EACH day, EVERY time you eat one of these foods record the following details in the appropriate space:-

1. The TYPE OF FOOD EATEN, indicating cut of meat, portion of poultry and species of fish, for example:-

   beef, sirloin
   lamb chump chop
   chicken leg
   flounder fillet
   egg

   Give details, including BRAND of any packaged, tinned food, e.g. Seakist Sandwich Tuna.

2. Record HOW THE FOOD WAS COOKED, or served, for example:-

   grilled, barbecued
   fried
   casserole, braised, stewed
   roast, baked
   battered, crumbed
   in pie
   in bread roll or sandwich

3. Record WHERE THE FOOD WAS COOKED, for example:-

   home
   restaurant, cafe
   take-away food bar, fish shop

4. Record the AMOUNT OF FOOD EATEN by weight or size

   (i) WEIGHT. Preferably weigh foods accurately using kitchen scales or estimate weight or edible portion

   (ii) SIZE is indicated by measurement (dimension, cup or tablespoon) and/or by number, for example:-

   Rump steak - 6" x 4" x ½" (15cm x 10cm x 1cm)
   Bream fillet - 8" x 4" (20cm x 10cm)
   Mince steak - ½ cup
   Hamburger - 3" diameter (8cm)
   Chicken wings - 2
   Egg, scrambled - 1 (2 tablespoons)
   Prawn chopsuey - 1 cup (6 prawns)

NOTE: Imperial or metric measures may be used.

TO OBTAIN WEIGHT OF FOOD EATEN

1. Weigh your portion of food AFTER COOKING and BEFORE EATING.
2. Weigh any plate waste e.g. bone, fat and skin.
3. Weight of food eaten equals 1 minus 2.

DIETARY RECORD

DAY 1

Day... Wednesday.....

Time of day	Description of food	How cooked	Where cooked	Size of serving	Weight
Breakfast	Egg	fried	home	1	55g
	Bacon, middle-cut	fried	home	1 rasher (6" x 1½" (15cm x 4cm))	⅓oz. (10g)
Between breakfast & lunch	Seafood sandwich tuna	tinned		1 tablespoon	1g (25g)
Lunch	Bream fillet	Battered and fried	Fish shop	2 pieces 7" x 4" (18cm x 10cm)	10oz. (280g)
Between lunch & dinner					
Dinner	Round steak	Casserole	home	1 cup	8oz (225g)
After dinner	Hamburger, beef	fried	Take-away food bar	1 3" diam. (8cm diam.)	2oz (55g)

NOTE: Please READ INSTRUCTIONS CAREFULLY and COMPLETE RECORD as DIRECTED.

DIETARY RECORD

DAY 1

Day.....

Time of day	Description of food	How cooked	Where cooked	Size of serving	Weight
Breakfast					
Between breakfast & lunch					
Lunch					
Between lunch & dinner					
Dinner					
After dinner					

NOTE: Please READ INSTRUCTIONS CAREFULLY and COMPLETE RECORD as DIRECTED.

DIETARY RECORD

DAY 2

Day.....

Time of day	Description of food	How cooked	Where cooked	Size of serving	Weight
Breakfast					
Between breakfast & lunch					
Lunch					
Between lunch & dinner					
Dinner					
After dinner					

NOTE: Please READ INSTRUCTIONS CAREFULLY and COMPLETE RECORD as DIRECTED.

DIETARY RECORD

DAY 3

Day.....

Time of day	Description of food	How cooked	Where cooked	Size of serving	Weight
Breakfast					
Between breakfast & lunch					
Lunch					
Between lunch & dinner					
Dinner					
After dinner					

NOTE: Please READ INSTRUCTIONS CAREFULLY and COMPLETE RECORD as DIRECTED.

DIETARY RECORD

DAY 4

Day.....

Time of day	Description of food	How cooked	Where cooked	Size of serving	Weight
Breakfast					
Between breakfast & lunch					
Lunch					
Between lunch & dinner					
Dinner					
After dinner					

NOTE: Please READ INSTRUCTIONS CAREFULLY and COMPLETE RECORD as DIRECTED.

DIETARY RECORD

DAY 5

Day.....

Time of day	Description of food	How cooked	Where cooked	Size of serving	Weight
Breakfast					
Between breakfast & lunch					
Lunch					
Between lunch & dinner					
Dinner					
After dinner					

NOTE: Please READ INSTRUCTIONS CAREFULLY and COMPLETE RECORD as DIRECTED.

DIETARY RECORD

DAY 6

Day.....

Time of day	Description of food	How cooked	Where cooked	Size of serving	Weight
Breakfast					
Between breakfast & lunch					
Lunch					
Between lunch & dinner					
Dinner					
After dinner					

NOTE: Please READ INSTRUCTIONS CAREFULLY and COMPLETE RECORD as DIRECTED.

DIETARY RECORD

DAY 7

Day.....

Time of day	Description of food	How cooked	Where cooked	Size of serving	Weight
Breakfast					
Between breakfast & lunch					
Lunch					
Between lunch & dinner					
Dinner					
After dinner					

NOTE: Please READ INSTRUCTIONS CAREFULLY and COMPLETE RECORD as DIRECTED.

ATTACHMENT 1

COMMONWEALTH DEPARTMENT OF HEALTH

FOOD SURVEY

QUESTIONNAIRE ON FISH-EATING HABITS

(To be completed by interviewer)

Identification No. ☐☐☐☐

Name:.....

Address:.....

.....

PERSONAL DETAILS:-

1. Age .....yrs

2. Sex: Male ☐
   Female ☐ If pregnant, please tick (✓) ☐

3. Height .....cm
   Weight .....kg

4. Is the subject on a special diet? YES ☐ NO ☐

   If YES, what is the reason for the diet?

   .....

   Please tick (✓) if diet is,

   ☐ Medically prescribed
   ☐ Self-medicated
   ☐ Prepared by slimming club

5. Has the subject changed his/her diet in the last 12 months?

   YES ☐ NO ☐

   If YES, how has it changed?

   .....

FISH EATEN DURING DIET RECORD:-

1. Please summarize from the diet record and conversation with the subject, details of each fish meal:-

Species	weight-gm	Where purchased	if fish sampled	
			Date taken	Weight taken-gm

2. During the week, did other members of the household eat the same fish meals as the subject?

   YES ☐ NO ☐

   If YES, what is the family (or household) composition?

   No. Adult males ☐
   No. Adult females ☐ If pregnant, please tick (✓) ☐
   Ages of children (yrs) ☐☐☐☐☐☐

FISH EATING HABITS

1. Is the amount and type of fish eaten during the diet record typical for the subject?

YES ☐ NO ☐

If NO, (i) what is the usual amount? .....times/week
(ii) why is it different? Please specify

☐ Availability of favourite species .....
.....

☐ Seasonal variation .....
.....

☐ A typical activity pattern during week .....
.....

☐ Other e.g. illness, special diet .....
.....

2. List all species of fish the subject most frequently eats.

Species	How often	Usual length of fish

3. Why does the subject eat fish regularly? Indicate major reasons

☐ custom
☐ religious belief
☐ for special diet
☐ Catches own fish -
If subject fishes, how frequently? ..... times/week
☐ Receives fish from friends or relatives who fish -
If subject given fish, how frequently? ..... times/week
☐ Convenience as a take-away food
☐ Likes flavour
☐ Other.....

4. Does the subject buy food from fish and chip shops? YES ☐ NO ☐

If YES, how frequently ..... times/week
What does he/she usually buy? Please indicate.

☐ Chips, potato scallops or potato cakes
☐ Chiko Rolls, Dim Sims, etc.
☐ Fried fish, specify species . . .
☐ Other - specify .....

p.t.o.

HAIR PRODUCTS

List the brands of hair shampoo and conditioner most frequently used by the subject .....

.....

.....

FOR OFFICE USE

Summary of Study

Date of Diet Record:- from .....to 197
(inclusive)

Date of Hair Sample taken:- 197

Result of Hair Analysis ..... pg. Hg.

Result of Fish sample taken:-

Sample	Weight of fish eaten gm.	Mercury Level	
		Concentration ppm	Conte ug
Total Hg intake for week			ug

Further contact required for blood sample

YES ☐ NO ☐