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Association Between Dietary Fibre and Cancer: A Case-Control Study in Malaysia

Suzana Shahar[1], Azhar Yusoff[2] & Fatimah Arshad[1]

1 *Department of Nutrition and Dietetics, Faculty of Allied Health Sciences, Universiti Kebangsaan Malaysia, Jalan Raja Muda Abdul Aziz, 50300 Kuala Lumpur*
2 *Family Health and Development Division, Department of Public Health, Ministry of Health, Tingkat 2, Blok B, Kompleks Pejabat-pejabat Kesihatan, Jalan Cenderasari, 50590 Kuala Lumpur*

ABSTRACT

A case control study to determine the association of dietary fibre and cancer among Malaysians. It was conducted among 100 newly-diagnosed cancer patients admitted to the Radiotherapy and Oncology Ward, Hospital Kuala Lumpur. A total of 100 controls matched with the cases for age, sex and ethnic origin were selected from the Outpatient Health Clinic in Sentul. The subjects were interviewed to obtain information on their habitual dietary intakes and lifestyles. Family history of cancer, smoking habits, and alcohol consumption were found to be significant risk factors for cancer ($p<0.05$ for all parameters). The mean intake of total energy was higher among men with nasopharyngeal cancer and women with gastrointestinal cancer as compared to their controls ($p<0.05$ for both parameters). The percentage of energy contribution from fat was higher among cases (35%) than controls (32.1%). The mean dietary fibre intake among cases (10.86 ± 8.90 g/d) was apparently lower than the controls (13.22 ± 5.99 g/d), with significant differences noted for breast cancer and also nasopharyngeal cancer. Women with low fibre intake (< 10g/d) had a 2.2 times higher risk of getting breast cancer. There is a need to educate the public to adhere to a wholesome diet, in particular to increase the consumption of high-fibre food for disease prevention.

INTRODUCTION

Globally, cancer ranks as the second leading cause of death. It is also the second leading cause of death in Malaysia after cardiovascular disease (Ministry of Health Malaysia, 2000). In Malaysia, the incidence of cancer is approximately 30-40 thousand cases per year and accounted for 9.9% of all medically certified deaths (Ministry of Health Malaysia, 2000). Cancer has a multi-factorial aetiology, with diet as one of the important risk factors (WCRF/AIRC, 1997). In developed countries, the relationship between diet and cancer has been investigated since 1930 (Reddy & Cohen, 1986), and food has been identified as a carcinogenic agent which contributes to cancer (Wahlqvist, 1993). In the early 70s, dietary fibre intake had been suggested to be able to prevent cancer (Armstrong & Doll, 1975). Dietary fibre was initially defined by Hipsley, in 1953, as indigestible plant cell wall material that was predominantly carbohydrate in nature but included lignin. Later, the

Correspondence author: Assoc Prof Dr Suzana Shahar, email: suzanas@medic.ukm.my

definition was enlarged to include all non-absorbable carbohydrates of plant origin (Trowell *et al*., 1976). Epidemiological studies reported that an increased consumption of high-fibre foods, especially fruits and vegetables, have been recognised as a preventive measure for many diseases including cancer (Steinmetz & Potter, 1996). For more than 30 years, the association between increased amounts of dietary fibre and a lower risk of colorectal cancer has been a matter of controversy. Studies using different methodologies and outcome measures have given contrasting results. However, a recent case control study by Peters *et al*. (2003) involving 34,000 participants who had no polyps on sigmoidoscopy, and 3,600 cases who had at least one adenoma in the distal bowel, indicated that subjects in the highest quintile of fibre intake had a 27% decreased risk compared with participants in the lowest quintile. This is supported by findings from the European Prospective Investigation into Cancer and Nutrition (EPIC) study, involving 500,000 participants, that indicated a high fibre intake of 35 g per day could lead to a reduction of 40% in colorectal cancer risk (Bingham *et al*., 2003).

Rapid economic development has changed the lifestyles of Malaysians, from consuming a traditional diet that is rich in complex carbohydrates to higher intake of fat and refined carbohydrates (Tee *et al*., 1997). This phenomenon occurred simultaneously with the increased incidence of chronic diseases, including cancer (Ministry of Health, 2000). The association between cancer and selected dietary components, namely fats, carcinogens and antioxidants, among Malaysians has been investigated recently (Fatimah *et al*., 2004). Therefore, the study is aimed at investigating the relationship between fibre consumption and the occurrence of cancer among Malaysians.

METHODOLOGY

This is a retrospective case-control study involving 100 newly-diagnosed adult in-patients aged 18 years and above (50% men), who had been admitted to Radiotherapy and Oncology Institute, Hospital Kuala Lumpur (HKL) as cases. A total of 100 controls who did not have cancer and chronic diseases, matched with cases for age, sex and ethnic, were selected from the Outpatient Health Clinic in Sentul, Kuala Lumpur. It is essential to get controls with no diagnosed chronic diseases as the conditions might cause them to change their dietary habits (Gifft, Washbon & Harrison, 1972). The study was conducted between August to December 2002 and approved by the Ethical Committee of Hospital Universiti Kebangsaan Malaysia.

A pre-tested questionnaire was used to collect data on demographic and health habits. Food intake was obtained through interviews using a diet history questionnaire (DHQ) (Wilkens *et al*., 1992). The cases were asked to report their habitual food intake before the diagnosis of cancer or symptoms of cancer. The controls were asked to report on their habitual food intake. Household measures like teaspoon, dessertspoon, tablespoon, cup, glass and Chinese bowls were used to estimate the portion size and amount. Food pictures and models were also used.

In addition to the dietary intake data, the subjects were also asked about the frequency of consuming foods from thirteen food groups, namely cereals, seafood, meats, beans and pulses, fruits, vegetables, eggs, milk and milk products, oils and fats, cakes and pastries, local sweets, drinks and beverages, as well as fast foods, according to the Nutrient Composition of Malaysian Foods (Tee *et al*., 1997). The FFQ was used to cross-examine the DHQ. The subjects were asked to verify intake if they reported consumption in the FFQ, but not in DHQ.

Besides typical food consumption, the subjects were also asked about their dietary behaviour including consumption of fruits, vegetables and fat, as well as their preferred cooking methods. Food intake was analysed using Diet 4 Program based on the Nutrient Composition of Malaysian Foods (Tee *et. al*., 1997). Since total dietary fibre values were 2 to 6 times greater than the crude fibre values (Zeman 1991), a conversion factor of 4 was used to convert the composition of crude fibre in the Malaysian food tables (Tee *et al*., 1997) to dietary fibre.

The subjects were also weighed using a digital Tanita weighing scale to the nearest 0.5kg. Height was measured to the nearest 0.1 cm using a microtoise. SPSS program version 10.0 was used to analyse the data. Independent sample t-test was used to compare mean nutrient intake of cases and controls. Chi-squared test was used to investigate associations between categorical variables. The Relative Risk or Odds Ratio (OR) was also calculated using 2 by 2 table, without adjusting for other risk factors.

RESULTS

The ethnic composition of the men among the cases were as follows: 64% Malays, 30% Chinese and 6 % Indians. The ethnic composition of the women were 46% Malays, 42% Chinese and 12% Indians. The control subjects consisted of similar ethnic compositions. It should be borne in mind that these ethnic compositions were not comparable to those reported by the Ministry of Health (2000), which highlighted that cancer occured mostly among the Chinese. This was probably because the cases recruited in this study were mainly from the Kuala Lumpur General Hospital, where the patients were predominantly Malays.

The mean age of cases, 47.88 ± 10.04 years, was not significantly different from controls (48.00 ± 10.11 years). The mean age of the cases was also consistent with the figure reported in the Second National Morbidity Survey on Cancer (Ministry of Health 2000). According to this report, the incidence of cancer occurred mostly at the age of 45-49 years.

Table 1 presents the socioeconomic profile of cases and controls according to sex. It was found that more men in the control group were still working (74%) as compared to their counterparts in the case group (62%)($p<0.05$). Most of the women in both cases (66%) and controls (62%) were not working.

Monthly household income of most of the men in the control group ranged from RM1,000 to RM2000 (48%), as compared to 42% in their case counterparts. This was probably due to the fact that the control subjects were mostly working adults around Kuala Lumpur, while the cases were probably referred to HKL from other states. The monthly household income among women subjects was comparable between both cases and controls, with most of them falling within the range of RM1,000 to RM2,000. Previous studies reported that cancers of the breast, colon, prostate, testis, ovary, melanoma and leukaemia associated possitively with economic status (Pearce & Howard, 1986; Levi *et al*., 1988). On the other hand, cancers of the oral, nasopharynx, oesophagus, stomach, liver, lungs and cervix associated negatively with socioeconomic status (Williams *et al*., 1991; Smith, Taylor & Coates, 1996). However, the above associations were not found in the present study, probably due to its small sample size.

Subjects in the case group comprised mainly patients with breast cancer (42%), followed by ovarian (30%), gastrointestinal (12%), nasopharynx (4%), lungs (6%) and others (6%) as shown in Table 2. The mean body weight of men was 58.5 ± 13.6kg in cases and 68.7 ± 12.8kg in controls. The corresponding figures for

Table 1. Sociodemographic profile of cases and controls according to sex

Variables	*Men (n = 100)*				*Women (n = 100)*			
	Cases (n = 50)		*Controls (n = 50)*		*Cases (n = 50)*		*Controls (n = 50)*	
	No	*%*	*No*	*%*	*No*	*%*	*No*	*%*
Marital status								
Single/Widowed	6	12	4	8	8	16	4	8
Married	44	88	46	92	42	84	46	92
Educational level								
Not schooling	1	2	1	2	9	18	6	12
Primary school	24	48	11	22	17	34	24	48
Secondary school	22	44	35	70	21	42	17	34
Higher institution	3	6	3	6	3	6	3	6
Living arrangement								
Alone/Children	0	0	0	0	10	20	0	0
Spouse/& Children	44	88	46	92	36	72	46	92
Others	6	12	4	8	4	8	4	8
Employment								
Yes	31	62	37	74	17	34	19	38
No	19	38	13	26	33	66	31	62
Monthly Income (RM)								
<=500	6	12	7	14	10	20	9	18
> 500-1000	20	40	9	18	16	32	14	28
> 1000-2000	21	42	24	48	18	36	19	38
> 2000	3	6	10	20	6	12	8	16

women were 54.90 ± 13.90kg and 59.63 ± 9.8kg, respectively. The relatively low body weight among the cases was probably due to the disease condition (Billings, 1985; Saunders, 1984).

Table 3 shows that the non-dietary risk factors investigated were significantly different between cases and controls, with a higher percentage of cases having a family history of cancer, smoking cigarettes and consuming alcohol. The Crude Odds Ratio or Relative Risk of getting cancer for smokers, those with a family history and those who consumed alcohol were 1.3, 1.5 and 1.4, respectively. Family history has been associated with colon and breast cancers (Willet, 1989; St John *et al*., 1993). Smoking has been identified as a non-dietary habit that can cause lung cancer (Marmot, Shipley & Rose, 1984; Feldman *et al*., 1989). These studies reported that the majority of lung cancer patients (77%) had smoked up to 20 cigarettes daily. Alcohol has been associated with oral, pharynx and oesophagus cancer (WCRF/AIRC, 1997).

Table 4a and Table 4b present the energy and fibre intake in cases and controls according to the types of cancer in men and women, respectively. It appeared that the energy intake of the cases was higher than controls, with significant differences noted among men who were diagnosed with nasopharyngeal cancer

Table 2. Distribution of type of cancer according to sex

Type of Cancer	*Men (n = 50)*		*Women (n = 50)*	
	N	*%*	*No*	*%*
Breast	0	0	21	42
Ovarian	0	0	15	30
Gastrointestinal	19	38	6	12
Nasopharynx	16	32	2	4
Lung	9	18	3	6
Others	6	12	3	6

Table 3. Distribution of non-dietary risk factors among cases and controls

	Cases (n = 100)		*Controls (n = 100)*		*Crude Odds Ratio (Relative Risk)*
	No	*%*	*No*	*%*	
Family History					
Yes	24	24	10	10	1.5
No	76	76	90	90*	
Smoking					
Yes	38	38	25	25	1.3
No	62	62	75	75*	
Alcohol					
Yes	12	12	6	6	1.4
No	88	88	94	94*	

*$p < 0.0001$, Chi-squared test at 2-tail

($p<0.0001$) and women who were diagnosed with gastrointestinal cancer ($p<0.05$). The apparent higher energy intake among selected cancer cases was also reported earlier (Fatimah *et al.*, 2004), although other studies could not demonstrate the differences (Holmes *et al.*, 1999; Katsouyanni *et al.*, 1994).

Investigation on the contribution of macronutrients to energy intake among the subjects indicated that cases had consumed a diet with a relatively high composition of fat compared to the controls (Figure 1). Other case control studies among breast cancer patients also noted similar findings (Fatimah *et al.*, 2004; Howe *et al.*, 1990).

As shown in Table 4, the mean dietary fibre intake of the cases was 13.26 ± 13.61g/day in men, and 10.86 ± 8.90g/day in women. The level of fibre intake in the control group was comparable to the intake reported in a study among Malaysians by Ng (1997), i.e. 13-16g/day. Neither the cases nor the controls achieved the desirable fibre intake of 20 to 35 g/day (Marlett & Slavin, 1997). Most surveys in the US indicated that Americans consume

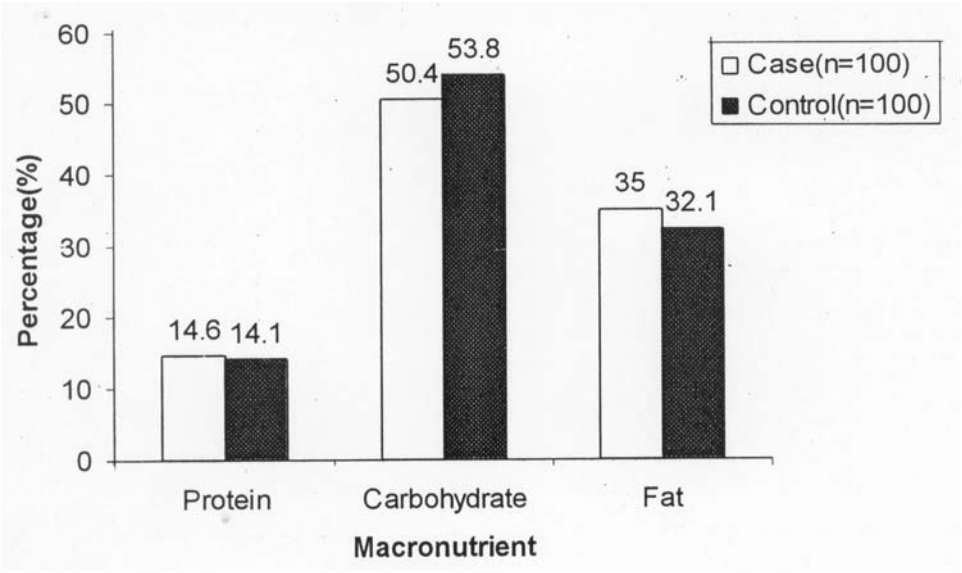

Figure 1. Percentage of macronutrient contribution to energy in cases and controls

Table 4a. Energy and fibre intake in cases and controls according to type of cancer in men

	Cases			*Controls*			
	n	*Mean*	*Sd*	*n*	*Mean*	*Sd*	*P value*
Energy (kcal/d)							
All	50	2229.11	550.39	50	2050.55	539.71	0.105
Gastrointestinal	19	2189.17	447.59	19	2068.52	573.86	0.475
Nasopharynx	16	2346.11	455.87	16	1808.58	265.24	0.000*
Lung	9	2176.75	882.33	9	2274.30	704.25	0.799
Others	6	2122.14	556.67	6	2303.25	556.05	0.585
Dietary Fibre (g/d)							
All	50	13.26	13.61	50	14.51	6.66	0.563
Gastrointestinal	19	14.66	19.15	19	13.48	6.42	0.801
Nasopharynx	16	13.31	8.26	16	14.86	5.66	0.541
Lung	9	7.86	3.60	9	14.67	9.37	0.059
Other	6	16.79	13.98	6	16.57	6.38	0.972

*$p < 0.05$ independent sample t-test at 2 tail

Table 4b. Energy and fibre intake in cases and controls according to type of cancer in women

	Cases			*Controls*			
	n	*Mean*	*Sd*	*n*	*Mean*	*Sd*	*P value*
Energy (kcal/d)							
All	50	1977.59	436.90	50	1822.39	370.00	0.058
Gastrointestinal	6	1934.56	333.60	6	1495.06	220.17	0.023*
Breast	21	1995.03	463.87	21	1848.36	293.81	0.228
Gynaecology	15	2089.77	375.42	15	1921.17	409.79	0.250
Nasopharynx	2	2160.36	568.50	2	1582.71	291.74	0.329
Lung	3	1750.77	658.66	3	2129.93	469.80	0.462
Others	3	1485.71	296.42	3	1653.65	535.89	0.660
Dietary Fibre (g/d)							
All	50	10.86	8.90	50	13.22	5.95	0.122
Gastrointestinal	6	9.47	2.94	6	10.42	4.74	0.686
Breast	21	10.21	4.99	21	14.85	6.87	0.017*
Gynecology	15	12.93	15.02	15	11.99	4.39	0.818
Nasopharynx	2	11.19	4.96	2	18.56	12.11	0.000**
Lung	3	10.54	2.54	3	11.65	3.49	0.681
Other	3	7.90	3.81	3	11.56	4.46	0.340

*p < 0.05, **p < 0.005 independent sample t-test at 2 tail

Table 5. Relative risk of breast cancer with low fibre intake

Dietary exposure	*Breast cancer*		*Total (n = 42)*
	Yes (n = 21)	*No (n = 21)*	
< 10g/day of dietary fibre	14	6	20
> 10g/day of dietary fibre	7	15	22

Relative risk = 1e / 1d = $\frac{14 / 20}{7 / 22}$ = 2.2

Table 6. Percentile values and Odds Ratio for dietary fibre in breast cancer cases and their controls

	Percentile		
	25th	50th (median)	75th
Dietary fibre / g	8.16	10.63	14.98
Odds Ratio	2.4	2.17	1.7

an average of about 15g of dietary fibre daily (Slavin & Darling, 2000). The mean intake of fibre was significantly lower in women with breast cancer (10.21 ± 4.99g/d) and nasopharyngeal cancer (11.19 ± 4.96 g/d) as compared to their controls (14.85 ± 6.87 g/d, 18.56 ± 12.11 g/d, respectively) (Table 4b). Table 5 indicates that women with low fibre intake (<10 g/d) were 2.2 times more at risk of getting breast cancer than those who consumed more fibre (>10 g/d).

The data on fibre intake in the breast cancer cases and their controls have been further analysed using Npar Test and Chi Square test to determine the values of fibre intake and Odds Ratio at 25th, 50th and 75th percentile as shown in Table 6. The OR of having cancer decreased at a higher level of dietary fibre intake, i.e at the 75th percentile. For example, there is a 2.4 times risk of getting breast cancer with a low fibre intake of 8.16 g/day, as compared to a higher intake. It should be borne in mind that the data from the study is derived from a case control study which may have been confounded by several factors, such as memory and influence of disease states on dietary habits. The association between diet and disease can be accurately examined using a longitudinal cohort prospective study. However, such a study is time-consuming and requires a large amount of funding and subjects.

CONCLUSION

This study supported previous studies in the Western countries, showing that dietary fibre is regarded as an important risk factor for cancer. In addition, other dietary factors such as energy and fat intake are also related to cancer among Malaysians. It is, therefore, important for Malaysians to consume a diet high in fibre and low in fat in order to prevent cancer. Further studies are needed to investigate the source of dietary fibre among Malaysians and also to study ways to promote desirable intake.

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REFERENCES

Armstrong B & Doll R (1975). Environmental factors and cancer incidence and Mortality in different countries, with special reference to dietary practices. *Int J Cancer* 15: 617-631.

Bingham SA, Day NE, Luben R, Ferrari P, Slimani N, Norat T, Clavel-Chapelon F et al. (2003). Dietary fiber in food and protection against colorectal cancer in the European Prospective Investigation into Cancer and Nutrition (EPIC): an observational study. *Lancet* 361: 1496-1501.

Billings JA (1985). *Outpatient Manage--ment of Advance Cancer.* Lippincott, London.

Fatimah A, Nooriah S, Suzana S, Ruzita AT, Lingam MS, Lau FN, Tan EP & Lim PK (2004). A retrospective case-control study: the association between antioxidant, carcinogen and dietary fat intake and cancer. *Jurnal Kesihatan Malaysia* (In press).

Feldman JJ, Makuc DM, Kleinman JC & Cornoni-Huntley J (1989). National trends in education differentials in mortality. *Am J Epidemiol* 129: 919-933.

Gifft HH, Washbon MB & Harrison GG (1972). *Nutrition, Behavior and Change.* Prentice-Hall Inc, New Jersey.

Holmes MD, Hunter DJ, Colditz GA, Stampfer MJ, Hankinson SE, Speizer FR, Rosner B & Willett WC (1999). Association of dietary intake of fat and fatty acids with risk of breast cancer. *JAMA*. 281: 914-920

Howe GR, Hirohata T, Hislop TG, Iscovich JM, Yuan JM, Katsouyanni K, Lubin F, Murubini E, Modan B, Rohan T, Toniolo P & Shunzhang Y (1990). Dietary factors and risk of breast cancer: Combined analysis of 12 case-control studies. *J Natl Cancer Inst* 82: 561-569.

Katsouyanni K, Trichopoulou A, Stuver S, Garas Y, Kritselis A, Kyriakou G, Stoikidou M, Boyle P & Trichopoulous D (1994). The assossiation of fat and other macronutrients with breast cancer: a case-control study from Greece. *Br J Cancer* 70: 537-541.

Levi F, Negri E La, Vecchia C & TE VC (1988). Socioeconomic groups and cancer risk at death in the Swiss canton of Vaud. *Int J Epidemiol* 17: 711-717.

Marlett JA & Slavin JL (1997). American Dietetic Association: Health implication of dietary fiber. *J Am Diet Assoc* 97: 1157-1159

Marmot MG, Shipley MJ & Rose G (1984). Inequalities in death - specific explanations of a general pattern? *Lancet:* 1. 1003-1006.

Ministry of Health Malaysia (2000). Cancer Registry in Malaysia. Malaysia's Health 2000: Technical report of the director. General of health Malaysia 2000. Ministry of Health Malaysia. p. 71-75.

Ng TKW (1997). Dietary fat and fiber intakes of Malaysian adults: issues and implications when 'western target' are set as dietary goals. *Mal J Nutr* 3(2): 137-147.

Pearce NE & Howard JK (1986). Occupation, social class and male cancer mortality in New Zealand, 1974-1978. *Int J Epidemiol* 15: 456-462.

Peters U, Sinha R, Chatterjee N, Subar AF, Ziegler RG, Kulldorff M, Bresalier R et al. (2003). Dietary fiber and colorectal adenoma in a colorectal cancer early detection programme. *Lancet* 361: 1491-1495.

Reddy BS & Cohen LA (1986). *Diet, Nutrition and Cancer:* A Critical Evaluation. Vol. 2. Florida. CRC Press, Inc.

Saunders C (1984). *The Management of Terminal Malignant Disease.* 2nd edition. Edward Arnold Publication, New Jersey.

Slavin J & Darling M (2000). *Fiber in the Diet.* Department of Food Science and Nutrition, University of Minnesota Extension Service publication. http://www.extension.umn.edu/distribution/nutrition/DJ0423.html.

Smith D, Taylor R & Coates M (1996). Socioeconomic differentials in cancer incidence and mortality in urban New South Wales, 1987-1991. *Aust NZ J Public Health* 20: 129-137.

Steinmetz KA & Potter JD (1996). Vegetables, fruit, and Cancer Prevention: A Review. *Amer Diet Assoc Journal* 96: 1027-1039

St John DJ, McDermott FT, Hopper JL, Debney EA, Johnson WR & Hughes ES (1993) Cancer risk in relatives of patients with common colorectal cancers. *Am Intern Med* 118: 785-790.

Tee ES, Mohd Ismail N, Mohd Nasir A & Kahtijah I (1997). *Nutrient composition of Malayisan foods,* 4th Edition, Malaysian Food Composition Database Programme, Institute for Medical Research, Kuala Lumpur; 310 p.

Trowell H, Southgate DAT, Wolever TMS, Leeds AR, Gassull MA & Jenkins DJA (1976). Dietary fiber redefined. *Lancet* 1:976.

Wahlqvist ML (1993). Nutritional factors in carcinogenesis. *Asia Pacific J Clin Nutr* 2: 141 - 148.

WCRF/AIRC (1997). *Food, Nutrition and the Prevention of Cancer: a Global Perspective.* World Cancer Research Fund/ American Institute for Cancer Research (WCRF/AIRC), Washington DC.

Wilkens LR, Hankin JH, Yoshizawa CN, Konel LN & Lee J (1992). Comparison of long-term dietary recall between cancer cases and control. *Am J Epidemiol* 136: 825-35.

Willet WC (1989). The search for the causes of breast and colon cancer. *Nature* 338: 389-394.

Williams J, Clifford C, Hooper J. & Gilles G (1991). Socio-economic status cancer incidence in Melbourne. E*ur J Cancer* 27: 917-921.

Zeman FJ (1991). *Clinical Nutrition and Dietetics: Fiber and related substances.* 2nd Edition. MacMillan Publishing Co., New York.