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Incidence in Izmir in 1993–1994: first results from Izmir Cancer Registry

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Abstract

A population-based cancer registry, covering the province of Izmir (population 2.7 million, 1993–1994) in Western Turkey was established in 1992. Results for 1993–1994 are presented. Overall cancer incidence was higher in males than in females (age-standardised rates 157.5 and 94.0 per 100 000, respectively), as in previous non-population-based series. The principal cancers in males were tobacco-related — lung (age-standardised incidence rate (ASR) 61.6), bladder (ASR 11.0) and larynx (ASR 10.6), consistent with the high prevalence of smoking, and use of traditional high-tar tobaccos. Skin cancers were also relatively common (ASR 11.5 for cancers excluding melanoma). Gastrointestinal cancers were relatively rare. In women, breast cancer was by far the most common malignancy (ASR 24.4); cervical cancer was relatively rare (ASR 5.4). There is probably an underestimate of incidence, due to an inability to use data from certain sources (e.g. death certificates), resulting in a rather high proportion of histologically verified cases (93.7% overall). Nevertheless, the overall profile is an accurate reflection of incidence in this region of Turkey and provides much of the information required for planning strategies to control cancer.

Keywords: Cancer registry; Cancer statistics; Cancer control

1. Introduction

Turkey is situated in both the European and Asian continents, and has a total population of 62.8 million (1997). It is a democratic, secular republic, and the religion of the most of the people is Islam.

The province of Izmir is in the extreme west of the country, on the Aegean Sea coast (Fig. 1). The population is 3.3 million (1998), making it the third largest in Turkey; 89.4% of the population lives in urban areas, with the remaining 10.6% in rural areas. The area of the province is 11 530 km^2 and is divided into 28 districts. The city of Izmir is the major commercial and industrial centre of the Aegean region, while there are agricultural activities (tobacco, cotton, vegetables, fruits, etc.) in the rural areas of the province; tourism is one of the main industries for Izmir. Izmir is a destination for substantial internal migration, especially for people coming from the east and southeast regions of Turkey. As a result, the population comprises a mixture representing the major ethnic and socio-economic groups of the whole country.

In spite of several attempts, real cancer incidence data have never been available for a defined population within Turkey. The Ministry of Health established a 'passive cancer registration system' for the entire country in 1983. Since it was a passive system, relying upon notification of cancer cases from the whole country, information could only be obtained for approximately one-quarter of the estimated total of cancer cases. Thus, the Ministry of Health, together with the Turkish Association on Cancer Control, initiated a new 'active data collection system' in ten provinces in 1992. This system requires designated staff (usually nurses) to notify cases to a central office, where statistics are compiled. The first results from this system, for the years 1993–1994 have been published [1]. These data strongly suggest under-ascertainment, because there is a gap between the recorded and expected numbers of cancer cases.

In addition, sporadic relative frequency information from hospitals (including Hacettepe and Ege Universities) and pathology departments [2] have been published; these, however, suffer from several selection

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Fig 1. Izmir Province, Turkey.

biases and are not representative of a determined region. Mortality data in Turkey are incomplete, and are published only for selected urban areas; in addition, they suffer from problems concerning the accuracy of the certified cause of death. Statistics on cancer in Turkey, based on data from these various sources, have also been published from time to time [3,4].

The Izmir Cancer Registry (ICR) is the first population-based cancer registry to be organised in Turkey. It was founded in May 1992 by the Ministry of Health and Ege University, in collaboration with the Turkish–American Collaborative for Health Research and Programming, University of Massachusetts; now it is functioning as a department of the Izmir Provincial Health Directorate and is a member of the ENCR (European Network of Cancer Registries).

In this report, we present the incidence data from the second and third years of operation (1993–1994), and compare the results obtained with earlier frequency data from Turkey, with cancer incidence in neighbouring countries, and with migrants living in New South Wales, Australia, who were born in Turkey [5].

2. Patients and methods

The Izmir Cancer Registry (ICR) collects data on all new cases of cancer from all the hospitals ($n=22$) in the city, including university hospitals, state hospitals, hospitals of the social security administration, municipality hospitals, other governmental hospitals and private hospitals. Six hospitals have hospital-based cancer registries, from which the ICR receives the data directly. For all other sources, data collection is active, at the time of visits by five, full-time, medically qualified registry personnel, who collect cancer data from 22 hospitals, plus 12 clinics and laboratories, from the medical record onto specially designed notification forms.

All hospitals and centres accept the same definitions of 'cancer case', 'first date of diagnosis', etc. the same classification scheme (ICD-O-2) and the same rules for registry. Registrars of hospital-based centres use various sources for data of cancer cases, including patient files from all clinics, clinical reports and patient lists. They take advice from clinicians when they need to, and most of the centres collect data both on hardcopy and computers. The ICR receives their data periodically, as copies of the data form of each case.

Staff of the central office of the ICR visit contacts at other hospitals and obtain data directly from its sources, they also ask for advice from physicians when they need to. The ICR also receives data from 12 private pathology laboratories and oncology centres; however, since most of these data have insufficient socio-demographic information (missing age, address...), they could not be included in the main database. It is believed that cases missed for this reason comprise less then 1% of the total.

An advisory committee provides supervision of the overall registration activity, which has a right to make strategic decisions. Members of that committee are senior people working in different fields of oncology in the major hospitals of Izmir.

People who give any address from Izmir province for their residences are considered as 'residents'. 55.5% ($n=6162$) of the 11 105 total cancer cases which have been recorded in the ICR for 1993–1994 are Izmir residents. 378 (34%) of the total cases had no known

address, and these cases are not included in the analysis. Some of these cases would be Izmir residents, but the proportion of all cases is probably approximately 2%, so incidence rates are probably underestimated to this degree.

It is possible that some Izmir residents with cancer choose to be treated elsewhere, such as Istanbul or Europe. However, this is unlikely to be more than 1% of the cancer patients, bearing in mind the social composition of the population.

Cancer cases diagnosed by all methods are identified and recorded. The cases registered include both invasive and *in situ* lesions in all anatomical sites (including non-melanoma skin cancers); but only invasive cases are included in the incidence rates and tables in this paper.

The ICR also collects copies of death certificates mentioning cancer from the Provincial Health Directorate, but because of poor quality and lack of information regarding socio-demographic data and addresses, these data could not be matched with the records of incident cases. Therefore, death certificates were not used as a source for the incidence rates for the 1993–1994 period.

The site, morphology and behaviour of the tumours are coded using the International Classification of Diseases: Oncology, second edition (ICD-O-2) of the World Health Organization (WHO) [6], translated into Turkish by Canda [7], and International Agency for Research on Cancer (IARC)/International Association of Cancer Registries (IACR) rules are accepted for coding multiple primaries [8].

All data collected are computerised using a customised version of the CANREG-3 which was created by the Department of Descriptive Epidemiology of IARC for population-based cancer registries. This comprehensive computer programme includes facilities for detecting duplicate registration of the same cancer, multiple primaries, and for performing 'checks' on the validity of the entered data.

Cancer cases among residents of Izmir province, incident during 1993–1994 were included in the present analysis.

For the source of population data, two options were considered: (1) extrapolation from 1990 national census; (2) annual registrations by health centres of the Provincial Health Directorate of Izmir.

After evaluating annual figures, it was decided to use the latter, because it is updated annually and reflects internal immigration more precisely.

Therefore, the person-years of population at risk by sex and 5-year age groups were estimated based on population tables for 1993–1994 prepared by the Provincial Health Directorate of Izmir. The average annual population at risk, by age group and sex, is shown in Table 1.

Table 1
Population distribution of Izmir province by age and sex (1993–1994)

Age group (years)	Males	Females	Total
0–4	109 589	105 849	215 438
5–9	118 781	116 151	234 932
10–14	130 639	127 685	258 324
15–19	130 304	127 747	258 051
20–24	121 665	130 036	251 701
25–29	124 645	126 670	251 315
30–34	122 355	118 285	240 640
35–39	110 671	105 113	215 784
40–44	93 943	87 463	181 406
45–49	75 793	70 385	146 178
50–54	63 499	60 233	123 732
55–59	53 451	53 633	107 084
60–64	49 026	48 418	97 444
65–69	34 309	35 188	69 497
70–74	18 942	20 229	39 171
75+	19 579	24 110	43 689
Total	1 377 191	1 357 195	2 734 386

Arithmetical mean of 1993 and 1994 mid-year population figures.

3. Results

Of the 11 105 cases registered in the 2-year period (1 January 1993–31 December 1994) 6162 (55%) were residents of Izmir Province, 3786 (61%) of them were males and 2376 (39%) were females. Tables 2 and 3 show the principal cancer sites, the number of cases within 10-year age groups (with the exception of the first and last age groups), as well as crude and age-standardised incidence rate (ASR) for males and females, respectively. The incidence rates for all cancers combined were 137.5 per 100 000 (crude) and 157.5 per 100 000 (ASR) for males and 87.5 (crude) and 94.0 per 100 000 for females (ASR).

In males, lung cancer was by far the most frequently recorded malignancy (38.6% of cancers; ASR 61.6), followed by non-melanoma skin cancers (7.1%, ASR 11.5), larynx (6.9%; ASR 10.6), bladder (6.8%; ASR 11.0) and stomach (5.2%; ASR 8.0). In females, breast was the most common site of cancer (26.7%; ASR 24.4), followed by non-melanoma skin cancer (8.8%, ASR 8.8), corpus uteri (6.5%, ASR 6.4) ovary (6.4%; ASR 5.9), and cervix uteri (5.9%; ASR 5.4).

Fig. 2 shows the age-specific incidence rates for lung, bladder and larynx cancers in males. Fig. 3 shows the equivalent curves for cancers of the breast, corpus and cervix uteri in females.

Table 4 shows the percentage of cases with morphological verification. 93.7% of the cases had been diagnosed on the basis of histology, haematology or cytology. The remainder comprises cases which had been diagnosed clinically or on the basis of radiological or biochemical investigation. The cancers with the highest percentage of histological verification were those

located in readily accessible sites (e.g. cervix and oral cavity). Sites more difficult to access (e.g. liver and pancreas) had the lowest percentage of histological verification. The proportion of histologically diagnosed cases decreased with age from 96% in the age group <35 years to 91% at $\geqslant 65$ years. Table 5 shows the numbers, and incidence rates, for the most common cancers in the childhood age group (0–14 years of age), classified according to the International Classification for Childhood Cancer [9]. The most common cancers in this age group were leukaemia (34.9% of cases, ASR 42.9 per 1 000 000), lymphomas (15.1% of cases, ASR 18.4 per 1 000 000), and brain and spinal neoplasms (16.3% of cases, ASR 19.8 per 1 000 000). There was a marked deficit of cancer cases recorded as being less than 1 year of age, since children less than 12 months of age are recorded as being '1 year old'.

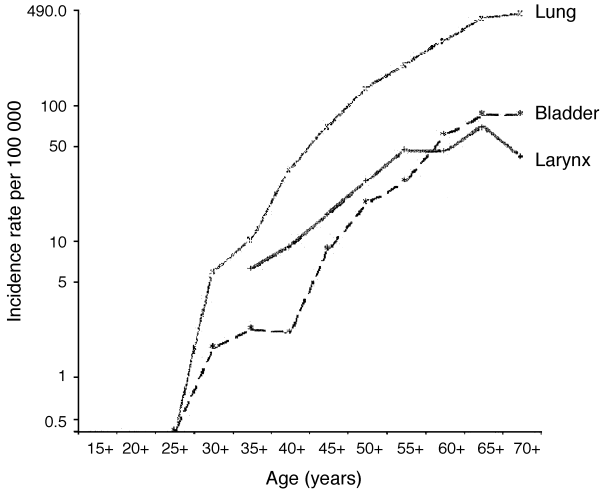

Fig. 2. Incidence rates of principal cancers in Izmir for males (1993–1994). IARC, 1999.

4. Discussion

Although several case series (from hospitals, or pathology data) have been published in the past, the results presented here are the first from a population-based registry in Turkey. During the registration process, care is taken to match all notified cancer cases against the database, so that the possibility of duplicate registration is avoided. Only cases resident in the Izmir province are included in the analysis presented. Since

Table 2
Number of cancer cases and incidence rates by site and age groups in Izmir for 1993–1994 (males) performed by a direct method using the world standard population

Site	Numbers of cases by age groups (years)									Relative frequency (%)	Annual incidence rate (per 100 000)	
	0–14	15–24	25–34	35–44	45–54	55–64	65–74	>74	Total		Crude	ASR
Oral cavity	0	1	1	5	7	16	16	3	49	1.3	1.8	2.0
Nasopharynx	3	1	1	2	3	3	3	1	17	0.4	0.6	0.6
Other pharynx	1	1	1	4	6	9	4	1	27	0.7	1	1.0
Oesophagus	0	0	0	3	6	19	12	4	44	1.2	1.6	1.8
Stomach	0	0	5	17	35	70	55	13	195	5.2	7.1	8.0
Colon/rectum	1	1	3	19	30	51	45	20	170	4.5	6.2	7.0
Liver	1	0	0	0	8	13	13	1	36	1.0	1.3	1.5
Gall bladder	0	0	0	1	1	7	5	3	17	0.4	0.6	0.7
Pancreas	0	0	1	4	6	14	17	3	45	1.2	1.6	1.9
Larynx	0	0	1	31	59	95	63	13	262	6.9	9.5	10.6
Bronchus, lung	0	0	16	87	277	500	480	103	1463	38.6	53.1	61.6
Bone	2	18	8	1	1	1	2	1	34	0.9	1.2	1.2
Connective tissue	3	2	3	3	4	7	10	4	36	1.0	1.3	1.5
Melanoma of skin	0	2	3	2	3	6	4	1	21	0.6	0.8	0.8
Other skin	0	3	5	19	39	68	82	52	268	7.1	9.7	11.5
Prostate	1	0	0	1	4	28	58	25	117	3.1	4.2	5.4
Testis	2	7	14	10	3	1	0	0	37	1.0	1.3	1.2
Bladder	0	0	5	9	37	87	90	28	256	6.8	9.3	11.0
Kidney, etc.	3	0	1	0	11	18	9	2	44	1.2	1.6	1.9
Brain, nervous system	11	9	11	20	17	23	11	2	104	2.7	3.8	3.9
Thyroid	0	1	0	2	2	4	4	0	13	0.3	0.5	0.5
Non-Hodgkin's lymphoma	11	10	6	7	12	16	16	7	85	2.2	3.1	3.4
Hodgkin's disease	8	2	8	6	6	4	1	1	36	1.0	1.3	1.3
Multiple myeloma	0	0	0	0	6	7	9	2	24	0.6	0.8	1.0
Lymphoid leukaemia	29	6	5	0	3	7	4	2	56	1.5	2	2.3
Myeloid leukaemia	8	12	11	8	13	12	14	7	85	2.2	3.1	3.3
Other leukaemias	0	0	0	0	2	1	1	0	4	0.1	0.1	0.1
Other, non-specified	10	4	11	24	44	74	62	12	241	6.4		
All sites	94	80	120	285	645	1161	1090	311	3786	100.0	137.5	157.5
All sites, but skin									3497		127.7	145.4

information from several data sources had insufficient personal identifiers, or places of residence, such cases have not been included.

It is important therefore to review the quality of data in terms of completeness and validity. The percentage of cases registered with microscopic verification (MV) of diagnosis is very high, with values similar to those observed in developed countries. This may represent an under-registration of clinically-diagnosed cases. Advanced cases of malignancies clinically diagnosed in outpatient departments and in offices of clinicians are less likely to be subjected to intense diagnostic and therapeutic procedures, and in this context, it is noticeable that the proportion of histologically diagnosed cases decreases with age, from 96% in the age group < 35 years to 91% at ages 65 years and over. Furthermore, inadequate death registration procedures, particularly in terms of cause-specific mortality, and the place of residence of the deceased, means that death certificate notifications were not used as a source of information.

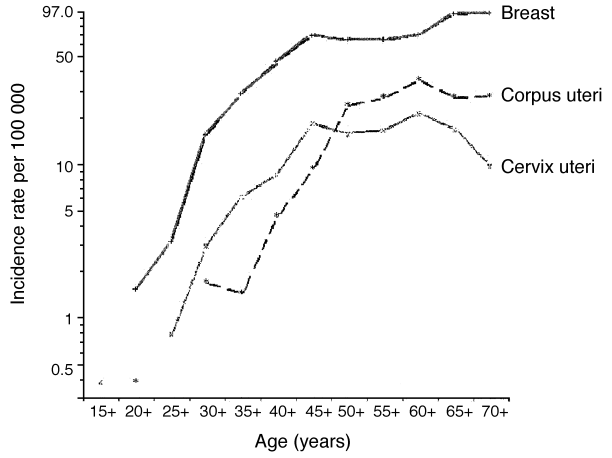

Fig. 3. Incidence rates of principal cancers in Izmir for females (1993–1994). IARC, 1999.

Nevertheless, the data that we collected were generally valid, in view of the standard registration practices [10] followed by the ICR and the collection of data from

Table 3
Number of cancer cases and incidence rates by site and age groups in Izmir for 1993–1994 (females) performed by a direct method using the world standard population

Site	Numbers of cases by age groups (years)									Relative frequency (%)	Annual incidence rate (per 100 000)	
	0–14	15–24	25–34	35–44	45–54	55–64	65–74	>74	Total		Crude	ASR
Oral cavity	0	1	1	3	4	14	12	3	38	1.6	1.5	1.5
Nasopharynx	1	1	0	2	1	0	0	0	5	0.2	0.2	0.2
Other pharynx	0	0	1	1	2	3	3	0	10	0.4	0.3	0.4
Oesophagus	0	0	2	1	6	5	5	2	21	0.9	0.8	0.8
Stomach	0	0	9	15	10	24	26	8	92	3.9	3.4	3.6
Colon/rectum	0	0	7	11	22	46	39	14	139	5.9	5.1	5.6
Liver	1	1	0	2	3	6	1	5	19	0.8	0.7	0.8
Gall bladder	0	0	1	2	6	10	9	7	35	1.5	1.3	1.4
Pancreas	0	0	2	1	2	8	9	3	25	1.1	0.9	1.0
Larynx	0	0	0	0	2	5	1	0	8	0.3	0.3	0.3
Bronchus, lung	2	1	3	9	21	34	42	11	123	5.2	4.5	5.1
Bone	2	6	4	2	5	0	4	0	23	1.0	0.8	0.8
Connective tissue	5	3	4	2	1	2	3	5	25	1.1	0.9	1.0
Melanoma of skin	0	0	2	3	4	6	4	0	19	0.8	0.7	0.8
Other skin	0	2	3	7	22	55	75	44	208	8.8	7.7	8.8
Breast	0	4	45	142	175	136	106	26	634	26.7	23.4	24.4
Cervix uteri	0	1	9	28	45	39	16	2	140	5.9	5.2	5.4
Corpus uteri	0	1	4	11	42	63	30	4	155	6.5	5.7	6.4
Ovary	2	7	14	25	39	36	24	4	151	6.4	5.7	5.9
Bladder	0	0	0	2	2	8	15	8	35	1.5	1.3	1.5
Kidney etc.	7	2	0	5	5	11	6	0	36	1.5	1.3	1.6
Brain, nervous system	19	16	8	9	8	15	5	0	80	3.4	2.9	3.0
Thyroid	1	3	10	6	2	9	1	0	32	1.3	1.2	1.1
Non-Hodgkin's lymphoma	3	6	10	6	8	15	13	6	67	2.8	2.5	2.6
Hodgkin's disease	4	1	3	4	2	1	0	2	17	0.7	0.6	0.6
Multiple myeloma	0	0	0	2	2	12	5	0	21	0.9	0.8	0.9
Lymphoid leukaemia	18	1	0	0	5	9	3	2	38	1.6	1.4	1.7
Myeloid leukaemia	5	5	6	2	8	5	9	0	40	1.7	1.5	1.5
Other leukaemias	0	0	0	0	0	2	1	0	3	0.1	0.1	0.1
Other, non-specified	8	3	6	12	21	38	33	16	137	5.8		
All sites	78	65	154	315	475	617	500	172	2376	100.0	87.5	94.0
All sites, but skin									2149		79.9	85.3

ASR, age-standardised incidence rate.

Table 4
Basis of diagnosis for cancer cases of Izmir by site, 1993–1994

Sites	Basis of diagnosis (% of cases)	
	Microscopically verified[a]	Others [b]
Oral cavity	100.0	0
Nasopharynx	100.0	0
Other pharynx	97.3	2.7
Oesophagus	87.7	12.3
Stomach	91.6	8.4
Colon/rectum	87.1	12.9
Liver	81.8	18.2
Gall-bladder	90.4	9.6
Pancreas	60.0	40.0
Larynx	98.5	1.5
Lung and bronchus	92.5	7.5
Melanoma of skin	100.0	0.0
Breast	95.2	4.8
Cervix uteri	100.0	0.0
Corpus uteri	99.4	0.6
Ovary	96.0	4.0
Prostate	98.3	1.7
Testis	100.0	0
Bladder	96.9	3.1
Kidney, etc.	96.3	3.6
Brain, nervous system	93.5	6.5
Thyroid	100.0	0.0
Non-Hodgkin's lymphoma	98.0	2.0
Hodgkin's disease	98.1	1.9
Multiple myeloma	100.0	0
Leukaemia	92.9	7.1
All sites (total $n=6162$)	93.7	6.3

[a] Cancer diagnosis by cytological, histological and haematological methods.

[b] Cancer diagnosis by clinical, radiological, immunological methods, etc.

multiple data sources. The data collection is regularly supervised and the information is carefully scrutinised. The use of CANREG-3 software for data management further enhances the validity of data reported.

Incidence rates in females were much lower than in males. In part, this is a consequence of the much lower incidence rates for tobacco-related cancers (see below), but rates for almost all sites showed a decrease in females. Thyroid and gallbladder cancers were the only exceptions which showed an increase and multiple myeloma and melanoma of the skin showed similar incidence rates. This may represent some selective underregistration in females, although in 1994 both hospital admissions for cancer and the notifications to the Central Cancer Registry [4] show a marked male predominance for almost all sites; for example, the 'male/female' (M/F) ratios from these two sources were 1.6 and 1.7 for stomach cancer, and 1.4 and 1.5 for leukaemia–lymphoma cases.

In Table 6 the ASRs for the major cancer sites in Izmir are summarised and compared with the results from cancer registries elsewhere in Western Asia (Kuwait, Israel), in the Mediterranean region (Spain, southern Italy, Malta), and south-eastern Europe (Bulgaria). In addition, incidence rates from the Saarland Cancer Registry in Germany are included, and also Turkey residents who migrated to New South Wales in Australia [5].

The most striking feature of the cancer profile is the high incidence of tobacco-related cancers (lung, larynx and bladder) in men. The incidence of lung cancer is high — almost equal to that in Germany, but higher than in other Mediterranean or West Asian populations.

Table 5
Childhood cancer cases (age group 0–14 years), Izmir 1993–1994

Cancer groups	Number of cases		Relative frequency (%)	Annual incidence rate (ASR per 1 000 000)
	Total (n)	Boys/Girls n (%)/n (%)		
Leukaemia	60	37 (62)/23 (38)	34.9	42.9
Acute lymphocytic	47	29 (62)/18 (38)	27.3	34.4
Lymphomas	26	19 (73)/7 (27)	15.1	18.4
Hodgkin's disease	12	8 (67)/4 (33)	7.0	8.6
Burkitt's lymphoma	3	3 (100)/0 (0)	1.7	2.0
Other NHL	11	8 (73)/3 (27)	6.4	7.8
Brain + spinal neoplasms	28	11 (39)/17 (61)	16.3	19.8
Astrocytoma	11	5 (45)/6 (55)	6.4	7.7
Primitive neuroectodermal tumours	10	4 (40)/6 (60)	5.8	7.3
Neuroblastoma	13	6 (46)/7 (54)	7.6	11.7
Wilm's tumour	9	3 (33)/6 (67)	5.2	7.9
Retinoblastoma	4	2 (50)/2 (50)	2.3	3.4
Hepatic tumours	2	1 (50)/1 (50)	1.2	1.5
Bone tumours	4	2 (50)/2 (50)	2.3	2.2
Soft tissue sarcomas	12	5 (42)/7 (58)	7.0	8.0
Germ cell/gonadal tumours	7	3 (43)/4 (57)	4.1	5.3
Carcinomas	7	5 (71)/2 (29)	4.1	4.1
Total	172	94 (55)/78 (45)	100.0	125.0

NHL, non-Hodgkin's lymphoma.

Table 6
Age standardised incidence rates (world standard) in Izmir, and comparison registries [11]

Males

	Oesophagus	Stomach	Colon/ rectum	Liver	Larynx	Lung	Prostate	Bladder	NHL	Hodgkin's	Leukaemias
Izmir 1993–1994	1.8	8.0	7.0	1.5	10.6	61.6	5.4	11	3.4	1.3	5.7
Israel: all Jews (1988–1992)	1.7	13.0	39.2	3.2	4.8	27.0	23.9	25.2	12.6	2.9	7.4
Israel: non-Jews (1988–1992)	0.5	6.8	9.3	2.6	3.7	29.1	10.4	13.1	8.3	2.4	6.0
Kuwait: Kuwaitis (1988–1993)	1.7	4.1	7.4	7.4	2.5	20.3	6.5	7.0	5.5	4.0	5.1
Italy, Ragusa (1988–1992)	1.0	13.2	19.8	8.5	4.8	39.0	12.0	13.7	6.5	2.7	7.1
Malta (1992–1993)	3.3	11.2	22.9	1.8	10.5	48.2	22.3	27.2	6.8	1.8	7.6
Spain, Granada (1988–1992)	3.8	15.5	19.1	7.2	13.7	45.3	15.1	23.5	5.6	2.1	6.7
Bulgaria (1995)[a]	1.6	15.1	23.2	4.0	7.9	43.2	12.3	4.0	2.9	1.8	4.1
Germany, Saarland (1988–1992)	6.7	18.5	42.8	4.2	8.1	70.9	35.9	23.1	9.4	2.3	9.3
Migrants to New South Wales[b]	2.8	15.1	24.2	10.0	0.0	49.4	32.7	19.9	13.8		14.7

Females

	Oesophagus	Stomach	Colon/ rectum	Liver	Lung	Breast	Cervix uteri	Corpus uteri	Ovary	NHL	Hodgkin's	Leukaemia
Izmir 1993–1994	0.8	3.6	5.6	0.8	5.1	24.4	5.4	6.4	5.9	2.6	0.6	3.3
Israel: all Jews (1988–1992)	1.1	6.2	31.3	1.6	9.2	77.4	5.3	10.8	11.6	10.4	2.8	4.9
Israel: non-Jews (1988–1992)	0.2	3.2	9.4	1.4	3.7	21.3	3.0	4.9	3.0	6.5	1.6	4.5
Kuwait: Kuwaitis (1988–1993)	2.5	4.8	6.7	3.5	9.2	32.8	7.6	2.4	4.7	7.1	2.0	4.6
Italy, Ragusa (1988–1992)	0.4	6.4	15.4	3.3	5.0	44.1	7.6	10.5	6.9	4.1	2.0	5.1
Malta (1992–1993)	1.0	6.0	18.8	0.9	3.4	79.9	6.4	16.4	12.0	5.5	2.1	6.0
Spain, Granada (1988–1992)	0.5	7.0	14.6	3.4	2.7	37.4	5.6	9.0	6.5	4.3	1.4	5.4
Bulgaria (1995)[a]	0.2	7.5	15.9	2.3	5.5	45.1	14.8	14.8	10.6	1.7	1.0	3.1
Germany, Saarland (1988–1992)	0.8	9.0	31.4	1.6	10.3	61.5	11.4	12.7	9.6	5.8	1.9	5.8
Migrants to New South Wales[b]	0.0	7.3	14.4	1.4	10.6	43.0	4.9	10.3	9.2	7.9		4.4

NHL, non-Hodgkin's lymphoma.
[a] Ref. [12].
[b] Ref. [5].

The incidence in Turkish migrants to New South Wales, Australia, was also relatively high. Lung cancer was the most common site among hospital admissions for cancer in men in 1994 (27.7%) and the commonest cancer notified to the National Registry (26.3%) [4]. Laryngeal cancer rates are typical of those generally observed in other Mediterranean countries, although considerably higher than in Israel and Kuwait. Conversely, incidence of these cancers in females is low (Table 6, data not shown). A large case–control study in Istanbul showed a clear association between tobacco smoking and both lung and laryngeal cancers in men, with a dose–response relationship for both sites [13]. The lung cancer rates in males were much higher than those predicted in GLOBOCAN (http://www-dep.iarc.fr/dataava/globocan/globojava.html) (61.6 compared with 35.8) although the relative frequencies were similar (GLOBOCAN 32% versus Izmir 38.6%). There are several possible explanations for the differences: (1) inaccuracy of national data; (2) high rates in Izmir for lung cancer in men (tobacco is one of the main agricultural products of the province and the smoking rate is very high in some areas); (3) difference by chance. In general, the Izmir registry data are more accurate.

Turkey ranks fifth in the world in total tobacco production, and is the world's leading producer of oriental tobacco. Annual adult per capita consumption of cigarettes has declined slightly since the late 1970s, and averaged approximately 2100 in the early 1990s. However, these figures may be underestimates, since an estimated 2000 tonnes of illegally imported cigarettes find their way into the domestic market each year. A national survey undertaken in 1988 reported that the overall prevalence of smoking among adults (age >15 years) was 43.0% (63% males; 24% females), while according to a 1993 survey, smoking prevalence among males was 58% and was 13% among females. In the study by Dosemeci and colleagues [13], 65% of controls were 'ever-smokers'. The proportion of cancer deaths in Turkey which were recorded as due to lung cancer increased between 1985 and 1991 [14].

Tobacco smoking may also be responsible for the relatively high incidence of bladder cancer among males, as mentioned in a study from the Aegean region [15]. Cigarette smoking (as well as alcohol and coffee intake) were observed to increase the risk of bladder cancer in a case–control study in Istanbul [16]. Occupa-

tional exposures may account for some cases, since there are chemical, petrochemical and plastics industries in Izmir.

While smoking is common in Turkey, alcohol drinking, as reflected in the statistics on consumption and use [17] is not. Thus, consumption of commercial alcohol in 1985 was equivalent to only 1.0 l of ethanol per head of population (compared with 10.8 l per caput in W. Germany). Only 13% of control subjects (men) in the study by Dosemeci and associates [13] had ever consumed alcohol. This pattern may account for the rather low rates for other cancer sites associated with the combination of tobacco plus alcohol — e.g. pharynx and oesophagus as seen in Table 1. Cancers of the oral cavity were not frequent either. Chewing tobacco is not practised in Izmir, by either sex.

The incidence of stomach cancer in Izmir was lower than elsewhere in Southeast Europe, and lower than in Israel, with incidence rates similar to those in the USA [11]. There may be some under-registration, or underdiagnosis of stomach cancer, since the rates in migrants to Australia were substantially higher [5]. Nevertheless, the relative frequency of gastric cancer in the National Registry data for 1994 was also rather low: 6.9% of male cancers, 6.2% of females. Infection with *Helicobacter pylori* is considered to be an important carcinogen [18], and the prevalence of infection has been found to be high, with 85% of adults testing as antibody-positive [19]. Therefore, there must be important protective factors — possibly dietary (in Izmir, the diet is typically 'Mediterranean') — which contribute to the low risk. In this context, a case–control study in Ankara has suggested a protective effect for the consumption of fruit and vegetables, with risk enhanced by a higher intake of salt [20].

The incidence of liver cancer in Izmir was rather low. In addition, liver cancer is not one of the most frequent cancers among hospital cases for Turkey [4]. Hepatitis viruses B and C, and aflatoxin are major risk factors for hepatocellular carcinoma [21] and the international incidence pattern of liver cancer correlates well with the prevalence of hepatitis B viral infection. In Turkey, the WHO reported the prevalence of chronic carriers of hepatitis B virus who test positive for hepatitis B surface antigen (HBsAg) as approximately 4%, and a survey of pregnant women in Ankara found a prevalence of 4.3% [22]. The prevalence of markers of infection with hepatitis C virus has been investigated in a community survey in five districts — it was 1.5% overall, similar to that in other countries of Southern Europe [23]. Moderate prevalence of infections such as these might have been expected to give a rather higher risk of liver cancer than that recorded by the registry; however, there may be some underascertainment of cases, since the incidence in migrants from Turkey to Australia was considerably higher (Table 6) [5]. It is assumed that aflatoxin exposure is also low in Izmir, although no information on the exposure levels is available.

Breast cancer was the most frequent cancer of women in Izmir, accounting for approximately a quarter (26.7%) of female cancers. The age-standardised rate was, however, relatively modest — similar to that in the other countries of Western Asia (except Israel), and considerably less than in the European countries. The incidence in Turkish women in Australia is considerably higher [5]. Hospital frequency data from Turkey have consistently shown a high frequency of breast cancer — 14.9% of hospital admissions of women with cancer in 1994, and 23.1% of notifications to the National Registry [4]. The age-specific pattern was rather different from that usually observed, in that, as well as a flattening in the age-specific curve after the menopause, there was a high risk in the oldest age groups (65–74 years) (Fig. 3).

The major influences on breast cancer risk are reproductive factors. Among Turkish women, fertility has declined in recent years, with total fertility rates declining from 4.3 in 1978, to 3.0 in 1988 and to 2.6 in 1998. This might be expected to be associated with an increasing incidence of breast cancer in the future.

The low incidence of cervical cancer, a cancer that is associated with sexual and reproductive factors and the oncogenic subtypes of the human papilloma virus [24] is the pattern observed in Muslim countries in Western Asia. The ASR in this study was similar to that in Jews in Israel, and in migrants to Australia (Table 6). Muslims in Bombay have a lower incidence than the other major religious groups [25].

The incidence of prostate cancer was low, and similar to that observed in other Asian populations. The incidence of prostate cancer varies widely between countries and ethnic groups, and differences in genes associated with androgen metabolism or inherited susceptibility may explain some of this variability [26]. The incidence in Turkish men who have migrated to Australia was six times higher (Table 6) suggesting that underdiagnosis accounts for the low recorded rates, which are readily inflated by examination of prostatic tissue obtained during trans-urethral prostatectomies, or by prostate specific antigen (PSA) screening.

The incidence of lymphomas and leukaemias was relatively low, as in several Asian populations. The age distribution of Hodgkin's disease in Izmir, at least in males, showed features intermediate between developing and developed countries, with a raised incidence both in childhood, and in young adults. Among histologically specified subtypes, mixed cellularity predominated (even among young adults), as observed in other developing countries. Among leukaemia, myeloid leukaemia was seen in excess of lymphoid leukaemias in men, as observed in other cancer registries in West Asia.

The profile of cancer in childhood (Table 5) was quite comparable with that in countries of Southern Europe

[27]. Several previous studies in Turkey [27,28] have drawn attention to the frequency of Burkitt's lymphoma (BL) in clinical series of lymphomas in childhood. In the Izmir registry data, it does not seem that BL was particularly frequent, the recorded incidence (2 per million) being quite similar to rates in North America and Europe [29].

In conclusion, the cancer patterns revealed by the ICR, despite some probable under ascertainment of non-histologically diagnosed cases, are of considerable interest. The results provide valuable leads to cancer control in western Turkey. Tobacco control measures in particular are important, in view of the major burden of related cancers, particularly among men. Breast cancer accounts for approximately a quarter of all new cancers in women and appropriate methods of ensuring early detection and effective treatment are important for its control.

It is important to develop population-based cancer registration in other representative regions of Turkey to have better estimates of the national pattern and the overall cancer burden. This will be useful in the overall context of planning and evaluation of cancer control activities.

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