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Cancer incidence in eighteen cities of the State of São Paulo, Brazil

Incidência de câncer em dezoito cidades do Estado de São Paulo

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Keywords
Neoplasms, epidemiology.# Morbidity.# Health surveys.# Incidence. Diseases registries. Brazil, epidemiology. – Population-based cancer registries.

Abstract

Objective
As in Brazil cancer registries are mostly based on large cities, there are no estimates per state or per region and information on the disease incidence in the vast in-land areas is very scarce. An incidence survey was conducted in 18 major cities of the state of São Paulo, excluding the capital, aiming to collect information about cancer incidence in the state of São Paulo.

Methods
Of the 18 cities in state of São Paulo included in the survey, all had available resources for cancer management. Data from the year of 1991 were collected by the personnel of the Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Statistics), who were especially trained by the study coordinators at the Fundação Oncocentro de São Paulo (Cancer Center of São Paulo). The collected data were processed and analyzed at the Oncocentro. Data collection, processing, and analyses were performed according to the recommendations of the International Agency for Research on Cancer.

Results
Although some discrepancies were observed in cancer incidence rates between the cities, results obtained for all 18 cities combined were remarkably close to those recently found for the city of São Paulo in the year 1993. One remarkable finding was the relatively high cancer incidence rates in both sexes in the city of Santos.

Conclusions
The very similar all-sites cancer incidence rates found in the year 1991, when compared to those for the city of São Paulo in the year 1993, are suggestive that all regions have common cancer-related factors. Nevertheless, other explanations, such as the inclusion in the study of prevalent cases, as well as of non-residents, may have occurred in both studies, biasing the results. There is a need of further studies to confirm the high cancer incidence in Santos.

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Descritores
Neoplasias, epidemiologia.# Morbidade.# Levantamentos epidemiológicos.# Incidência. Registros de doenças. Brasil, epidemiologia. – Registros de câncer com base populacional.

Resumo

Objetivo
Os registros populacionais de câncer no Brasil são invariavelmente baseados em cidades grandes. Não existem registros de câncer em que a abrangência inclua Estados ou regiões e em que os achados possam refletir mais fielmente a incidência da doença no interior do País. Com base nessa percepção, foi realizado estudo sobre a incidência de câncer em 18 cidades do interior do Estado de São Paulo, visando a dimensionar a importância da doença nessa região brasileira.

Métodos
Das 18 cidades do interior do Estado de São Paulo incluídas no estudo, duas não eram sede de região administrativa, e todas contavam com recursos para diagnóstico e tratamento de câncer. O ano escolhido para ser pesquisado foi 1991. A coleta de dados foi realizada por equipes do Instituto Brasileiro de Geografia e Estatística, especialmente treinadas pelo pessoal técnico da Fundação Oncocentro de São Paulo; nesta última, as informações foram processadas e analisadas. Os procedimentos adotados para a coleta e análise dos dados seguiram as recomendações da International Agency for Research on Cancer.

Resultados
Apesar das discrepâncias observadas nas taxas de incidência de câncer entre as cidades componentes do estudo, os resultados obtidos no conjunto das 18 cidades mostraram-se próximos aos apurados pelo registro populacional de câncer do Município de São Paulo em 1993. Ressaltaram-se as altas taxas de incidência de várias formas de câncer tanto no sexo feminino quanto masculino, na cidade de Santos.

Conclusões
A similitude das taxas de incidência de câncer (todas as localizações combinadas) entre o Município de São Paulo em 1993 e o conjunto das 18 cidades pesquisadas neste estudo parece sugerir a existência de fatores genéticos e ambientais em comum, influindo na gênese da doença nessas populações; no entanto, outras razões podem igualmente ser aventadas, como a inclusão de casos prevalentes e de não-residentes em ambos os estudos. As altas taxas de incidência registradas para quase todas as formas de câncer em Santos necessitam ser confirmadas em novos estudos.

INTRODUCTION

Despite the growing importance of cancer on morbidity and mortality in Brazil,[5] and the increasing value of monitoring incidence,[2] cancer incidence has never been recorded in geographic areas other than large cities, since the existing Brazilian cancer registry system is based on big cities. In fact, as of the mid-nineties, there were five registry centers in operation in the country, namely Belém, Campinas, Fortaleza, Goiânia, and Porto Alegre,[10,13] whereas the São Paulo registry was just resuming its activities.[7,8] However, not a single attempt had been made to establish a cancer registry system covering a wider geographic area, such as a whole region or state, that could provide a more precise estimate of the disease incidence in a certain region. In an attempt to shorten this gap, a cancer incidence survey was conducted in 18 cities representative of all regions of the state of São Paulo between 1993 and 1996, aiming to assess for the first time the impact of the disease on a specific region instead of on a single city. In order to collect information on cancer incidence in a large number of cities, some of them more than 600 kilometers apart from the coordinating center, the Instituto Brasileiro de Geografia e Estatística – IBGE (Brazilian Institute of Statistics) was involved in the study.

The study was planned and coordinated at the Fundação Oncocentro de São Paulo (FOSP), an agency of the health department of the state of São Paulo, in charge of the administrative and epidemiological issues related to cancer on a state-level basis.

METHODS

The IBGE was hired to collect relevant information about cancer incidence.

The IBGE staff involved in the fieldwork was trained by the FOSP technical personnel. The training consisted of three intensive courses including basic notions on medical terminology, anatomy, tumor biology, organization of medical records, diagnosis reports, and classification and coding of the collected data. Internationally accepted procedures were

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adopted for data coding and classification, to ensure their consistency and comparability. The diagnosis coding was made according to the International Classification of Diseases, 10th revision.[12]

The methodology of the field survey was based on the recommendations of the International Agency for Research on Cancer (IARC).[4,14]

The total population of the 18 cities combined amounted to a total of 3,730,002, according to the nationwide census of 1991, the selected year for the study. The selection of cities was based on their administrative, economical, medical (existence of local resources for cancer management), and geographical relevance. Every major region of the state of São Paulo, excluding its capital, was represented by one or two cities, usually the most populous within each state region.

Data were collected from a total of 785 institutions, comprising hospitals, outpatient services, pathology and clinical laboratories, radiotherapy and chemotherapy clinics. Data on mortality were obtained through death certificates and autopsy records. The total number of cases collected was 35,471. After excluding non-residents, duplicates, benign tumors cases and cases with the diagnosis of in situ cervical cancer, 13,161 cases remained. The IBGE personnel filled out a notification form for each cancer case including demographic and specific diagnostic information. Starting in 1993, the fieldwork took eight months to be completed. On Table 1, the distribution of both the population and number of cases from each city surveyed is presented.

Data quality control was undertaken by comparing with routinely collected data, such as official mortality statistics, hospital admission reports available at the Department of Health of the State of São Paulo, and hospital cancer registry reports available at FOSP. In addition, a local revision of the information collected for one major city (Santos) was carried out.

Table 1 - Cancer cases and population, São Paulo State cities, 1991.

City	Population	Number of records (cancer cases)
Araçatuba	159,557	632
Barretos	95,414	228
Bauru	261,112	1,335
Botucatu	90,761	399
Bragança Paulista	108,980	312
Catanduva	93,317	501
Franca	233,098	653
Itapeva	81,858	150
Jaú	94,116	249
Marília	161,149	456
Presidente Prudente	165,484	356
Ribeirão Preto	436,682	2,298
Santa Bárbara D´Oeste	145,266	177
Santos	428,923	2,295
São João da Boa Vista	69,148	100
São José do Rio Preto	283,761	1,026
São José dos Campos	442,370	949
Sorocaba	379,006	1,045
All cities	3,730,002	13,161

Table 3 - Proportional distribution of cancer cases according to percents of cases with age and primary site of the tumor unknown, São Paulo State cities studied, 1991.

City	Unknown primary site age	Number of unknown	records
Araçatuba	0.9	3.2	632
Barretos	4.4	1.8	228
Bauru	2.9	5.9	1,335
Botucatu	0.5	2.5	399
Bragança Paulista	1.3	4.8	312
Catanduva	1.6	4.6	501
Franca	6.3	3.4	653
Itapeva	0.7	5.3	15
Jaú	0.4	5.6	249
Marília	3.1	2.2	456
Presidente Prudente	1.1	4.2	356
Ribeirão Preto	17.9	4.9	2,298
Santa Barbara D'Oeste	0.0	5.6	177
Santos	3.0	5.1	2,295
São João da Boa Vista	0.0	8.0	100
São José do Rio Preto	0.4	3.7	1,026
São José dos Campos	2.6	7.5	949
Sorocaba	2.3	5.6	1,045
All cities	5.0	4.8	13,161

Table 2 - Proportional distribution of cancer cases according to confirmatory diagnostic means, São Paulo State cities studied, 1991.

City	Diagnosis histological/citological	Death certificate only records (DCO)	Other diagnostic means	Number of records
Araçatuba	88.1	8.4	3.5	632
Barretos	63.6	21.5	14.9	228
Bauru	71.1	6.4	22.5	1,335
Botucatu	80.5	13.5	6.0	399
Bragança Paulista	59.3	29.2	11.5	312
Catanduva	81.6	14.8	3.6	501
Franca	79.3	15.0	5.7	653
Itapeva	47.3	14.0	38.7	150
Jaú	76.7	22.5	0.8	249
Marília	72.8	21.7	5.5	456
Presidente Prudente	75.0	21.9	3.1	356
Ribeirão Preto	85.1	10.4	4.5	2,298
Santa Barbara D'Oeste	92.3	2.3	5.4	177
Santos	67.7	16.4	15.9	2.295
São João da Boa Vista	39.0	40.0	21.0	100
São José do Rio Preto	78.1	18.1	3.8	1,026
São José dos Campos	63.9	18.1	18.0	949
Sorocaba	67.8	17.1	15.1	1,045
All cities	74.3	14.9	10.8	13,161

In addition, the quality of the collected data was assessed through the following characteristics: percent of cases with diagnosis confirmed through histological and/or cytological methods, age, and primary site of the tumor unknown (Tables 2 and 3).

Incidence rates were age-adjusted according to the world population.[1] Records whose age was unknown were excluded. The calculation of the rates' confidence interval was performed using the statistical package Confidence Interval Analysis (CIA).[3]

RESULTS

Cancer incidence (all sites combined, excluding skin cancer), by sex, and by city, including the city of São Paulo, is presented on Table 4.

Although there were considerable variations in rates between cities, the summarized age-standardized rate for all 18 cities was remarkably close to that of the city of São Paulo. In fact, the incidence rate for males was 337.1 per 100,000 population for the cities, whereas that for the capital was 339.4. Rates for females were slightly more divergent, although they could also be considered close (282.1 for the combined cities, and 275.5 for the capital). Ninety-five percent confidence intervals (CI) of the age-adjusted rates were narrow for both the city of São Paulo and all cities combined, whereas the CI for individual cities was slightly wider, varying with the size of their respective populations.

Table 4 - All-sites cancer incidence, excluding skin, by sex, in São Paulo State cities studied, and in São Paulo city, 1991.

City	standardized rates/ 100.000 hab.* (95% confidence interval)	
	Males	Females
São Paulo city (1993)[7]	339.4 (333-347)	275.5 (271-281)
Araçatuba	379.5 (331-428)	313.9 (273-355)
Barretos	204.0 (159-249)	165.0 (127-203)
Bauru	420.1 (380-460)	312.3 (281-344)
Botucatu	331.5 (274-389)	311.1 (259-364)
Bragança Paulista	260.1 (213-307)	270.6 (225-316)
Catanduva	375.5 (317-434)	288.2 (240-336)
Franca	307.9 (268-348)	245.9 (214-278)
Itapeva	241.0 (181-301)	249.4 (190-309)
Jaú	274.5 (224-325)	201.0 (160-242)
Marília	270.4 (230-311)	207.8 (175-241)
Presidente Prudente	201.6 (166-237)	188.6 (157-220)
Ribeirão Preto	406.6 (375-438)	349.5 (324-375)
Santa Bárbara D'Oeste	198.8 (155-242)	133.8 (100-167)
Santos	494.8 (465-525)	365.1 (342-388)
São João da Boa Vista	158.6 (115-202)	120.1 (83-157)
São José do Rio Preto	318.8 (285-352)	204.8 (181-229)
São José dos Campos	287.5 (255-320)	285.5 (257-314)
Sorocaba	295.6 (266-325)	335.3 (307-364)
All cities	337.1 (328-347)	282.1 (274-290)

*Age standardized rates by the "world population"[2]

As shown on Table 5, the most common cancer in men was stomach cancer, with a standardized rate of 44.0, followed closely by prostate cancer (41.3), and lung cancer (36.6). However, both stomach and lung cancer rates very largely variable between the cities; at its extremes were Araçatuba with a high stomach cancer rate of 85.2, while compared with only 18.6 found in Jaú and 15.7 in São João da Boa Vista. Lung cancer rate in Santos was 61.0, contrasted with 13.1 and 6.6 found in Santa Bárbara D'Oeste and São João da Boa Vista, respectively. Incidence rates of prostate cancer were not as divergent between cities. In most cities the rates ranged around 30 and 40, except for Bauru, with a rate of 68.6. Colon/rectum, larynx and esophageal cancers, in this order, were the next more common cancers seen in men, though this rank varied between individual cities. It worth noticing that the rates found for each city were not very precise, as evidenced by the confidence intervals shown on Table 4.

The incidence of the main cancers affecting women is presented on Table 6. Considering the population of all studied cities, the most common cancer was by far breast cancer, with an age-adjusted rate of 68.3, followed by cervical cancer (31.0), colon/rectum and

Table 5 - Incidence* of the most common cancers, excluding skin, in São Paulo state cities studied, males, 1991.

City	Lung	Stomach	Prostate	Esophagus	Colon/ rectum	Larynx
Araçatuba	28.3	85.2	32.6	19.1	29.8	10.0
Barretos	36.3	32.0	29.0	7.5	17.1	8.0
Bauru	37.8	58.8	68.6	18.0	27.8	23.4
Botucatu	27.6	46.4	36.2	19.3	45.9	15.3
Bragança Paulista	23.3	51.2	33.7	9.4	13.3	8.4
Catanduva	21.5	53.3	33.3	23.1	32.5	32.2
Franca	47.1	33.5	44.0	23.3	13.9	16.4
Itapeva	28.8	37.3	39.2	33.1	12.0	0.0
Jaú	26.4	18.6	43.9	14.8	32.7	16.2
Marília	36.4	35.0	35.0	11.3	16.1	12.2
Presidente Prudente	18.1	32.1	32.6	4.5	25.0	6.3
Ribeirão Preto	41.8	38.0	44.8	20.8	28.4	23.1
Santa Bárbara D'Oeste	13.1	50.3	40.1	16.1	12.4	9.0
Santos	61.0	54.2	58.9	28.3	35.1	50.5
São João da Boa Vista	6.6	15.7	24.8	9.3	15.8	3.1
São José do Rio Preto	37.0	35.4	30.5	20.2	27.2	24.1
São José dos Campos	30.9	39.3	27.4	16.1	15.6	6.4
Sorocaba	34.7	44.1	31.6	5.8	15.2	11.5
All cities combined rates	36.6	44.0	41.3	17.7	24.3	20.1

*Age standardized rates by the "world population"[2]

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Table 6 - Incidence* of the most common cancers, excluding skin, in São Paulo State cities studied, females, 1991.

City	Lung	Stomach	Breast	Cervix uteri	Colon/ rectum	Ovary
Araçatuba	17.7	48.3	67.8	32.0	24.5	14.1
Barretos	7.2	2.5	39.5	34.7	8.5	6.1
Bauru	17.6	28.6	62.5	35.1	19.7	14.9
Botucatu	1.6	35.9	63.9	41.3	29.6	32.7
Bragança Paulista	9.0	27.8	59.0	19.4	13.7	22.2
Catanduva	2.0	27.0	59.8	16.4	28.7	9.5
Franca	13.4	18.2	64.8	30.8	15.6	9.7
Itapeva	7.4	15.6	52.3	60.6	3.3	4.4
Jaú	4.7	10.6	37.5	15.5	11.7	17.2
Marília	11.0	7.6	48.7	32.2	12.4	5.3
Presidente Prudente	3.8	13.0	48.2	17.3	27.4	10.1
Ribeirão Preto	15.3	19.2	87.4	23.9	20.2	22.3
Santa Bárbara D'Oeste	8.6	19.7	25.7	19.8	2.3	6.5
Santos	15.3	20.8	97.9	38.6	24.8	21.8
São João da Boa Vista	11.5	5.7	23.4	3.1	9.2	5.6
São José do Rio Preto	4.0	15.8	51.5	24.5	25.5	7.4
São José dos Campos	13.7	8.9	69.6	25.2	18.3	13.6
Sorocaba	9.1	20.3	82.4	60.1	21.1	12.7
All cities combined rates	11.3	19.5	68.3	31.0	20.0	7.2

*Age standardized rates by the "world population"[2]

stomach cancers (20.0 and 19.5, respectively) and lung and ovary cancers (11.3 and 7.2, respectively). Similar to the men group, there was a considerable rate variation between cities; the incidence of breast cancer reached its highest value of 97.9 in Santos, and its lowest of 23.4 in São João da Boa Vista. Similar differences between individual cities were observed for all other cancers.

A comparison of age-adjusted rates for all 18 cities combined with data derived from population-based registries, both national and foreign, is shown on Table 7. Incidence rates for males were considerably higher in the 18 cities than in Goiânia, Belém and the United Kingdom; but they were approximately equal to those seen in the cities of Porto Alegre, São Paulo, and in Canada, and lower than those found in France, Hawaii and the U.S. For females, the observed rates were slightly lower than in Hawai, higher than those seen in all other Brazilian registries, also higher than in France and the UK, and approximately equal to those seen in other registries presented on Table 7.

Table 7 - Cancer incidence (excluding skin), by sex, in São Paulo state cities studied, in São Paulo city, some others Brazilian cities, and in selected foreign countries and regions, 1980/90 decades.*

City/region/country	Sex	
	Males	Females
São Paulo (18 cities) (1991)	337.1	282.1
São Paulo city (1993)	339.4	275.5
Goiânia (1990/93)	190.9	187.6
Porto Alegre (1990/92)	326.4	231.5
Belém (1988/91)	183.4	177.5
França – Bas-Rhin (1988-92)	394.0	229.3
Hawaii – whites (1988/92)	397.7	294.7
USA – SEER – whites (1988/92)	370.9	280.9
USA – Connecticut –whites (1988/92)	356.7	289.4
Canadá (1988/92)	322.1	252.8
UK – England & Wales (1988/90)	261.1	225.5

*Age standardized rates by the "world population"[2]
Sources: Mirra,[7] Muir et al,[10] Parkin et al[13]

DISCUSSION

The low cancer incidence rates observed for smaller cities were most probably due to a combination of factors, including the small population size, which resulted in data fluctuation and lower rate accuracy; the short study period; and the attraction exerted by large cities where cancer management facilities are more readily available — though every participant city had cancer diagnosis and/or treatment resources available.

The quality of collected information is paramount to assess the validity of the incidence data. One of the most widely accepted means to evaluate quality is the proportion of histologically confirmed cancer diagnosis. In the present study, 74% of the cases had an histological or cytological diagnosis, a figure indicating an acceptable quality. Although a considerable variation was observed between the cities, with the histological diagnostic confirmation ranging from 39% to 92%, the primary site of the tumor and age were unknown in 4.8% and 5%, respectively, of the cases, indicating a reasonably good data quality.

The all-sites cancer incidence was remarkably close to the incidence seen in the city of São Paulo in 1993, but higher than for most cities, both nationwide and worldwide, where cancer incidence rates were available. This might be due to bias derived from the unadvised inclusion of prevalent cases, quite unavoidable when registry systems are just starting out. However, it is worth of note that the city of São Paulo cancer registry had just resumed its activities at that time, and its data might have been biased in the same way as discussed above. Biases notwithstanding, the possibility that the rates for both the city of São Paulo city and the 18 cities were in fact close could not be ruled out, especially

when the likeness of genetic and environmental forces involved in cancer causation in both populations is taken into account. However, a closer look at the individual cities reveals that, for both sexes, in places such as Santos and Ribeirão Preto, the incidence was higher than for other state capital, while in others, such as Barretos, São José dos Campos, Santa Bárbara d'Oeste, São João da Boa Vista, and Itapeva, the incidence was lower than that for the city of São Paulo city. The higher incidence rates found in Santos and Ribeirão Preto could be explained by the higher availability of resources for cancer management in these two regional centers, attracting the population living in smaller neighboring towns, and resulting in an overestimation of rates, despite their relatively larger population size and the efforts to exclude non-residents. However, cities with similar population sizes and good cancer management facilities, such as São José dos Campos and Sorocaba, showed much lower rates. There is a need to find other explanations for the higher cancer incidence in Santos and Ribeirão Preto. Further exploratory studies with a broader geographic reach can contribute to that, raising questions to be addressed in more detailed, risk factor-oriented local studies.[9]

As of individual cancers in males, the highest incidence of lung cancer was seen in Santos, stomach cancer in Araçatuba, Bauru, and Santos, and prostate cancer in Bauru, and Santos. In females, Santos showed to have rates in the highest ends of the range for almost all cancers selected, whereas Araçatuba had the highest lung and stomach cancer rates. By examining the regional cancer incidence rates, the pattern observed suggests the need of further investigation of both cancer incidence and risk factors prevalence in Santos due to its consistently higher cancer rates, whereas some other regions, such as Araçatuba, and Bauru should be further studied concerning individual cancers, such as stomach in the former, and prostate in the latter.

Cancer registries covering wider geographic areas are commonplace in smaller and richer countries, such as Scandinavian countries. Larger and more populous countries, like the U.S., rely on some well-structured network of cancer registry systems throughout the country to provide their cancer incidence data (the SEER Program).[11] Countries large in area with limited resources, such as Brazil, have adopted the strategy of locally adapt the U.S. approach, establishing a representative network of cancer registry systems, which has been accomplished with the current available registries, and it is expected to improve with the planned new ones. The current paper, reporting a pioneer attempt to measure cancer incidence in somewhat smaller and more numerous cities, adds further information to fuel the debate on the wisdom of such strategy.

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