Mortality due to cancer of the uterine cervix in the state of Minas Gerais, Brazil, 1980-2005: period and cohort analysis

Mortalidade por câncer de colo de útero no Estado de Minas Gerais, Brasil, 1980-2005: análise de período e coorte

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Abstract

This study identifies the period and cohort effects on the decreasing mortality trend of cancer of the uterine cervix and of the uterus, part unspecified, in the state of Minas Gerais, Brazil, during the period 1980-2005. 11,243 cases were included. A non-parametric method was used to calculate Z statistics and p-values. The cohorts were assessed one by one and also in blocks of three, so as to allow for a larger number of comparisons to be made. Greater than expected mortality reduction was observed for the cohort blocks of women born in 1913-1920; 1927-1936; 1937-1946; 1949-1956; 1963-1970; and 1969-1976. For the 1901-1908 and 1921-1928 cohort blocks a smaller than expected mortality decrease was found. As for period effect, we found a greater than expected reduction for the 2000-2001 period, in comparison with the previous one. The study suggests the existence of a significant cohort effect on mortality due to cancer of the uterine cervix in the study population, and such results have been placed in their social and political contexts.

Uterine Cervical Neoplasms; Mortality; Cohort Effect; Period Effect

Introduction

Cancer of the uterine cervix, hereafter referred to as cervical cancer, is considered to be theoretically avoidable by means of a long-standing screening test, the Papanicolaou smear (Pap smear), which can detect the disease at an early and curable stage [1,2]. Furthermore, its strong association with persistent infection with the human papillomavirus (HPV) is well recognized. Although this sexually transmitted infection is necessary for the development of cervical cancer, not all HPV infections will give rise to cancer [1].

Although amenable to prevention and early detection, cervical cancer is the second most common malignancy affecting women worldwide [3]. In general, it is more frequent in developing countries, which account for 83% of cases worldwide, with cervical cancer representing 15% of all female malignancies in such countries [4].

Early studies of temporal disease trends were chiefly based on graphic representations of incidence or mortality rates according to age. Although graphic representations remain important for these assessments, time effects, measured through models such as linear regression, must be formally considered.

Linear regression, however, assumes that temporal trends are strongly related to age, and that such a relation has a linear character. Although age plays an important role in the etiology of many diseases, different birth cohorts may have different levels of exposure to certain risk factors [5]. While the age (or aging) effect means different risks associated to different age ranges, period and cohort effects try to explain changes in time-associated rates within same-age populations. The period effect represents changes in the rates associated with all age ranges, whereas the cohort effect is associated with changes in the rates in successive age ranges in successive periods [6].

Acknowledging the importance of cervical cancer for community health, we undertook a study involving period and cohort effects on mortality due to cancer of the uterine cervix and malignant neoplasm of the uterus, part unspecified, in the state of Minas Gerais, Brazil, during the period 1980-2005.

Minas Gerais has an estimated population of 19.6 million inhabitants, representing 10% of the Brazilian population. It is the state with the largest number (853) of municipalities. Such municipalities have distinct features, with the more developed center-south, and the less developed regions of the semi-arid north and the *cerrado* (an area of xeromorphic vegetation akin to the savanna) to the west (Governo de Minas Gerais. http://www.mg.gov.br, accessed on 10/May/2009).

The inclusion in this study of cases of malignant neoplasm of the uterus, part unspecified, thus defined by the International Classification of Diseases – 10th revision (ICD-10) [7], is because most cases thus codified are in fact cases of cervical cancer [8]. Because there is no consensus in the literature on the best method to undertake exploratory or confirmatory analyses of period and cohort effects, we chose the non-parametric method described by Tarone & Chu [9], which allows for the exploratory partition of period and cohort effects [6].

Material and methods

Population and mortality data were collected from the Brazilian Ministry of Health database (DATASUS; http://www.datasus.gov.br), using the Demographic and Socioeconomic Health Information and the Mortality Information System (SIM), respectively. All women aged 30 to 79 years, who had, as the underlying cause of death, cervical cancer or malignant neoplasm of the uterus, part unspecified during the period 1980-2005 in the state of Minas Gerais were included.

The 9th revision of the International Classification of Diseases (ICD-9) [10] was applied to the 1980-1995 period, and the 10th revision (ICD-10) [7] was applied to the 1996-2005 period. The ICD-9 codes were 180 for cervical cancer (malignant neoplasm of cervix uteri) and 179 for malignant neoplasm of the uterus, part unspecified, with the ICD-10 codes being C53 and C55, respectively.

Cases were grouped in biennial ranges (30-31, 32-33, 34-35,…, 78-79). Because the aforementioned databases provide population data in quinquennial age ranges, population interpolation by age and year, followed by grouping in biennial ranges, was necessary. For population interpolation we used Sprague's fifth difference formula, the most commonly used procedure, that preserves population totals in 5-year ranges [11].

Because comparisons were made between women from the same age range, no standardization of the calculated mortality rates was made.

According to Tarone & Chu's [9] method, tables were built, with lines representing the cohorts, columns the periods, and diagonals the age ranges. In each line one cohort was compared with the next one, and in each column one period was compared with the next one. In both cases, comparisons were always made between individuals from the same age range [6]. The cohorts were further combined in blocks of three to allow for a larger number of comparisons to be made.

Each set of comparisons, be it to assess the period or cohort effects, has a binomial distribution, for which both the probability of trend increase and the probability of trend decrease, under the null hypothesis, of uniformity of trend, are 0.5. The expected value is then the number of comparisons multiplied by the probability of reduction or increase, that is, the mean [12].

For the calculations of the cohort and period effects, one by one, variance is considered as the number of comparisons (n) multiplied by the observed reduction probability (p) and by the increase probability (q), both (reduction and increase) under the null hypothesis, that is, variance = n x p x q. Standard deviation is the positive square root of variance. Z statistics is calculated as the observed value minus the expected value under the null hypothesis, divided by the corresponding standard deviation [12]. In this study, the observed value was considered to be the number of reductions in the compared periods or cohorts. When the numbers of reductions are calculated for the cohorts in blocks of three, a strategy to allow for a greater number of comparisons, the calculations of variance and standard deviation must be modified. Variance is then calculated for each line, and its value is given by the number of comparisons added to 2 and divided by 12, while the standard deviation is the square root of the sum of variances [12].

Z statistics was thus calculated, and the p value obtained. Periods and cohorts with $p < 0.05$ were identified.

For demonstration, the continuity correction described by Tarone & Chu [9] was also made: the expected value is subtracted from the observed value, and 0.5 is subtracted from the resulting absolute number, before division by the standard deviation, in order to obtain the approximate Z value from the binomial discrete distribution. Furthermore, the p-value referring to the corrected Z was also obtained. From the data compiled for this study, tables representing 25 age ranges, 13 periods and 37 cohorts were used. Age ranges correspond to biennial intervals and the cohorts were built for four-year intervals. Cohort superimposition was observed, something that always happens with this method. However, the midpoint of the period used to define a given cohort may be considered as representative of that cohort [12].

Preliminary analyses to assess tendency of mortality by age and period using linear regression modelling showed a general trend towards reduction in the study period [13] (Figure 1).

Based on this overall trend, the analyses presented here were undertaken, considering deviations between the observed (as reported by data) and expected mortality rates. The effects that were found to be significant, related either to period or cohort, are relative effects, reflecting the overall trend already analyzed and contained in what is generally referred to as the changing age structure of mortality.

Results

Of the 11,243 cases included, 6,123 (54.46%) were of cervical cancer and 5,120 (45.54%) were of malignant neoplasm of the uterus, part unspecified.

On one by one cohort comparison, a smaller than expected reduction for the 1923-1926 birth cohort was observed, with (Z = -2.1), compared to the previous cohort (1921-1924). There was a greater than expected reduction for the 1917-1920 (Z = 2.1), 1931-1934 (Z = 2.3) and 1967-1970 (Z = 2) cohorts, compared with the previous ones, 1915-1918, 1929-1932 e 1965-1968, respectively (Table 1).

The assessment of birth cohorts in blocks of three revealed smaller than expected reduction for the blocks of women from the 1901-1908 (Z = -1.96) and the 1921-1928 (Z = -2.33) cohorts. Greater than expected reduction was found for the 1913-1920 (Z = 1.98); 1927-1936 (Z = 2.62); 1937-1946 (Z = 1.96); 1949-1956 (Z = 2.33); 1963-1970 (Z = 2.4) and 1969-1976 (Z = 1.9) blocks (Table 2).

Note that the trends highlighted by this exploratory analysis do not undergo relevant variation when blocks of three are used.

For the period effect, there was greater than expected reduction for the 2000-2001 period, when compared to the previous one (1998-1999), with Z = 3 (Table 1).

Both tables show changes in Z values and their corresponding significances produced by continuity correction. As this study is of an exploratory nature, where the distance of the calculated statistic from zero is considered a trend indicator, we discussed the results of the uncorrected Z statistic.

Discussion and conclusion

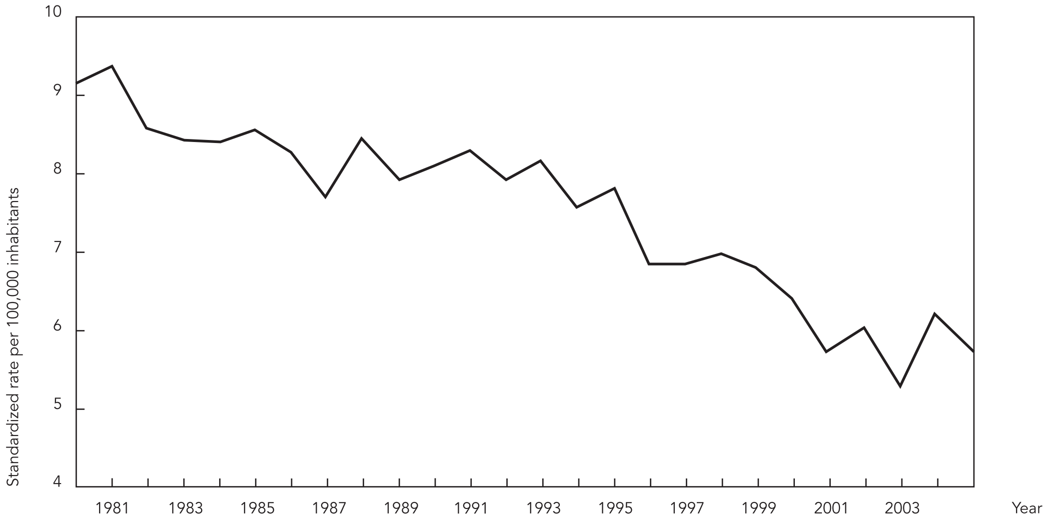
Tarone & Chu's [9] non-parametric test aims to identify changes in the inclination of the linear risk trend in successive birth cohorts or along the calendar-period, as it assumes that age-specific rates will remain constant in the absence of any secular change in the disease risk, which justifies the fact that the procedure is based on the comparison of age-specific rates.

A smaller than expected reduction of mortality due to cervical cancer was observed for the 1901-1908 cohort block. These cohorts comprise women who are likely to have initiated their sexual lives in the 1920s, a historical period shaped by important socioeconomic changes in Brazil, such as: immigration, urbanization and the onset of industrialization. Furthermore, cancer-related policies were just beginning, with cancer being then seen as a communicable disease like tuberculosis [14]. The entry of new HPV strains with immigration, lack of knowledge about the disease, and absence of preventive policies then, may all have contributed to the higher mortality of women from those cohorts.

Another cohort block where smaller than expected mortality reduction was observed was the 1921-1928 one, which comprises women who were in their 20's at the time of the Second World War. In spite of the geographic distance from the involved areas, and of the small part Brazil took in the conflict [15], the introduction of new HPV strains may have contributed to this finding in the study population. The same was observed by Tarone & Chu [16], in a study on the age-period-cohort effect on mortality due to cervical cancer in the United States. The authors reported in-

Figure 1

Temporal trend of mortality due to cancer of the uterine cervix and malignant neoplasm of the uterus, part unspecified, during the period 1980-2005, for the state of Minas Gerais, Brazil.



creased mortality in the 1930 cohort (1924-1934 interval), which might have been related to the introduction of new HPV strains after the Second World War.

There was a greater than expected mortality reduction in the 1913-1920 period. Women from this cohort lived during a conservative political period in Brazil known as the New State (1930-1945), where there were strong links between State and Church, including compulsory religious teaching in public schools [15]. This conservative background, against which these women lived their late teens and young adulthood, may have, to a certain extent, contributed to a reduction in mortality. Furthermore, these women witnessed the beginning of national initiatives targeting cervical cancer, such as the creation of the National Cancer Service (1941); introduction of colposcopy and colpocytology (1945/1946); creation of the first outpatient facility for the early diagnosis of gynecologic cancer at the Hospital Moncorvo Filho, Rio de Janeiro (1948); organization of colposcopy courses (1949) taught by its own inventor, Dr. Hinselman; and radio broadcasts (1948) highlighting the importance of the gynecologic examination [14]. Therefore, the measures implemented in Brazil at that time may have contributed to the mortality reduction observed for this cohort in Minas Gerais. Accordingly, a 2006 study related the reduced mortality due to cervical cancer observed in the 1920 birth cohort in Hong Kong to easier access to preventive examinations through time [17].

Another mortality reduction was observed in the 1927-1936 cohort block. It is noteworthy that the early 1950s were marked by conservatism and intense influence of the Church on Brazilian society [15]. The health field was impacted by a number of events including: the creation of the Ministry of Health (1953); the Luíza Gomes de Lemos Research Center of the Social Pioneers Foundation, in 1956, with the first course for the formation of technicians in cytology in Brazil; and the National Cancer Institute, in 1961, important not only for care, but also for human resource training and the development of cancer basic research [14].

The 1937-1946 cohort block also showed a reduction in mortality, which may be partly explained by the fact that women from this cohort were exposed to a greater concern about cervical cancer, which chiefly happened from 1963 onwards, with the creation and strengthening of a more permanent health services structure, over the campaign-based strategy which until then predominated [14].

There was mortality reduction among the women from the 1949-1956 birth cohort, com-

Table 1

Cervical cancer and uterus not otherwise specified, cohort and period one by one, from 1980-2005. Minas Gerais State, Brazil.

	1980-1981	1982-1983	1984-1988	1986-1987	1988-1989	1990-1991	1992-1993	1994-1995	1996-1997	1998-1999
1901-1904	32.91									
1903-1906	57.35	44.01								
1905-1908	67.59	60.38	63.94							
1907-1910	39.47	65.43	44.41	33.56						
1909-1912	45.88	33.05	47.19	47.90	60.85					
1911-1914	36.43	42.11	49.19	55.60	52.65	34.63				
1913-1916	33.23	43.31	40.87	41.56	52.20	42.56	49.57			
1915-1918	27.04	36.63	34.19	37.59	47.55	50.74	49.69	55.62		
1917-1920	37.35	38.61	29.04	26.88	31.55	37.56	48.57	38.65	35.39	
1919-1922	32.34	23.07	28.66	22.37	39.56	37.11	39.17	64.53	40.39	50.62
1921-1924	24.09	34.10	17.62	24.53	25.09	34.46	33.38	37.73	33.48	31.66
1923-1926	32.34	24.98	34.20	35.51	24.45	34.25	37.76	35.23	24.14	40.98
1925-1928	20.70	27.55	32.70	29.24	36.45	30.98	36.31	30.25	32.52	34.99
1927-1930	17.95	19.00	28.64	28.05	20.23	32.48	30.97	33.18	32.36	33.41
1929-1932	28.01	29.17	34.29	30.17	26.84	24.05	27.73	28.69	34.61	30.35
1931-1934	19.95	14.17	24.43	22.72	19.47	28.95	18.28	26.73	23.82	28.44
1933-1936	23.38	14.42	18.27	20.08	23.13	30.86	20.23	24.33	17.94	23.87
1935-1938	16.83	19.66	13.33	22.95	23.47	22.56	24.41	24.89	18.81	24.28
1937-1940	13.21	9.21	14.99	11.49	23.42	18.63	22.66	26.38	22.83	27.13
1939-1942	11.48	10.34	12.97	14.72	19.23	18.83	21.43	22.75	15.81	25.99
1941-1944	6.78	6.97	8.77	8.38	19.45	14.96	25.42	16.44	14.49	21.06
1943-1946	8.20	6.63	7.54	14.06	13.97	16.12	14.37	14.72	17.47	15.39
1945-1948	3.23	4.08	8.32	6.82	8.01	11.74	13.32	16.09	16.85	17.46
1947-1950	3.04	3.56	4.35	4.62	6.19	14.75	9.94	12.17	18.43	17.17
1949-1952	1.96	4.47	3.56	5.93	8.15	7.02	12.03	12.73	13.22	11.57
1951-1954		2.33	3.86	4.31	3.28	5.65	7.77	6.41	12.24	11.73
1953-1956			0.96	2.39	4.98	2.61	6.13	7.43	9.42	9.02
1955-1958				2.46	2.69	3.57	6.13	4.60	7.78	11.36
1957-1960					0.84	4.42	4.90	3.58	7.48	8.92
1959-1962						2.58	4.23	2.94	4.02	4.58
1961-1964							1.91	2.58	3.05	3.53
1963-1966								2.06	2.00	3.15
1965-1968									2.52	3.37
1967-1970										1.58
1969-1972										
1971-1974										
1973-1976										
Expected number		12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Decrease		14	14	16	10	15	13	15	12	10
Z test		0.60	0.60	1.40	-1.00	1.00	0.20	1.00	-0.20	-1.00
p-value		0.55	0.55	0.16	0.32	0.32	0.84	0.32	0.84	0.32
Z corrected		0.40	0.40	1.20	-0.80	0.80	0.00	0.80	0.00	-0.80
p-value corrected		0.69	0.69	0.23	0.42	0.42	1.00	0.42	1.00	0.42

(continues)

Table 1 (continued)

	2000-2001	2002-2003	2004-2005	Decrease	Expect	Z	p-value	Z corrected	p-value corrected
1901-1904									
1903-1906				0	0.5	-1.00	0.32	0.00	1.00
1905-1908				0	1	-1.41	0.16	-0.71	0.48
1907-1910				3	1.5	1.73	0.08	1.15	0.25
1909-1912				2	2	0.00	1.00	-0.50	0.62
1911-1914				2	2.5	-0.45	0.65	0.00	1.00
1913-1916				4	3	0.82	0.41	0.41	0.68
1915-1918				3	3.5	-0.38	0.71	0.00	1.00
1917-1920				7	4	2.12	**0.03**	**1.77**	**0.08**
1919-1922				3	4.5	-1.00	0.32	-0.67	0.51
1921-1924	31.49			8	5	1.90	0.06	1.58	0.11
1923-1926	32.41	52.31		2	5.5	-2.11	**0.03**	**-1.81**	**0.07**
1925-1928	32.18	38.09	40.55	6	6	0.00	1.00	-0.29	0.77
1927-1930	30.02	37.62	47.44	7	6	0.58	0.56	0.29	0.77
1929-1932	32.56	36.18	28.14	6	6	0.00	1.00	-0.29	0.77
1931-1934	31.08	21.92	35.99	10	6	2.31	**0.02**	**2.02**	**0.04**
1933-1936	23.29	23.14	33.67	6	6	0.00	1.00	-0.29	0.77
1935-1938	20.77	29.16	30.28	6	6	0.00	1.00	-0.29	0.77
1937-1940	21.31	25.17	25.83	7	6	0.58	0.56	0.29	0.77
1939-1942	22.81	14.96	24.98	7	6	0.58	0.56	0.29	0.77
1941-1944	16.28	21.47	23.40	8	6	1.15	0.25	0.87	0.39
1943-1946	18.78	11.03	18.81	7	6	0.58	0.56	0.29	0.77
1945-1948	13.55	19.14	21.07	7	6	0.58	0.56	0.29	0.77
1947-1950	15.26	14.99	17.14	6	6	0.00	1.00	-0.29	0.77
1949-1952	13.04	12.06	10.51	6	6	0.00	1.00	-0.29	0.77
1951-1954	12.21	10.71	15.73	7	6	0.58	0.56	0.29	0.77
1953-1956	10.21	11.65	10.12	8	5.5	1.51	0.13	1.21	0.23
1955-1958	8.01	8.75	12.60	4	5	-0.63	0.53	-0.32	0.75
1957-1960	9.99	7.15	9.91	4	4.5	-0.33	0.74	0.00	1.00
1959-1962	5.75	7.47	9.10	5	4	0.71	0.48	0.35	0.72
1961-1964	5.59	6.00	8.25	3	3.5	-0.38	0.71	0.00	1.00
1963-1966	3.58	4.73	5.07	3	3	0.00	1.00	-0.41	0.68
1965-1968	2.67	3.14	4.23	3	2.5	0.45	0.65	0.00	1.00
1967-1970	1.77	1.56	2.88	4	2	2.00	**0.05**	1.50	0.13
1969-1972	1.24	2.07	2.52	1	1.5	-0.58	0.56	0.00	1.00
1971-1974		1.21	1.17	2	1	1.41	0.16	0.71	0.48
1973-1976			1.17	1	0.5	1.00	0.32	0.00	1.00
Expected number	12.5	12.5	12.5						
Decrease	20	15	14						
Z test	3.00	1.00	0.60						
p-value	**0.00**	0.32	0.55						
Z corrected	2.80	0.80	0.40						
p-value corrected	0.01	0.42	0.69						

Table 2

Cervical cancer and uterus not otherwise specified, cohort blocks size three, from 1980-2005. Minas Gerais State, Brazil.

	1980-1981	1982-1983	1984-1985	1986-1987	1988-1989	1990-1991	1992-1993	1994-1995	1996-1997	1998-1999
1901-1904	32.91									
1903-1906	57.35	44.01								
1905-1908	67.59	60.38	63.94							
1907-1910	39.47	65.43	44.41	33.56						
1909-1912	45.88	33.05	47.19	47.90	60.85					
1911-1914	36.43	42.11	49.19	55.60	52.65	34.63				
1913-1916	33.23	43.31	40.87	41.56	52.20	42.56	49.57			
1915-1918	27.04	36.63	34.19	37.59	47.55	50.74	49.69	55.62		
1917-1920	37.35	38.61	29.04	26.88	31.55	37.56	48.57	38.65	35.39	
1919-1922	32.34	23.07	28.66	22.37	39.56	37.11	39.17	64.53	40.39	50.62
1921-1924	24.09	34.10	17.62	24.53	25.09	34.46	33.38	37.73	33.48	31.66
1923-1926	32.34	24.98	34.20	35.51	24.45	34.25	37.76	35.23	24.14	40.98
1925-1928	20.70	27.55	32.70	29.24	36.45	30.98	36.31	30.25	32.52	34.99
1927-1930	17.95	19.00	28.64	28.05	20.23	32.48	30.97	33.18	32.36	33.41
1929-1932	28.01	29.17	34.29	30.17	26.84	24.05	27.73	28.69	34.61	30.35
1931-1934	19.95	14.17	24.43	22.72	19.47	28.95	18.28	26.73	23.82	28.44
1933-1936	23.38	14.42	18.27	20.08	23.13	30.86	20.23	24.33	17.94	23.87
1935-1938	16.83	19.66	13.33	22.95	23.47	22.56	24.41	24.89	18.81	24.28
1937-1940	13.21	9.21	14.99	11.49	23.42	18.63	22.66	26.38	22.83	27.13
1939-1942	11.48	10.34	12.97	14.72	19.23	18.83	21.43	22.75	15.81	25.99
1941-1944	6.78	6.97	8.77	8.38	19.45	14.96	25.42	16.44	14.49	21.06
1943-1946	8.20	6.63	7.54	14.06	13.97	16.12	14.37	14.72	17.47	15.39
1945-1948	3.23	4.08	8.32	6.82	8.01	11.74	13.32	16.09	16.85	17.46
1947-1950	3.04	3.56	4.35	4.62	6.19	14.75	9.94	12.17	18.43	17.17
1949-1952	1.96	4.47	3.56	5.93	8.15	7.02	12.03	12.73	13.22	11.57
1951-1954		2.33	3.86	4.31	3.28	5.65	7.77	6.41	12.24	11.73
1953-1956			0.96	2.39	4.98	2.61	6.13	7.43	9.42	9.02
1955-1958				2.46	2.69	3.57	6.13	4.60	7.78	11.36
1957-1960					0.84	4.42	4.90	3.58	7.48	8.92
1959-1962						2.58	4.23	2.94	4.02	4.58
1961-1964							1.91	2.58	3.05	3.53
1963-1966								2.06	2.00	3.15
1965-1968									2.52	3.37
1967-1970										1.58
1969-1972										
1971-1974										
1973-1976										

(continues)

Table 2 (continued)

	2000-2001	2002-2003	2004-2005	Decrease	Expect	Z	p-value	Z corrected	p-value corrected
1901-1904									
1903-1906									
1905-1908				0	1.5	-1.96	**0.05**	-1.31	0.19
1907-1910				3	2.5	0.58	0.56	0.00	1.00
1909-1912				5	3.5	1.57	0.12	1.04	0.30
1911-1914				4	4.5	-0.48	0.63	0.00	1.00
1913-1916				6	5.5	0.45	0.65	0.00	1.00
1915-1918				7	6.5	0.42	0.67	0.00	1.00
1917-1920				10	7.5	**1.99**	**0.05**	1.59	0.11
1919-1922				10	8.5	1.13	0.26	0.76	0.45
1921-1924	31.49			11	9.5	1.08	0.28	0.72	0.47
1923-1926	32.41	52.31		10	10.5	-0.35	0.73	0.00	1.00
1925-1928	32.18	38.09	40.55	8	11.5	**-2.33**	**0.02**	-2.00	0.05
1927-1930	30.02	37.62	47.44	13	12	0.65	0.51	0.33	0.74
1929-1932	32.56	36.18	28.14	13	12	0.65	0.51	0.33	0.74
1931-1934	31.08	21.92	35.99	16	12	**2.62**	**0.01**	**2.29**	**0.02**
1933-1936	23.29	23.14	33.67	16	12	**2.62**	**0.01**	**2.29**	**0.02**
1935-1938	20.77	29.16	30.28	12	12	0.00	1.00	-0.33	0.74
1937-1940	21.31	25.17	25.83	13	12	0.65	0.51	0.33	0.74
1939-1942	22.81	14.96	24.98	14	12	1.31	0.19	0.98	0.33
1941-1944	16.28	21.47	23.40	15	12	**1.96**	**0.05**	**1.64**	**0.10**
1943-1946	18.78	11.03	18.81	15	12	**1.96**	**0.05**	**1.64**	0.10
1945-1948	13.55	19.14	21.07	14	12	1.31	0.19	0.98	0.33
1947-1950	15.26	14.99	17.14	13	12	0.65	0.51	0.33	0.74
1949-1952	13.04	12.06	10.51	12	12	0.00	1.00	-0.33	0.74
1951-1954	12.21	10.71	15.73	13	12	0.65	0.51	0.33	0.74
1953-1956	10.21	11.65	10.12	15	11.5	**2.33**	**0.02**	**2.00**	**0.05**
1955-1958	8.01	8.75	12.60	12	10.5	1.04	0.30	0.69	0.49
1957-1960	9.99	7.15	9.91	8	9.5	-1.08	0.28	-0.72	0.47
1959-1962	5.75	7.47	9.10	9	8.5	0.38	0.71	0.00	1.00
1961-1964	5.59	6.00	8.25	8	7.5	0.40	0.69	0.00	1.00
1963-1966	3.58	4.73	5.07	6	6.5	-0.42	0.67	0.00	1.00
1965-1968	2.67	3.14	4.23	6	5.5	0.45	0.65	0.00	1.00
1967-1970	1.77	1.56	2.88	7	4.5	**2.40**	**0.02**	**1.92**	**0.05**
1969-1972	1.24	2.07	2.52	5	3.5	1.57	0.12	1.04	0.30
1971-1974		1.21	1.17	3	2.5	0.58	0.56	0.00	1.00
1973-1976			1.17	3	1.5	**1.96**	**0.05**	1.31	0.19

prising those becoming sexually active (around 20 years of age) at the onset of political repression and military dictatorship in Brazil. These women also experienced the National Campaign Against Cancer, institutionalized in 1968; the birth of the worldwide Primary Care principles in the late 1970s; the creation of the National Program Against Cancer, chiefly targeting radiotherapy and early diagnosis of cervical cancer (1972-1975) [12]; the birth of the women's modern movement in Brazil, in 1975 [18], and the coming of age of the Motherhood-Childhood Program, which had gynecologic cancer as one of its priorities [19]. Furthermore, these women were around 40 years of age when the Brazilian Unified National Health System (SUS) and the Program Against Cervical Cancer (Viva-Mulher) were created [20]. As a consequence, the lower mortality observed among these women may have been due to easier access to diagnosis and treatment, as well as a greater awareness of female rights and cancer-targeted campaigns.

There was another mortality reduction for the 1963-1970 cohort block, comprising women who witnessed the end of the Brazilian military dictatorship. It is noteworthy that the opposite happened in Spain, that is, there was increased mortality due to cervical cancer among women born after the 1939-1948 cohort, a finding that was related to the end of Franco's dictatorship in 1975 [21]. Notwithstanding, the end of the Brazilian dictatorship came as the result of political inertia on the part of the military government itself [22]. During this period, there was easier access to prevention and diagnosis, through the creation of the Comprehensive Program of Women's Health Care (PAISM), which introduced the colpocytologic examination in the routine of the gynecology examination (1984) [14]; the birth of Pro-Onco, in 1986, that among other things created the Expansion of Prevention and Control of Uterine Cancer Program [14]; and the beginning of the SUS [22].

Women from the 1969-1976 cohorts, for whom another mortality reduction was observed, witnessed SUS implantation and universal access to health. They also became aware of the relationship between the disease and HPV infection, being also exposed to the massive Viva-Mulher campaigns, targeted at cervical and breast cancer [23].

The 2000-2001 showed a greater reduction in mortality than the previous one, that is 1998-1999. This period effect may be related to the creation of the National Program Against Cervical Cancer (PNCCC), in 1998 [24]. The context saw an 81% increase in the annual number of cytologic examinations performed in the SUS in the period 1995-2003, with a 112.6% increase for the southeastern region alone [23]. This fact, coupled with the aggressive campaign targeting cervical cancer in 1998, may be associated to the period effect found.

Our study has limitations though. We used secondary data, more prone to problems with collection and processing, and 46.58% of our cases were classified as malignant neoplasm of the uterus, part unspecified. On the other hand, the proportion of female deaths recorded as ill-defined causes in the state of Minas Gerais has been reduced [25] in the period under study (19.37% in 1980; 11.26% in 2005) (DATASUS. http://www.datasus.gov.br, accessed on 17/Jan/2009). Besides, reports of cancer as cause of death are generally recognized as well registered [26]. Both aspects make mortality data more reliable. Therefore, the results reported here tend to be more reliable as data become more reliable, in that the aforementioned effects are relative to the overall mortality trend represented by increasingly accurate data collected throughout a 26-year span.

Furthermore, although the focus of the method used was on exploratory analysis, it does not provide the quantification of the influence of the effects observed. There is also a limitation due to the multiple comparisons that are inherent to the method, and whose control, classically undertaken through the too conservative Bonferroni method, still seems elusive [27]. It must be taken into account, though, that the absence of corrections for multiple comparisons may lead to type 1 error, when statistical significance for a chosen significance level is thought to have been found, even when there is actually no statistical difference [28].

In spite of these limitations, this exploratory study suggests the existence of cohort effects on the mortality due to cervical cancer in the study population. It also highlights the importance of systematic approaches to the analysis of the mortality trends of several diseases. There is a scarcity of publications about cancer mortality trends focusing on age-period-cohort effects involving populations from developing countries based on the method we used. An adjusted age-period-cohort model approach to the data would be the next step to confronting the results found.

Resumo

Buscou-se identificar os efeitos período e coorte na tendência de mortalidade por câncer de colo de útero e útero porção não especificada, no Estado de Minas Gerais, Brasil, no período de 1980-2005. Foram incluídos 11.243 casos. Utilizou-se método não paramétrico para o cálculo da estatística Z e valor de p. As coortes foram avaliadas uma a uma e em blocos de três, para possibilitar o aumento do número de comparações. Observou-se redução da mortalidade maior que a esperada para os blocos de coortes das mulheres nascidas de 1913-1920; 1927-1936; 1937-1946; 1949-1956; 1963-1970; 1969-1976. Para os blocos de coortes de 1901-1908 e 1921-1928, encontrou-se redução da mortalidade menor que a esperada. No que se refere ao efeito período, foi evidenciada uma redução maior que a esperada para o período de 2000-2001, quando comparado ao anterior. O estudo sugere a existência do efeito coorte significativo sobre a mortalidade por câncer de colo de útero na população estudada, os resultados foram confrontados com o contexto social e político.

Neoplasias do Colo do Útero; Mortalidade; Efeito de Coortes; Efeito Período

Contributors

C. M. M. Alves participated in the data collection, analysis and article write up. R. R. Bastos and M. R. Guerra collaborated in the analysis, write up and critical revision of the article.

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