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Burden of cervical cancer in Europe: estimates for 2004

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The European Council recommends that organised cervical cancer screening be offered in all member states. In order to evaluate the impact of existing and new prevention methods, regularly updated information on the burden of cervical cancer is needed. The best estimates of mortality and incidence rates were applied to the 2004 projected population of 40 European countries using methods developed by the International Agency for Research on Cancer. Using the absolute number of cases and deaths, the standardised and cumulative rates (up to age of 74 years) were computed for individual countries, and aggregated for the 15 old (EU15) and the 10 new member states (EU10) of the European Union (EU25). For the 28 countries (25 belonging to the EU25 and three others), deaths from not otherwise specified uterine cancer were reallocated to cervix or corpus uteri cancer using age-specific rules described in GLOBOCAN 2002. The burden of cervical cancer deaths in the whole of Europe was assessed by analysing uterus cancer mortality in women aged <45 years. In 2004, ~31 000 women in the EU25 developed cervical cancer and almost 14 000 died from the disease. A striking contrast is noted between the 15 old and 10 new EU member states: world age-standardised incidence rates (per 10^5 women-years) of 9.5 versus 16.7; standardised mortality rates of 4.9 versus 10.7; cumulative mortality rate of 0.27% versus 0.71%. The burden was lowest in Finland (cumulative incidence and mortality rate of 0.38% and 0.12%, respectively) and highest in Lithuania (cumulative incidence and mortality of 1.64% and 0.94%, respectively). The mapping of uterine cancer mortality among women aged <45 years indicates that the burden of cervical cancer is particularly high across the whole of Eastern Europe. Cervical cancer still constitutes a considerable public health problem in Europe. The dramatic contrast between West and East European states merits particular attention from the health authorities of the countries concerned and the EU as a whole. The European Commission should maintain cervical cancer control in future action plans and increase support to the most affected member states.

Key words: cervical cancer, Europe, European Union, incidence, mortality

introduction

On 2 December 2003, the European Council adopted a recommendation to implement population-based screening for cancer of the breast and the uterine cervix in women and of the colon and rectum in both men and women in all member states of the European Union (EU) [1]. The recommendation was based on scientific evidence indicating that cause-specific mortality can be reduced significantly by offering high-quality mammography and cervical cytology screening to women and a faecal occult blood test to both men and women respecting well-defined target age groups and intervals [2–4]. Cytology screening should not start before the age of 20 but not later than the age of 30. Screening can be stopped safely at ages 60–64 if previous Pap smears did not show abnormalities [5–7]. Nevertheless, nonscreened older women should be considered as a particular risk group who should benefit from screening beyond that age.

In order to monitor the impact of preventive measures, regularly updated data on incidence and mortality are needed. In an époque where new effective screening and triage methods and even human papillomavirus (HPV) vaccinations are becoming available, the need for timely and reliable estimates is felt very strongly. The latest estimates of the burden of cancer in Europe are for the year 2002 and were compiled in the GLOBOCAN 2002 database [8]. According to these estimates, ~936 000 women living in the 25 countries that constitute the EU†, developed cancer and 501 000 died from it. Furthermore, 3.5% of these cancer cases and 2.9% of the deaths were due to cervix uteri cancer. Recently, the International Agency for Research on Cancer (IARC) estimated the burden of cancer in Europe for the year 2004 [9]. In the current paper, we describe the incidence of and the mortality from uterus cancer (with a focus on cervix uteri cancer) in 40 countries of the European continent and examine, in particular, the contrasts between the old and new EU member states.

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materials and methods

In this paper, we estimate the incidence of and mortality from uterine and cervical cancer in 40 European countries for the year 2004. The same data sources and methods were used as in a recent report of the IARC on the global burden of cancer [8, 9].

Data were compiled in eight age strata (0–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74 and 75 or older) at the national level, for the 15 old member states of the EU [(EU15): Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Portugal, Spain, Sweden, The Netherlands and the United Kingdom]; the 10 new member states (EU10), which acceded to the EU in 2004 (Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia); the three additional countries (Iceland, Liechtenstein and Norway) that together with the 25 EU members states constitute the European Economic Area (EEA) and 12 other countries of the European continent [Albania, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, the Former Yugoslavian Republic of Macedonia (FYROM), Moldova, Romania, the Russian Federation, Ukraine, Serbia and Montenegro and Switzerland].

mortality

Data on mortality from uterine cancer were obtained from the World Health Organisation (WHO) Mortality Database (http://www.who.int/whosis/mort) for all countries except Cyprus, Liechtenstein and Bosnia and Herzegovina. The most recent data were extracted for the period between 2000 and 2002 for all contributing countries except for Belgium where the latest death figures dated for 1997 (Table 1, in [9], published previously in this journal). For the countries of the EEA and Switzerland, data were coded according to the international classification of diseases (ICD) version 8, 9 or 10, where separate codes are available for cervical cancer [ICD8 (version 8) and ICD9 = 180, ICD10 = C53], corpus uteri cancer (ICD8 = 182.0, ICD9 = 182, ICD10 = C54) and uterus cancer not otherwise specified (NOS) (ICD8 = 182.9, ICD9 = 179, ICD10 = C55). Deaths from uterus cancer NOS were reattributed, respectively, to cervix or corpus uteri cancer according to country and age-specific proportions $[Cx_i/(Cx_i + Cp_i)]$ and $[Cp_i/(Cx_i + Cp_i)]$, where Cx_i and Cp_i stand for the number of deaths due to certified cervix uteri and corpus uteri cancer, respectively, in age group *i*.

For Belarus, the Russian Federation and Ukraine, causes of death were classified according to the ICD9 special list with a separate code for cervix cancer deaths and a combined code for deaths from cancer of the corpus uteri or uterus NOS (CpNOS). For non-EEA countries (except Switzerland), we present data for uterine cancer only.

For all countries, the total number of uterine cancer deaths (Ut) was computed by summing either of the two or three considered causes of death ($Ut_i = Cx_i + Cp_i + NOS_i$ or $Ut_i = Cx_i + CpNOS_i$).

Table 1. Burden of cervical cancer in the 25 member states of the EU, Iceland, Norway and Switzerland, estimates for 2004: number of cases and deaths from cervical cancer, crude, age-standardised rates (using the world and European reference population) and cumulative rates up to the age of 74 years

Country	Incidence					Mortality				
	Cases (× 100)	Crude rate	W-ASR	E-ASR	Cum rate (%)	Deaths (× 100)	Crude rate	W-ASR	E-ASR	Cum rate (%)
EU										
Austria	5.1	12.5	9.6	10.9	0.86	2.5	6.2	3.3	4.4	0.33
Belgium	6.9	13.1	10.8	12.0	0.92	3.7	7.0	3.8	4.9	0.37
Cyprus	0.5	13.2	12.5	13.1	1.00	0.3	6.1	5.6	6.2	0.49
Czech Republic	11.7	22.3	18.0	20.2	1.56	5.0	9.4	5.8	7.4	0.57
Denmark	4.5	16.5	13.9	15.2	1.20	1.8	6.6	3.9	5.0	0.38
Estonia	1.6	22.7	17.1	20.3	1.60	0.8	11.8	6.9	8.9	0.70
Finland	1.4	5.4	4.7	4.9	0.38	0.6	2.3	1.1	1.6	0.12
France	40.8	13.2	10.1	11.7	0.88	15.6	5.0	3.0	3.8	0.28
Germany	55.6	13.4	11.0	12.3	0.95	25.8	6.2	3.4	4.4	0.32
Greece	4.8	8.9	7.2	8.0	0.62	2.1	3.9	2.1	2.7	0.20
Hungary	9.7	19.0	16.7	18.0	1.39	5.6	10.9	7.2	8.9	0.68
Ireland	1.7	8.5	7.9	8.6	0.67	0.8	3.7	3.0	3.7	0.29
Italy	31.3	10.6	8.2	9.5	0.75	10.9	3.7	2.0	2.6	0.19
Latvia	1.6	12.9	10.2	11.5	0.92	1.7	13.1	7.9	10.0	0.81
Lithuania	4.3	22.0	17.2	20.1	1.64	2.8	14.6	10.0	12.4	0.94
Luxembourg	0.3	14.5	10.8	13.2	1.11	0.1	5.1	3.0	4.1	0.34
Malta	0.1	7.0	5.3	6.0	0.52	0.1	4.5	2.7	3.4	0.26
Netherlands	7.0	8.6	7.3	8.0	0.61	3.1	3.8	2.3	3.0	0.22
Poland	40.8	20.6	16.6	19.2	1.53	22.2	11.2	7.4	9.6	0.76
Portugal	9.8	18.7	14.8	17.2	1.28	3.8	7.2	4.3	5.6	0.41
Slovakia	5.8	20.8	18.0	20.3	1.60	2.3	8.1	5.8	7.4	0.60
Slovenia	2.1	20.5	18.6	19.6	1.49	0.7	6.9	4.0	5.1	0.38
Spain	21.1	10.3	8.2	9.5	0.73	7.8	3.8	2.3	3.0	0.23
Sweden	4.8	10.9	8.9	9.7	0.73	2.5	5.6	2.7	3.6	0.28
UK	32.3	10.6	9.1	9.8	0.74	14.3	4.7	2.9	3.6	0.27
Iceland	0.1	9.0	8.9	9.2	0.71	0.0	2.8	2.0	2.7	0.26
Norway	3.1	13.5	12.1	12.9	0.98	1.1	4.7	3.1	3.8	0.30
Switzerland	4.0	10.9	9.3	10.1	0.79	1.1	2.9	1.6	2.0	0.15

Crude and standardised rates are expressed per 100 000 women-years.
EU, European Union; W-ASR, world age-standardised rate; E-ASR, European age-standardised rate.

The mortality in Cyprus was estimated from the national incidence and pooled European survival data [10]. For Bosnia and Herzegovina and for Liechtenstein, a simple average of the mortality rates of neighbouring countries was accepted (for the first: Albania, FYROM, and Serbia and Montenegro; for the latter: Austria, Belgium, France, Germany, Luxembourg and Switzerland). For Albania, the reported mortality rates were multiplied by a correction factor to compensate for underregistration of deaths (based on 60% completeness estimate for 2001, according to the WHO mortality database).

incidence

Cervical cancer incidence data were extracted from national registries, extrapolated from regional or neighbouring registries or computed from cause-specific mortality data using Poisson regression as explained previously [9].

population

Estimates of the female population size in 2004, for each country and age group were computed by calculating the annual percentage change by sex and age between 2000 and 2005, obtained from the 2002 revision of the World Population Prospects of the United Nations Population Division [11]. For the number of women from Russia living on the European continent, the total population of the republics to the west of the Ural Mountains was cumulated, which accounted for 76% of the total Russian Federation, according to the 2002 census.

The number of deaths and incident cases were obtained by multiplying the age-specific rates by the corresponding population size. The directly age-standardised rates were computed using the European and World standard population as the reference [12]. The cumulative rates were computed by summing the products of the age-specific rates (a_i) multiplied by the width of the corresponding age groups (ΔT_i) up to the age of 74 yeas ($CR = \sum a_i * \Delta T_i$) [13].

results

cervical cancer incidence and mortality

In Table 1, we show the estimated number of cases, the crude rate, the World- and European age-standardised rates (W-ASR, E-ASR) and the cumulative rate of cervical cancer incidence and mortality for the 25 member states of the EU and also for Iceland, Norway and Switzerland. Henceforth, we will use the term standardised rate as being the W-ASR unless otherwise specified, and rates are expressed as numbers of cases or deaths per 100 000 women-years. In Figure 1, the standardised rates are displayed for the 25 member states of the EU, ranked according to mortality. The rates were lowest in Finland: standardised incidence rate of 4.7 and mortality rate of 1.1. The highest standardised mortality rate (10.0) was noted for Lithuania, while high standardised incidence rates (>16.0) were found in Slovenia, the Czech Republic, Slovakia, Estonia, Hungary, Poland and Lithuania. The probability of a diagnosis of cervical cancer before the age of 74, approximated by the cumulative rate, varied between 0.38%, observed in Finland, and 1.60%, observed in Estonia, Lithuania and Slovakia. The cumulative mortality rate was lowest in Finland (0.12%) and highest in Lithuania (0.94%).

The number of cases, deaths and rates, aggregated over the 15 old member states, the 10 new member states and the entire EU25, are shown in Table 3. According to our estimations, there were ~31 000 incident cases of cervical cancer in the EU25 and ~14 000 women died from this cancer. The

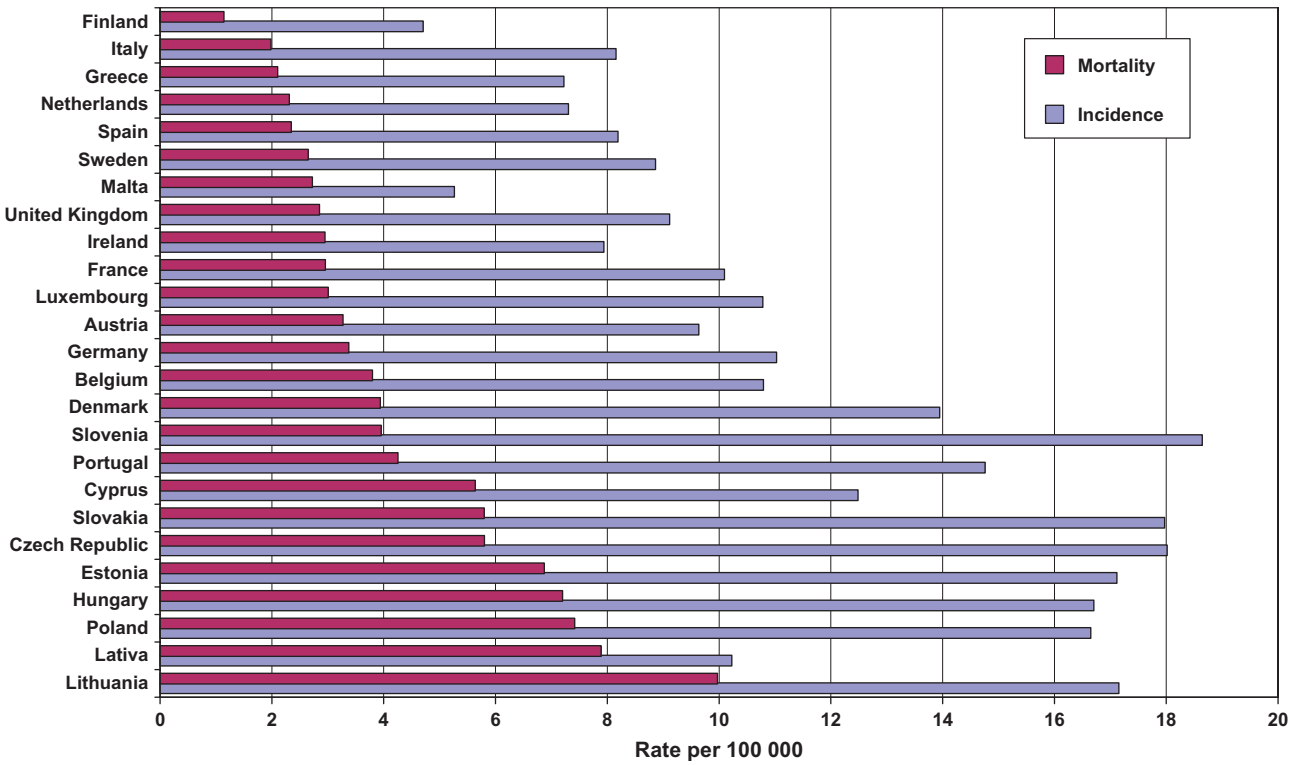

Figure 1. Age-standardised rates of incidence of and mortality from cervical cancer (/100 000 women-years) in 25 European Union (EU) member states, ranked by increasing mortality, estimates for 2004 (direct standardisation using the World reference population).

standardised incidence and mortality rates were, respectively, 9.5 and 2.8 for the 15 old EU member states, 16.7 and 7.0 for the 10 new member states and 10.7 and 3.5 for the 25 member states overall. The ratio of the standardised rates in the new over those in the old EU member states was 1.75 and 2.50 for incidence and mortality, respectively.

The geographical distribution of the standardised cervical cancer mortality rate in 28 European countries is displayed in Figure 2, using seven ranges with amplitude of $1.5/10^5$ women-years, over a green–yellow–red gradient. An obviously higher mortality is observed in the Central and East European new EU member states (with Cyprus, the Czech Republic and Slovakia coloured in yellow; Estonia, Hungary and Poland in orange, Latvia in red and Lithuania coloured in dark red).

uterus cancer incidence and mortality

The number of cases of and deaths from uterine cancers and the corresponding rates are shown in Table 2 for 40 European countries separately, and in Table 3 for different aggregations. In total, almost 129 000 new cases of cancer of the cervix or corpus occurred and almost 47 000 women died from these cancers. As for cervical cancer, the burden of uterine cancers is considerably higher in the new compared with the old EU member states: ratio of 1.41 for incidence and 2.14 for mortality. In order to obtain a surrogate indicator of the burden of cervical cancer mortality in all 40 countries, we computed and mapped the rate of mortality from uterine cancer among women aged <45 years. In this age group, nearly all uterine cancer deaths are due to cancer of the cervix uteri [14–16] (Table 4 and Figure 3). For the 28 countries, included in Table 1 and Figure 2, the under-45 years uterine cancer mortality correlated well with the standardised cervical cancer mortality ($r = 0.89$).

The uterine cancer mortality rate in women aged <45 years was lowest (dark green: $<0.75/10^5$) in Finland ($0.3/10^5$), Iceland ($0.5/10^5$), Luxembourg ($0.7/10^5$) and Sweden ($0.7/10^5$) and highest (red or dark red: $\geq 3.75/10^5$) in Serbia and Montenegro ($4.1/10^5$), Bulgaria ($4.4/10^5$), Cyprus ($4.5/10^5$), Moldova ($4.6/10^5$), Lithuania ($4.7/10^5$) and Romania ($5.9/10^5$). The map in Figure 3 confirms the East–West contrast: all countries east of the old 15 EU member states, except Croatia and Slovenia, are coloured in yellow, orange or red.

discussion

In 2004, almost 31 000 women in the EU25 were diagnosed with cervical cancer and 14 000 died from the disease. Assuming that the proportion of uterine cancer of cervical origin in the 12 non-EEA countries was similar to that in the 10 new EU members states brings us to a rough estimate of 52 000 cases and 27 000 deaths for the whole European continent. These data clearly illustrate that cervical cancer still remains a considerable public health problem in Europe in spite of the consistent evidence underpinning the efficacy of cytological screening.

The efficacy of cervical cancer screening has never been assessed by randomised controlled trials. Nevertheless, convincing evidence, derived from observational studies including trend analyses of incidence and mortality, indicates that screening is effective. Recently, the evidence on screening effectiveness was

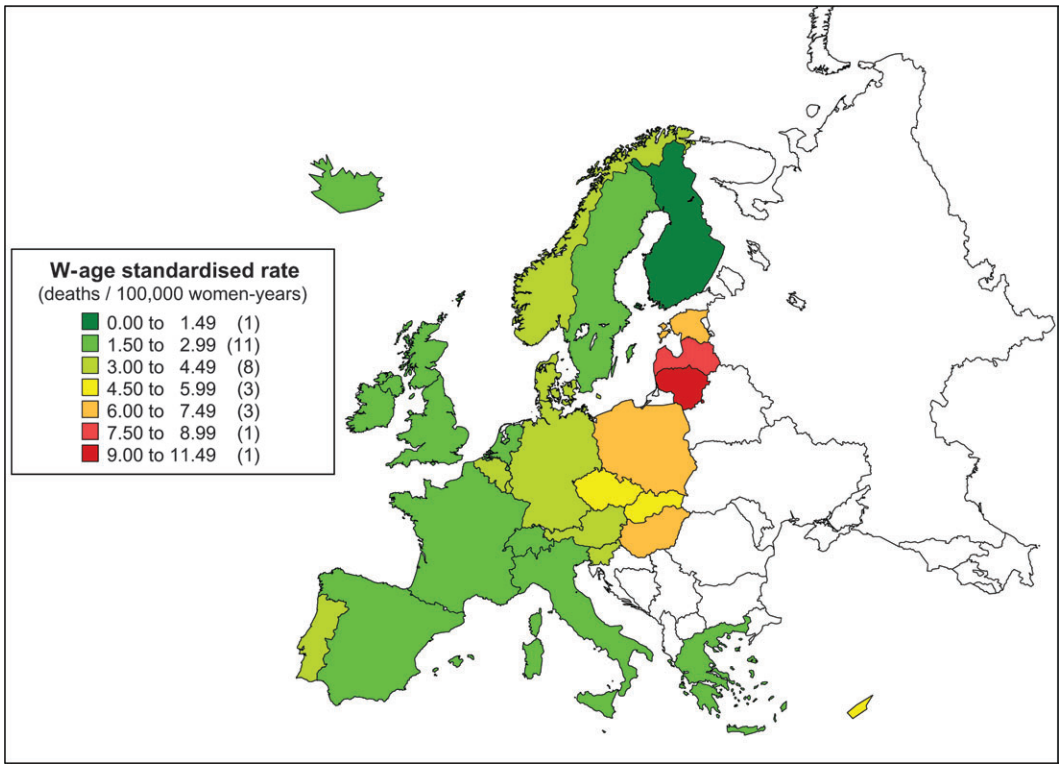

Figure 2. Geographical distribution of the world age-standardised mortality from cervical cancer in 28 European countries, estimates for 2004.

Table 2. Burden of uterine cancer in the 25 member states of the EU, Iceland, Norway and Switzerland, estimates for 2004: number of cases and deaths from uterus cancer, crude, age-standardised rates (using the world and European reference population) and cumulative rates up to the age of 74 years

Country	Incidence					Mortality				
	Cases (× 100)	Crude rate	W-ASR	E-ASR	Cum rate (%)	Deaths (× 100)	Crude rate	W-ASR	E-ASR	Cum rate (%)
Albania	1.9	12.2	12.7	15.4	1.29	1.0	6.1	6.0	7.7	0.97
Austria	15.0	36.6	21.9	28.0	2.29	5.1	12.5	5.6	8.0	0.40
Belarus	23.1	43.1	22.5	28.4	3.32	7.5	14.0	5.7	8.0	0.49
Belgium	19.0	36.1	25.4	29.9	2.38	6.6	12.7	9.5	12.4	0.51
Bosnia and Herzegovina	6.6	31.2	34.4	41.6	2.45	2.9	13.5	11.3	14.2	0.36
Bulgaria	18.8	48.1	32.4	39.3	3.48	7.0	17.8	8.7	11.4	1.06
Croatia	10.0	41.7	27.3	34.3	2.87	2.0	8.4	4.3	5.9	0.41
Cyprus	1.3	30.9	25.0	30.2	2.49	0.6	14.7	10.8	13.5	0.52
Czech Republic	29.5	56.2	36.7	46.1	3.87	9.3	17.7	9.3	12.8	0.43
Denmark	11.1	41.1	27.5	34.0	2.90	3.3	12.3	6.5	8.9	1.20
Estonia	3.4	48.5	31.4	40.0	3.28	1.1	16.2	8.8	11.9	0.50
Finland	9.2	34.7	19.7	26.0	2.33	2.2	8.2	3.5	5.2	1.42
France	106.6	34.5	22.1	28.4	2.35	30.2	9.8	4.8	6.6	0.43
FYROM (Macedonia)	2.3	22.1	24.4	32.9	2.46	1.3	12.8	5.2	7.1	1.00
Germany	155.7	37.4	23.6	29.2	1.65	46.1	11.1	5.0	6.9	0.56
Greece	12.8	23.7	15.7	19.9	2.84	3.7	6.9	3.4	4.7	1.23
Hungary	20.8	40.8	28.8	34.6	2.23	9.4	18.5	10.5	13.8	0.44
Iceland	0.4	27.8	21.7	27.7	1.92	0.1	5.6	3.6	5.1	0.59
Ireland	4.6	22.8	18.4	23.1	2.41	1.4	7.1	4.8	6.6	1.09
Italy	109.6	37.2	21.4	28.1	3.23	28.3	9.6	4.1	5.8	0.64
Latvia	5.7	45.3	29.5	37.2	2.35	2.5	19.6	10.9	14.3	1.58
Liechtenstein	0.1	35.0	21.9	27.9	3.33	0.0	5.8	4.8	6.8	1.11
Lithuania	8.8	45.4	31.3	39.6	2.61	4.4	22.8	14.0	18.3	1.35
Luxembourg	0.8	34.5	22.8	30.1	1.78	0.2	7.7	4.2	5.9	1.08
Malta	0.8	39.9	22.1	25.9	3.02	0.2	9.0	12.1	15.3	0.75
Moldova	5.6	25.4	18.4	23.7	2.12	3.3	15.1	4.4	6.2	0.47
Netherlands	22.9	28.2	27.4	34.7	2.00	7.0	8.6	5.5	7.5	0.55
Norway	9.5	41.4	28.2	34.9	2.84	2.4	10.5	10.0	13.5	0.44
Poland	75.9	38.4	24.9	31.0	2.96	31.8	16.1	6.2	8.4	1.19
Portugal	18.8	35.9	29.3	33.9	2.55	6.0	11.5	15.6	19.8	0.49
Romania	40.4	35.6	25.6	31.1	2.74	25.3	22.3	10.3	13.5	0.97
Russian Federation	197.1	34.5	35.2	44.1	2.63	95.8	16.8	9.7	13.2	0.40
Serbia and Montenegro	29.3	55.7	35.4	42.8	4.28	10.6	20.1	7.0	9.6	0.49
Slovakia	13.1	47.0	18.1	23.3	3.69	4.3	15.3	4.5	6.2	0.51
Slovenia	5.1	49.8	24.6	32.1	3.55	1.4	13.8	4.7	6.8	0.36
Spain	58.5	28.7	22.0	27.7	1.95	19.1	9.3	4.0	5.8	1.06
Sweden	19.4	43.7	30.4	37.1	2.73	5.0	11.3	11.0	14.4	0.41
Switzerland	12.9	35.7	19.4	22.5	2.39	3.4	9.5	9.8	12.6	0.52
Ukraine	106.5	42.0	20.4	25.7	3.14	47.4	18.7	4.7	6.5	0.43
United Kingdom	94.0	31.0	44.2	51.9	2.15	28.1	9.3	12.8	16.9	1.20

Crude and standardised rates are expressed per 100 000 women-years.
EU, European Union; W-ASR, world age-standardised rate; E-ASR, European age-standardised rate.

reviewed [17]. It was concluded that by careful implementation of a screening policy, as outlined in the European Council Recommendation, the incidence of cervical cancer can be reduced by 80% or more among participating women.

The current incidence of cervical cancer reflects the effect of exposure to the main risk factor (sexually transmitted infection with oncogenic HPV) and secondary prevention through detection and treatment of HPV-induced epithelial lesions [17–20]. To a certain degree, the influence of both factors can be disentangled by trend analysis using age-cohort-period models [21, 22], where cohort effects correspond with changes in HPV prevalence at young ages and period effects can be explained as the consequence of screening or improved treatment. From previous trend analyses, it was observed that in most European countries the risk of cervical cancer incidence and mortality was increasing for women born after 1935 [21]. This is probably the result of changes in sexual behaviour since the 1960s yielding the enhanced transmission of HPV. The increased frequency of smoking and oral contraception, both risk factors for cervical cancer, may have contributed to the recent rise of the cohort effect. Increased incidence and even mortality in young women was first noticed in England and Wales but was subsequently observed in other European countries [22–27].

Table 3. Number of cases and deaths from cervical and uterus cancer, crude, age-standardised and cumulative rates in parts of Europe [EU, EEA$^+$ (includes the EU, Iceland, Liechtenstein, Norway) and Switzerland], estimates for 2004

Region	Incidence					Mortality				
	Cases (× 100)	Crude rate	W-ASR	E-ASR	Cum rate (%)	Deaths (× 100)	Crude rate	W-ASR	E-ASR	Cum rate (%)
Cervical cancer										
EU, 15 old member states	227.4	11.8	9.5	10.7	0.82	95.2	4.9	2.8	3.6	0.27
EU, 10 new member states	78.3	20.4	16.7	18.9	1.49	41.3	10.7	7.1	9.0	0.71
EU, 25 current member states	305.6	13.2	10.7	12.1	0.94	136.5	5.9	3.5	4.5	0.34
EEA$^+$	312.8	13.2	10.7	12.1	0.93	138.7	5.8	3.5	4.5	0.34
Uterus cancer										
EU, 15 old member states	658.0	34.1	21.5	27.4	2.30	192.4	10.0	4.7	6.6	0.49
EU, 10 new member states	164.3	42.7	30.3	37.7	3.17	64.9	16.9	10.1	13.5	1.07
EU, 25 current member states	822.3	35.5	23.0	29.1	2.45	257.4	11.1	5.6	7.7	0.58
EEA$^+$	845.1	35.6	23.1	29.2	2.45	263.3	11.1	5.6	7.7	0.58
Europe, 40 countries	1286.8	36.2	24.9	30.9	2.59	467.2	13.2	7.5	10.0	0.79

Crude and standardised rates are expressed per 100 000 women-years.
EU, European Union; EEA, European Economic Area; W-ASR, world age-standardised rate; E-ASR, European age-standardised rate.

Table 4. Rate of mortality from uterine cancer (cervix uteri, corpus uteri, uterus not otherwise specified) in women younger than 45 years in 40 European countries (estimates for 2004)

Country	Mortality rate	Country	Mortality rate
Albania	2.2	Latvia	3.6
Austria	1.1	Liechtenstein	1.1
Belarus	2.5	Lithuania	4.7
Belgium	1.4	Luxembourg	0.7
Bosnia and Herzegovina	3.2	Malta	1.7
Bulgaria	4.4	Moldova	4.6
Croatia	1.2	Netherlands	1.0
Cyprus	4.5	Norway	1.4
Czech Republic	2.4	Poland	2.4
Denmark	1.9	Portugal	1.6
Estonia	2.4	Romania	5.87
Finland	0.3	Russian Federation	3.2
France	1.3	Serbia and Montenegro	4.1
FYROM (Macedonia)	3.3	Slovakia	2.2
Germany	1.4	Slovenia	1.8
Greece	0.9	Spain	1.0
Hungary	3.5	Sweden	0.7
Iceland	0.5	Switzerland	0.8
Ireland	1.1	Ukraine	3.5
Italy	0.8	United Kingdom	1.2

Rates are expressed per 100 000 women-years.

Substantial reductions in incidence and mortality were observed in Nordic countries, and the extent of these reductions correlated with the level of implementation of organised screening [28, 29]. By improving screening coverage and quality, subsequent to setting up a national screening programme in 1988, the rising trend in young cohorts has been reversed in UK [30, 31]. In Norway, a 20% reduction in incidence of cervical cancer has been observed since the initiation of organised screening in 1995 [32]. In Italy, it was shown that, by organised screening, cervical cancer incidence can be reduced further in areas with preexisting opportunistic screening [33]. Opportunistic screening also resulted in a reduction of cervical cancer incidence and mortality in several other West European countries [15, 21]. Nevertheless, in Ireland, Spain and Portugal, a tendency of increased mortality is observed, which is explained most plausibly by the absence of a population-based screening programme or the ineffectiveness of present opportunistic screening [15, 34].

The most striking observation of the current study is the dramatic contrast in the burden of cervical cancer between the 15 old and most of the new EU10 member states and between Western and Eastern Europe in general. More than one in every 100 women in the new EU10 member states dies from cervical cancer before the age of 75, which is twice as high when compared with the old 15 member states. Lithuania (cumulative mortality of 0.94%) shows even an eight-fold higher cumulative mortality rate compared with Finland (0.12%) where the rate is lowest. Mortality rates observed currently in Eastern Europe are similar to those observed in Western Europe several decades ago [31, 35]. It looks obvious that, by lack of adequate screening in Eastern Europe, the effect of increased transmission of HPV in cohorts born after 1935 was not counterbalanced. Moreover, the greater east–west contrast in mortality compared with incidence reflects lower survival from cervical cancer possibly resulting from more advanced staging at diagnosis and lower effectiveness of cancer treatment in the eastern states of Europe [10]. Detailed trend analyses, currently conducted by the European Network of Information on Cancer, an EU funded project, will provide more insight into the dynamics of this contrast.

The data estimated in this study should be considered with caution, since their reliability is determined by the quality and completeness of cancer and death registration and further by the appropriateness of external data used to model unavailable data. In particular, the proportion of deaths from uterine cancer without specification of the exact topographic origin compromises the accuracy of cause of death certification. For reasons of comparability, the same age-specific rules of

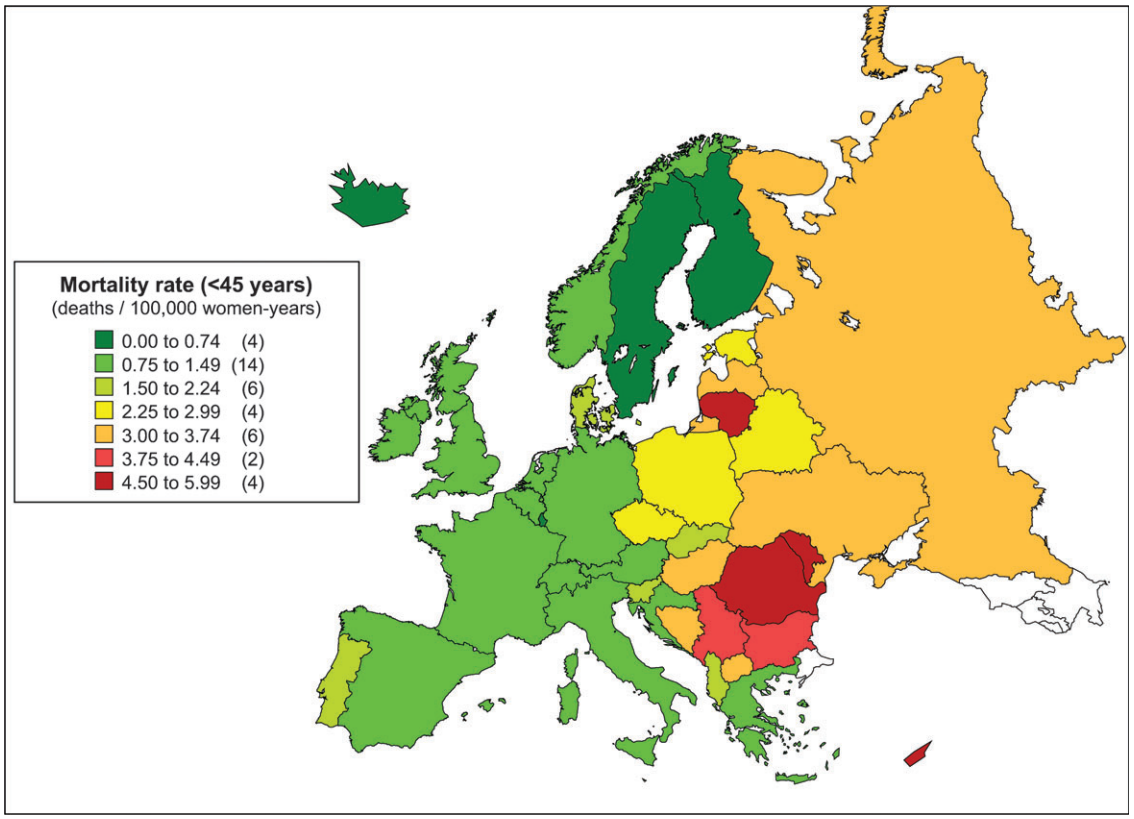

Figure 3. Geographical distribution of the mortality from uterine cancer among women younger than 45 years in 40 European countries, estimates for 2004.

GLOBOCAN 2002 were followed to reallocate uterine cancer NOS deaths into cervix and corpus uteri cancer deaths. More sophisticated reallocation principles could result in more reliable estimates of cervical cancer mortality in individual countries [16, 36]. Nevertheless, at least the dramatic East–West contrast probably can be accepted to correspond with the truth. The high correlation between the under-45 uterine cancer mortality with the estimated global cervical cancer mortality in the 28 countries (EU, Iceland, Norway and Switzerland) provides some evidence of the plausibility for this assumption. Moreover, the extreme discrepancy in mortality between Finland and Lithuania can be considered as reliable given the low proportion of uterus NOS cancer deaths and the availability of internationally recognised cancer registries with complete national coverage in these two countries (http://www.who.int/whosis/mort) [37].

The present study should motivate public health authorities from the EU and from all EU member states, in particular those in Eastern Europe, to maintain or to set up well-organised cervical cancer prevention programmes as proposed in the European Council Recommendation [1]. It is hoped that the pending publication of the new European Guidelines for Quality Assurance in Cervical Cancer Screening will contribute in establishing this goal [38].

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references

1. The Council of the European Union. Council recommendation of 2 December on cancer screening.Off J Eur Union 2003; 878: 34–38.
2. Boyle P, Autier P, Bartelink H et al. European Code Against Cancer and scientific justification: third version (2003). Ann Oncol 2003; 14: 973–1005.
3. Commission of the European Communities. Proposal for a Council Recommendation on Cancer Screening. 2003/0093 (CNS). Brussels: European Commission, 2003; 1–22.
4. Arbyn M, Van Oyen H, Lynge E et al. European Commission's proposal for a council recommendation on cancer screening. BMJ 2003; 327: 289–290.
5. Coleman D, Day N, Douglas G et al. European Guidelines for Quality Assurance in Cervical Cancer Screening. Europe against cancer programme. Eur J Cancer 1993; 29A (Suppl 4): S1–S38.
6. Lynge E. Recommendations on cancer screening in the European union. Eur J Cancer 2000; 36: 1473–1478. Advisory Committee on Cancer Prevention.
7. Anttila A, Ronco G, Lynge E, Fender M, Arbyn M, Baldauf JJ et al. Chapter 2: Epidemiological guidelines for quality assurance in cervical cancer screening. In Arbyn M, Antilla A, Jordan J et al (eds): European Commission European Guidelines for Quality Assurance in Cervical Cancer Screening. Luxembourg: Office for Official Publications of the European Communities 2007; In press.
8. Ferlay J, Bray F, Pisani P et al. GLOBOCAN 2002. Cancer Incidence, Mortality and Prevalence Worldwide. IARC CancerBase No. 5, version 2.0. Lyon, France: IARC Press 2004 .

9. Boyle P, Ferlay J. Cancer incidence and mortality in Europe, 2004. Ann Oncol 2005; 16: 481–488.
10. Sant M, Aareleid T, Berrino F et al. EUROCARE-3: survival of cancer patients diagnosed 1990–94-results and commentary. Ann Oncol 2003; 14: 61–118.
11. United Nations Population Division. World Population Prospects, Revision 2002. New York, NY: United Nations 2005; http://esa.un.org/unpp/ (1 December 2006, date last accessed).
12. Waterhouse JAH, Muir CS, Shanmugaratnam K. International Agency for Research on Cancer. Cancer Incidence in Five Continents. Lyon: France 1976.
13. Kleinbaum DG, Kupper LL, Morgenstern H. Epidemiologic Research: Principles and Quantitative Methods. New York, NY: Van Nostrand Reinhold 1982.
14. Jensen OM, Estève J, Moller H et al. Cancer in the European Community and its member states. Eur J Cancer 1990; 26: 1167–1256.
15. Levi F, Lucchini F, Negri E et al. Cervical cancer mortality among young women in Europe: patterns and trends. Eur J Cancer 2000; 36: 2266–2271.
16. Arbyn M, Geys H. Trend of cervical cancer mortality in Belgium (1954–94): tentative solution for the certification problem of not specified uterine cancer. Int J Cancer 2002; 102: 649–654.
17. IARC. Cervix Cancer Screening. IARC Handbooks of Cancer Prevention. Vol 10, Lyon, France: IARC 2005.
18. Lehtinen M, Dillner J, Knekt P et al. Serologically diagnosed infection with human papillomavirus type 16 and risk for subsequent development of cervical carcinoma: nested case-control study. BMJ 1996; 312: 537–539.
19. Wallin KL, Wiklund F, Angstrom T et al. Type-specific persistence of human papillomavirus DNA before the development of invase cervical cancer. N Engl J Med 1999; 341: 1633–1638.
20. Bosch FX, de Sanjose S. Chapter 1: Human papillomavirus and cervical cancer—burden and assessment of causality. J Natl Cancer Inst Monogr 2003: 3–13.
21. Bray F, Loos AH, McCarron P et al. Trends in cervical squamous cell carcinoma incidence in 13 European countries: changing risk and the effects of screening. Cancer Epidemiol Biomarkers Prev 2005; 14: 677–686.
22. Arbyn M, Van Oyen H, Sartor F et al. Description of the influence of age, period and cohort effects on cervical cancer mortality by loglinear Poisson models (Belgium, 1955–94). Arch Public Health 2002; 60: 73–100.
23. Hill GB, Adelstein AM. Cohort mortality from carcinoma of the cervix. Lancet 1967: 605–606.
24. Yule R. Mortality from carcinoma of the cervix. Lancet 1978: 1031–1033.
25. van der Graaf Y, Zielhuis GA, Vooijs GP. Cervical cancer mortality in the Netherlands. Int J Epidemiol 1988; 17: 270–276.
26. Kirn VP, Kovacic J, Primic Zakelj M. Epidemiological evaluation of cervical cancer screening in Slovenia up to 1986. Eur J Gynaecol Oncol 1992; 13: 75–82.
27. Llorca J, Prieto MD, Delgado-Rodr¡guez M. Increase in cervical cancer mortality in Spain, 1951–1991. J Epidemiol Community Health 1999; 53: 408–411.
28. Laara E, Day NE, Hakama M. Trends in mortality from cervical cancer in the Nordic countries: association with organised screening programmes. Lancet 1987; 1: 1247–1249.
29. Sankila R, Demaret E, Hakama M et al. Evaluation and monitoring of screening programmes. Luxembourg: Office for Official Publications of the European Communities 2000.
30. Quinn M, Babb P, Jones J. Effect of screening on incidence an mortality from cancer of the cercix in England: evaluation based on routinely collected statistics. BMJ 1999; 318: 904–908.
31. Peto J, Gilham C, Fletcher O et al. The cervical cancer epidemic that screening has prevented in the UK. Lancet 2004; 364: 249–256.
32. Nygard JF, Skare GB, Thoresen SO. The cervical cancer screening programme in Norway, 1992–2000: changes in Pap smear coverage and incidence of cervical cancer. J Med Screen 2002; 9: 86–91.
33. Ronco G, Pilutti S, Patriarca S et al. Impact of the introduction of organised screening for cervical cancer in Turin, Italy: cancer incidence by screening history 1992–98. Br J Cancer 2005; 93: 376–378.
34. Comber H, Gavin A. Recent trends in cervical cancer mortality in Britain and Ireland: the case for population-based cervical cancer screening. Br J Cancer 2004; 91: 1902–1904.
35. Levi F, Lucchini F, Negri E et al. Cancer mortality in Europe, 1995–1999, and an overview of trends since 1960. Int J Cancer 2004; 110: 155–169.
36. Loos AH, Bray F, McCarron P et al. Sheep and goats: separating cervix and corpus uteri from imprecisely coded uterine cancer deaths, for studies of geographical and temporal variations in mortality. Eur J Cancer 2004; 40: 2794–803.
37. Parkin DM, Whelan SL, Ferlay J et al. Cancer Incidence in Five Continents. Vol. VIII. Lyon, France: IARC Scientific Publications No. 155 2002.
38. Arbyn M, Anttila A, Jordan J, Ronco G, Schenck U, Segnan N, Wiener H (eds). European Commission. European Guidelines for Quality Assurance in Cervical Cancer Screening. Luxembourg: Office for Official Publications of the European Communities 2007; In press.