

Premature Mortality and Lost Productivity Due to HPV-Related Cancers in Europe

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Background and objectives

- Human papillomavirus (HPV) is responsible for various cancers, with an estimated 67,500 new cases annually in the 27 EU countries in 2022, many of which could be prevented through vaccination^{1,2,3}
- This analysis aims to provide estimates of cancer mortality due to HPV in one year across 27 European countries. Additionally, productivity loss associated with premature HPV-related cancer mortality was estimated

Methods

Model structure

Inputs and assumptions

- A model was developed to reflect the burden to society by calculating mortality and productivity loss due to premature deaths from 11 HPV-related cancers in 27 European countries. The human capital approach was used to estimate economic burden

- The following ICD-10 codes were used to identify these cancers: oral cavity (C02-06), oropharynx (C01, 09, 10), cervical (C53), vulva (C51), vaginal (C52), anal (C21), penile (C60), nasopharynx (C11), hypopharynx (C12-13), pharynx (C14), and larynx (C32)¹
- Individuals entered the model at time of death using a single year of mortality and outcomes were projected over the average lifetime. Outcomes were discounted by 3%
- Epidemiological inputs, including mortality data, retirement age, and life expectancy, were country specific. Mortality data, categorized by cancer type, age, and sex, came from national registries and databases, while life expectancy, retirement age, and labor force participation were sourced from international databases. In absence of national data, GLOBOCAN estimates were used as a proxy.⁴ 2022 mortality data were used, except in cases where it was unavailable, in which 2019 data served as a proxy (**Table 1**)

Estimating the humanistic burden

- Primary outcomes of the model were number of HPV-related deaths, years of life lost (YLL), and years of productive years of life lost (YPLL). HPV-related mortality rate per 100,000 in total and split by sex, was estimated for cross-country comparison
- Attributable fractions (AF) – the proportion of cancer-related deaths related to a specific infection – were applied to the number of deaths for each cancer type to estimate the number of cancer cases related to HPV. AF for HPV-related cancers, stratified by cancer type, were sourced from Hartwig et al¹
- YLL were estimated from the number of deaths, life expectancy and the attributable fractions for each cancer type

$YLL = \text{number of deaths} \times \text{expected life years remaining} \times AF$

- YPLL estimates average years of productive employment lost due to premature cancer death, assuming full economic activity until retirement, adjusted for labor force participation; no activity post-retirement was assumed

$YPLL = YLL \times (\text{expected productive life years remaining} / \text{expected life years remaining}) \times \text{labor force participation}$

Results

- The model estimated that there were approximately 19,052 cancer deaths attributable to HPV across Europe in 2022, translating to an average of 52 deaths/day (**Table 1**)
- These deaths resulted in a total of 293,868 YLL and 90,470 YPLL. On average, each death corresponded to a loss of 15 YLL (10 years in males and 17 years in females) with approximately 30% of these being YPLL (**Table 1**)
- The highest annual HPV-related cancer mortality rates were in Bulgaria (11.21/100,000) followed by Romania (10.27/100,000), and Serbia (8.38/100,000), and Latvia (7.37/100,000), primarily driven by female-related cancers (**Figure 1**)

Figure 1. Annual HPV-related cancer mortality per 100,000 in Europe

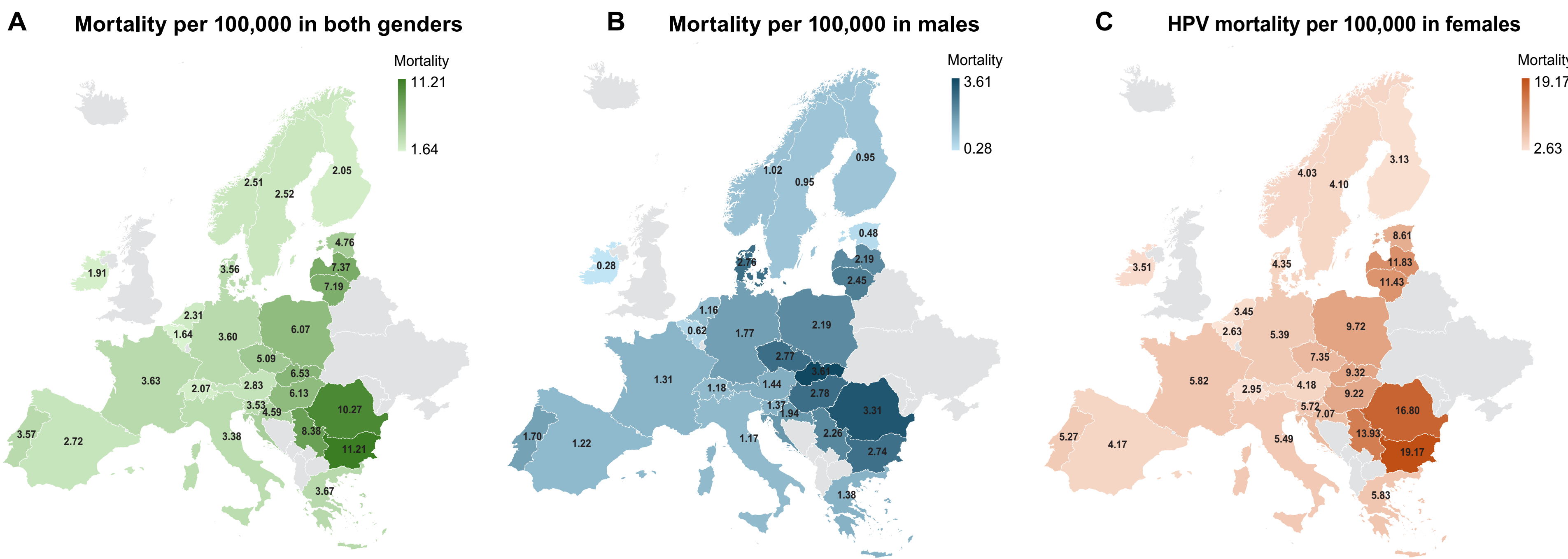


Table 1. Burden of HPV-related cancers in European countries in 2022

Country	HPV-related deaths/year			HPV-related death rate ³			YLL			YLL/death			YPLL			YPLL/death		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Austria	258	65	194	2.83	1.44	4.18	4,005	708	3,296	15.49	10.96	17.01	741	148	593	2.87	2.28	3.06
Belgium ¹	193	36	157	1.64	0.62	2.63	3,532	440	3,092	18.30	12.31	19.66	1,088	107	981	5.64	2.99	6.24
Bulgaria ⁴	723	85	638	11.21	2.74	19.17	6,763	173	6,590	9.35	2.02	10.34	3,090	175	2,915	4.27	2.05	4.57
Croatia ¹	177	36	141	4.59	1.94	7.07	2,433	294	2,138	13.74	8.13	15.18	715	101	614	4.04	2.79	4.36
Czechia	553	149	405	5.09	2.77	7.35	7,303	1,174	6,129	13.20	7.90	15.15	1,984	375	1,608	3.58	2.53	3.97
Denmark	212	82	130	3.56	2.76	4.35	2,908	846	2,062	13.75	10.37	15.87	794	185	609	3.75	2.27	4.68
Estonia ⁵	65	3	62	4.76	0.48	8.61	951	19	931	14.59	6.24	15.01	282	8	274	4.32	2.46	4.41
Finland	115	26	88	2.05	0.95	3.13	1,726	254	1,471	15.05	9.70	16.64	381	44	337	3.32	1.67	3.81
France ^{2,6}	2,481	434	2,047	3.63	1.31	5.82	45,246	5,239	40,006	18.23	12.07	19.54	14,396	1,650	12,746	5.80	3.80	6.23
Germany	3,001	729	2,272	3.60	1.77	5.39	47,316	7,882	39,434	15.77	10.82	17.36	13,844	2,002	11,842	4.61	2.75	5.21
Greece ^{2,6}	382	69	313	3.67	1.38	5.83	6,106	676	5,430	15.97	9.73	17.35	2,103	228	1,875	5.50	3.28	5.99
Hungary	588	128	460	6.13	2.78	9.22	8,246	900	7,345	14.03	7.04	15.97	3,438	426	3,013	5.85	3.33	6.55
Ireland ⁷	101	7	94	1.91	0.28	3.51	1,874	75	1,799	18.50	10.28	19.14	593	11	581	5.85	1.55	6.18
Italy ^{2,6}	1,995	338	1,657	3.38	1.17	5.49	32,587	3,794	28,793	16.34	11.22	17.38	9,787	1,019	8,768	4.91	3.01	5.29
Latvia ^{2,6}	138	19	119	7.37	2.19	11.83	2,109	86	2,023	15.24	4.51	16.94	869	56	813	6.28	2.93	6.81
Lithuania	207	33	173	7.19	2.45	11.43	3,109	272	2,837	15.05	8.20	16.36	1,111	161	950	5.38	4.86	5.48
Netherlands	413	103	310	2.31	1.16	3.45	7,306	1,139	6,166	17.69	11.09	19.88	2,716	286	2,429	6.58	2.79	7.83
Norway	139	28	110	2.51	1.02	4.03	2,238	321	1,917	16.13	11.35	17.36	635	66	569	4.58	2.34	5.15
Poland ¹	2,227	389	1,838	6.07	2.19	9.72	30,263	2,909	27,354	13.59	7.49	14.88	6,569	1,351	5,218	2.95	3.48	2.84
Portugal	378	85	292	3.57	1.70	5.27	7,088	1,281	5,807	18.77	14.99	19.88	2,325	521	1,805	6.16	6.09	6.18
Romania ¹	1,957	306	1,651	10.27	3.31	16.80	26,061	1,929	24,132	13.32	6.31	14.61	8,789	1,199	7,590	4.49	3.92	4.60
Serbia ¹	555	71	484	8.38	2.26	13.93	7,257	450	6,807	13.07	6.34	14.05	2,983	275	2,708	5.37	3.87	5.59
Slovakia	354	96	259	6.53	3.61	9.32	4,613	625	3,988	13.01	6.53	15.41	1,541	231	1,309	4.35	2.42	5.06
Slovenia ¹	75	15	60	3.53	1.37	5.72	1,323	178	1,145	17.66	12.23	18.97	402	49	352	5.36	3.39	5.84
Spain	1,316	289	1,027	2.72	1.22	4.17	24,482	3,845	20,638	18.60	13.31	20.10	7,674	1,195	6,478	5.83	4.14	6.31
Sweden	265	51	215	2.52	0.95	4.10	3,957	540	3,416	14.93	10.70	15.92	756	60	697	2.85	1.18	3.25
Switzerland ¹	184	52	132	2.07	1.18	2.95	3,068	608	2,460	16.68	11.70	18.65	867	115	752	4.71	2.21	5.70
Total/median	19,052	3,723	15,329	3.60	1.44	5.72	293,868	36,659	257,209	15.24	10.28	16.94	90,470	12,044	78,425	4.71	2.79	5.29

Notes: ¹2019 mortality data used as a proxy to 2022. ²GLOBOCAN estimates were used due to limited/no national data. ³HPV-related cancer death rate/ 100,000 individuals. ⁴Data was missing for vulvar, vaginal, penile cancers. ⁵Data was missing for nasopharynx cancers. ⁶Data was missing for pharynx cancers. ⁷Data was missing for vulvar, vaginal, anal and penile cancers.

Conclusions

- The findings indicate a substantial burden of HPV-related cancer mortality and loss of productivity throughout Europe. To effectively reduce the burden of HPV-related cancers, it is essential to maintain a sustained commitment to HPV prevention and disease treatment.

References

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