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# Trends in head and neck cancers in England from 1995 to 2011 and projections up to 2025

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SUMMARY

*Background:* The magnitude of the growing burden of oropharyngeal cancers (OPC), a sub-set of head and neck cancers (HNC), is unknown in England.
*Methods:* Data were extracted from population-based cancer registries in England. The burden of HNC overall and by anatomic site was described from 1995 to 2011. Projections of future rates up to 2025 were estimated using flexible age–period–cohort modelling.
*Results:* HNC increased by 59% between 1995 and 2011 in England. Projections indicate that the number of HNC cases will increase by 55% from 2011, totalling 11,748 new cases in 2025, ranking HNC as the sixth most common cancer. Of the anatomic sites, OPC is projected to account for 35% of HNC with the largest rate increase (annual percentage change, +7.3% for men and +6.2% for women between 2011 and 2025), predominantly affecting males <60 years. This projected burden is equivalent to a 239% increase in number of OPC cases. Incidence of the oral cavity, salivary glands and palate are projected to rise at lower rates, whereas rates of the nasopharynx, hypopharynx and larynx remain relatively stable or decreasing.
*Conclusion:* The substantial recent and predicted future significant increase in OPC highlights the need for prioritising the provision of cancer services for the considerable burden of OPC patients and survivors and cancer control strategies.



## Introduction

Global trends of increasing incidence of oropharyngeal cancers (OPC) have been observed over the last 20 years, particularly in men, and mainly in developed regions of Australia and New Zealand, Europe, North America, and parts of East Asia [1,2]. These trends are striking in the backdrop of declining use of tobacco and alcohol, which are conventional risk factors for head and neck cancers (HNC). Increasing trends of OPC are attributed to an increase in the proportion caused by human papillomavirus (HPV) [3,4], the causal agent of cervical cancer. Changes in sexual behaviours, including an increased in number of sexual partners and increased oral sexual contact [5] (leading to increased oral exposure and transmission of HPV), are significant risk factors associated with this rise in burden of HPV-related OPC [6].

Whilst the incidence of HPV-related OPC is steadily increasing, patients who have been treated demonstrate better prognosis and survival rates. Five year survival rates of treated patients with HPV-positive HNCs are reported to be between 62% and 82% compared to 25–47% for HPV-negative HNCs [6]. This change in burden of OPC survivors may have significant implications for the provision of cancer services. The Cancer Services Committee and the Houses of Parliament of the UK recently highlighted that the long-term impact of treatment and care for these survivors are devastating and grossly under-estimated [7], highlighting the potential magnitude of this unknown growing burden.

Understanding the current and future burden of HNCs will play a key role in the planning of the delivery of cancer services and in cancer control programme policy and strategies. Adequate allocation of resources, clinical services and rehabilitation support will be required to cope with the growing burden of HNC survivors. In addition, the suggested strong protection of vaccines offered against oral HPV 16/18 infection [8] and the high HPV vaccine coverage (up to 87% for all three doses) achieved in the UK [9–12] will have important implications for primary prevention of HPV-related

*Abbreviations:* ASIR, age-standardised incidence rates; APC, annual percentage change; HNC, head and neck cancers; HPV, human papillomavirus.

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HNCs, particularly for males. Currently, boys are excluded from the UK national immunisation programme. However, the potential clinical benefit of vaccination to prevent this growing burden of HPV-related HNC will strengthen the cost-benefit case for universal HPV vaccination for both boys and girls.

The objectives of the study were to assess the burden and trends of HNC incidence rates from 1995 to 2011 and to estimate the future burden of HPV-related HNCs up to 2025 in England. Incidence trends for OPC were also compared with lung cancer (proxy of smoking) and rates of sexually transmitted infections (a proxy measure of genital HPV exposure) to understand the impact of lifestyle behaviour patterns on observed incidence.

## Material and methods

### *Cancer registration and population data*

Routine cancer registration data have been available in England since 1971; however, there was no distinction between the base of tongue and other parts of the tongue and between the tonsil and oropharynx until 1995. Incidence data on HNCs were extracted from population-based cancer registries in England from 1995 to 2011 from the Office for National Statistics. Specifically, numbers of cases and population at risk, by 5-year age groups and sex were collected. National population estimates and projections for England by sex, 5-year age group and year, from 2011 to 2025 were obtained from the population projections of the Office for National Statistics [13]. Projections did not use data for 2011 since we are aware that there can be substantial delays in registrations for cancers and inclusion of data for 2011 released in April 2013 could underestimate future projections of the disease [14].

### *Definition of HNC*

Cases of HNCs were defined by 3-digit ICD-10 category codes (without further sub-classification) and classified by anatomic site according to the National Cancer Intelligence Network (NCIN) definition [15]: *oral cavity* (C02, C03, C04 and C06) *excluding lip and hard palate*, *palate* (C05), *salivary glands* (C07 and C08), *oropharyngeal* (C01, C09 and C10), *nasopharynx* (C11), *hypopharynx* (C12 and C13), *larynx* (C32), and thyroid gland (C73). Although NCIN defines the thyroid gland as part of HNCs, it has a different aetiology (e.g. exposure to ionising radiation and iodine deficiency) [16] to the other HNC anatomic sites (e.g. chronic tobacco smoking and alcohol use) [17] and has been excluded from this analysis. HPV-related HNC was defined by the oropharyngeal sub-anatomic sites (base of tongue (C01), tonsil (C09), and oropharynx (C10)). All other HNCs were considered HPV-non-related HNCs.

### *Comparison of lung, OPC and STI diagnoses*

For comparison with other smoking-related cancers, data on lung cancer (C33 and C34) from 1975 to 2011 were also extracted. Data were also extracted for cancer of the tonsil and oropharynx combined (C09 and C10) dating back for 1975–1994 when the two sites were not distinguished in national cancer registries. Data on base of tongue were not extracted as it could not be distinguished from other parts of the tongue (C01 and C02) which is associated with the oral cavity rather than OPC. To obtain a proxy measure of risk of exposure to HPV infections, sexually transmitted infection (STI) diagnoses of anogenital warts and genital herpes from 1975 to 2011 were extracted from routine surveillance data reported to Public Health England [18].

### *Statistical analyses*

Age-standardised incidence rates (ASR) were calculated by sex and year of cancer diagnosis (for the 16-year time period from 1995 and 2011) using the European standard population [19]. Generalised linear models were used to analyse trends in incidence and expressed as average annual percentage change (APC).

Cancer incidence rates were modelled and projected up to 2025 using age–period–cohort (APC) models described previously [20,21]. The basic APC cohort model was

$$g\{\lambda(\text{age},\text{period})\}^{-1} = \{f_A(\text{period}) + f_p(\text{period}) + f_C(\text{cohort})\},$$

where $\lambda$ is the incidence rate as a function of age and calendar period, $g$ is a 'link' function and $f_A$, $f_P$ and $f_C$ are functions of age, period (year of incidence) and cohort (year of birth, i.e., cohort = period − age), respectively. The link function is either the exponential function or the power 5 function (i.e., $g(x) = x^5$) [22] and $f_A$, $f_P$ and $f_C$ are natural cubic splines which allow incidence rates to change gradually. Projections of incidence are estimated using a drift parameter that takes into account the overall linear trend over the entire time period for the observed data and the future non-linear period are estimated based on the last estimated effect in the range of data available and assume that the future age effects are the same [23].

Analyses were carried out using Stata version 12.1 using the age spine command [21].

## Results

### *Burden in 1995 and 2011*

Table 1 shows the number of cases, ASRs and APCs for HNCs, overall and by anatomic site and OPC sub-anatomic site from 1995 to 2011. The number of HNC cases diagnosed per year increased by 58.9% during this 16-year period with 7601 (5253 males and 2348 females) cases diagnosed in 2011. Incidence rates increased for both sexes. In both sexes, the anatomic site that increased most between 1995 and 2011 was OPC (APC = +7.3% in males and +6.5% in females). Increases were also observed for oral cavity, palate, and salivary glands for both sexes; whereas incidence of nasopharyngeal and laryngeal cancers decreased. The ASR for cancer of the hypopharynx increased in men but decreased in women. Of the OPC sub-sites, the relative increase (in both sexes) was greatest for base of tongue (APC = +9.3% in males and APC = +7.3% in females). However, the largest increase in numbers was cancer of the tonsil: 509 additional male and 167 additional female cases.

### *Trends and future projections*

With a 10% projected increase (53.1 million in 2011 to 58.6 million in 2025) in population, the number of HNC cases is projected to increase. Fig. 1 shows the observed and projected overall HNC incidence and the relative contribution of each anatomic site in 1995, 2011 and 2025. Rates of HNC are projected to increase by 34.8% for men and 48.9% for women between 2011 and 2025, corresponding to a 55% increase in numbers with 11,748 projected new cases (7893 men and 3855 women) in 2025. In 1995, larynx ranked as the most frequent HNC site (38.2% of HNC cases) and oral cavity ranked as the most frequent in 2011 (30.8% of HNC cases). However, by 2025, it is projected that OPC will rank as the most frequent HNC, representing about 35% of HNC cases.

Trends (1995–2011) and projections (2011–2025) of ASR by gender and HNC anatomic site are shown in Fig. 2. It should be noted that the differences in projections between the exponential