# Burden of disease caused by keratinocyte cancer has increased in The Netherlands since 1989

Loes M. Hollestein, PhD,[a] Esther de Vries, PhD,[a,b,c] Mieke J. Aarts, PhD,[c] Caroline Schroten, PhD,[d] and Tamar E. C. Nijsten, MD, PhD[a]
*Rotterdam and Eindhoven, The Netherlands*

***Background:*** Keratinocyte cancer is the most common cancer among Caucasians.

***Objective:*** We sought to study time trends of the burden of disease attributable to keratinocyte cancer in The Netherlands.

***Methods:*** Data of all patients with newly diagnosed keratinocyte cancer (ie, squamous cell carcinoma and basal cell carcinoma) were obtained from the population-based Netherlands Cancer Registry and the Eindhoven Cancer Registry (1989-2008). Population structure, mortality data, and life expectancy data were extracted from Statistics Netherlands. The disability-adjusted life-years (DALY) was the sum of the years of life lived with disability and the years of life lost.

***Results:*** The world standardized rate of keratinocyte cancer has doubled and was 103 and 94 per 100,000 person-years for males and females in 2004 to 2008, respectively. DALYs as a result of basal cell carcinoma increased by 124% and DALYs as a result of squamous cell carcinoma increased by 66% from 1989 to 1993. Keratinocyte cancer accounted for a total loss of 19,913 DALYs (15,369 years of life lived with disability and 4544 years of life lost) between 2004 and 2008.

***Limitations:*** Only the first keratinocyte cancer was included in this study.

***Conclusion:*** Keratinocyte cancer is a large burden to the Dutch society. Because incidence rates of keratinocyte cancer continue to increase, the management becomes even more challenging. (J Am Acad Dermatol 2014;71:896-903.)

***Key words:*** basal cell carcinoma; burden of disease; cutaneous squamous cell carcinoma disability-adjusted life-year; keratinocyte cancer; population-based.

Keratinocyte cancer is the most common malignancy in The Netherlands and is associated with a large burden for the individual patient and for the population.[1-4] An individual patient may have scars from surgical procedures, fear recurrence, or be bothered by multiple actinic keratosis or keratinocyte cancers.[5,6] The high incidence of keratinocyte cancer is a strain to the health care system, because patients with

*Abbreviations used:*

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| BCC: | basal cell carcinoma |
| CI: | confidence interval |
| DALY: | disability-adjusted life-year |
| NCR: | Netherlands Cancer Registry |
| NMSC: | nonmelanoma skin cancer |
| SCC: | squamous cell carcinoma |
| YLD: | years of life lived with disability |
| YLL: | years of life lost |

From the Departments of Dermatology[a] and Public Health,[b] Erasmus MC University Medical Center, Rotterdam; Eindhoven Cancer Registry, Comprehensive Cancer Center South[c]; and Netherlands Cancer Registry, Rotterdam.[d]

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Reprint requests: Loes M. Hollestein, PhD, PO Box 2040, 3000 CA Rotterdam, The Netherlands. E-mail: l.hollestein@erasmusmc.nl.

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keratinocyte cancer often have subsequent keratinocyte cancer. Therefore they need regular follow-up and many surgical treatments. Health care costs will increase because of the required capacity of dermatologists and the many costly treatments.

The magnitude of the keratinocyte cancer burden in The Netherlands was expressed in incidence, survival, and mortality.[2,7] However, the magnitude of the societal problem can also be expressed in burden of disease measures, as suggested by the World Health Organization. The disability-adjusted life-year (DALY) also takes related conditions into account (eg, pain, psychological concerns) and is calculated by the sum of the years of life lost (YLL) as a consequence of premature death caused by keratinocyte cancer and the number of years of life lived with disability (YLD) caused by keratinocyte cancer.[8] One DALY represents the loss of 1 year of life lived in full health.[8]

One previous publication on DALYs was based on extrapolations and estimated that globally, 162,000 DALYs were lost in 2000 as a result of squamous cell carcinoma (SCC) and 58,000 as a result of basal cell carcinoma (BCC).[9] In The Netherlands SCC is routinely registered nationwide and BCC is routinely registered by 1 population-based comprehensive cancer registry. We estimated the time trends and the size of the burden of keratinocyte cancer in the general Dutch population using these high-quality population-based cancer registry data between 1989 and 2008.

**CAPSULE SUMMARY**

- The incidence of keratinocyte cancer increased in The Netherlands between 1989 and 2008.
- High-quality population-based cancer registry data demonstrate that the loss of disability-adjusted life-years as a result of keratinocyte cancer increased as well.
- The increased incidence rate has made management of the skin cancer burden more challenging.

## METHODS

### Population

Age- and gender-specific data on patients with newly diagnosed cutaneous SCC were obtained from The Netherlands Cancer Registry (NCR). Age- and gender-specific data on patients with newly diagnosed BCC and keratinocyte cancer were obtained from the Eindhoven Cancer Registry, which is part of the NCR and the only regional comprehensive cancer center in The Netherlands that registers BCCs. The NCR collects incidence and tumor data on all newly diagnosed, histologically confirmed cancers in The Netherlands from the regional comprehensive cancer centers since 1989. The NCR is based on notification of all newly diagnosed malignancies in The Netherlands by the automated pathological archive (Pathologisch-Anatomisch Landelijk Geautmatiseerd Archief [PALGA]).[10] Additional sources are the national registry of hospital discharge, which accounts for up to 8% of new cases; hematology departments; and radiotherapy institutions. The quality of the data is high, because of thorough training of the administrators and computerized consistency checks at regional and national levels. Completeness is estimated to be at least 98% on all cancers combined and 93% on skin cancer.[11,12] Only the first SCC or the first BCC was included in this study. The following morphology codes combined with topography "skin" were considered invasive cutaneous SCC: 8010 and 8050 to 8084 (excluding 8077, intraepithelial neoplasia; 8080, erythroplasia of Queyrat; 8081, Bowen disease; and 8082, lymphoepithelial carcinoma), and invasive BCC: 8090 to 8110.

Annual data on age and gender of deaths caused by "other and unspecified malignant neoplasms of the skin" (C44 of the *International Statistical Classification of Diseases, 10th Revision*), population composition, and life expectancies were obtained from Statistics Netherlands (Centraal Bureau voor de Statistiek [CBS]). Death caused by C44 of the *International Statistical Classification of Diseases, 10th Revision* is referred to as nonmelanoma skin cancer (NMSC) mortality in this article and may include other skin malignancies than keratinocyte cancer only.

Approval of the medical ethics committee is not needed for cancer registry data, but this research was conducted according to the code of conduct for health research of the Foundation Federation of Dutch Medical Scientific Societies.[13]

### Statistical analyses

All analyses were performed for 5-year periods and stratified for sex. Age-standardized incidence rates were calculated by direct standardization according to the world standard population.[14] Incidence rates of BCC obtained from the Eindhoven Cancer Registry were extrapolated to the Dutch population using the population composition from CBS. Patients with both BCC and SCC were counted only once in the keratinocyte cancer analyses. The 5-year relative survival estimates by age, gender, stage, and period of diagnosis were