

# Cancer in Norway 2019

Technical Supplement: Statistical Methods





Cancer in Norway 2019  
Technical Supplement: Statistical Methods

Cancer Registry of Norway  
Department of Registration

21st October 2020



# 1 Statistical methods

## 1.1 Target readership

The target readership for this technical supplement include statisticians and cancer epidemiologists.

## 1.2 Incidence and mortality rates

Rates are used to measure the frequency at which an event occurs in a defined population during a defined time period. Rates facilitate comparisons across groups of different sizes. Let  $d$  and  $Y$  denote the number of events and the number of person-years in the population, respectively. In Cancer in Norway 2019 (CIN2019) the mid-year population  $Y$  is calculated as the arithmetic mean of the population at the start and end of each calendar year. If the interest lies in calculating a rate over a period of more than one year, we first calculate the annual mid-year population, and then aggregate to determine the total number of person-years.

Rates are reported both as age-specific rates and age-standardised rates (ASR) per 100,000 person-years. The population is divided into 18 distinct five-year age groups. Let  $d_i$  and  $Y_i$  denote the number of events and the total number of person-years, respectively, for age group  $i$ . The age-specific rate  $r_i$  per 100,000 person-years, for age group  $i$  is then given by

$$r_i = \frac{d_i}{Y_i} \cdot 10^5 \quad (1)$$

The age-standardised rate is calculated as

$$ASR = \frac{\sum_{i=1}^{18} w_i r_i}{\sum_{i=1}^{18} w_i} \quad (2)$$

where  $w_i$  is a weight, for age group  $i$ , given by the reference population.

Typically the World Standard Population has been used (Doll & al, 1966). CIN2019 uses the age distribution of the Norwegian 2014 mid-year population as the standard population. The population weights for the World Standard Population

and the Norwegian 2014 population are given in the table below. One should note that the World Standard Population places a higher weight on younger age groups and a lower weight on older age groups compared to the 2014 Norwegian population.

$i$	Age	World (Doll/Segi)	Norway (2014)
1	0-4	12,000	6,039
2	5-9	10,000	6,102
3	10-14	9,000	5,993
4	15-19	9,000	6,349
5	20-24	8,000	6,681
6	25-29	8,000	6,770
7	30-34	6,000	6,690
8	35-39	6,000	6,670
9	40-44	6,000	7,296
10	45-49	6,000	7,207
11	50-54	5,000	6,492
12	55-59	4,000	6,108
13	60-64	4,000	5,575
14	65-69	3,000	5,369
15	70-74	2,000	3,702
16	75-79	1,000	2,663
17	80-84	500	2,063
18	85+	500	2,231
Sum		100,000	100,000

### 1.3 Cumulative risk

Cumulative risk (CR) is an estimate of the risk of developing a certain type of cancer by a given age. In CIN2019 CR is estimated up to the age of 74. It is defined as

$$CR = 1 - e^{-\left(5 \sum_{i=1}^N r_i\right)} \quad (3)$$

where  $i$  denotes age group and  $N$  denotes the number of age groups used.

## 1.4 Prevalence

Prevalence is calculated as the number of people in the population that are alive and have been diagnosed with the cancer of interest at some point during their lifetime.

## 1.5 Relative survival (net survival)

Estimation was restricted to patients younger than 90 year at diagnosis, and the number of patients in the group to be analysed should be minimum 30.

To estimate net survival the Pohar Perme estimator (Perme & al, 2012) was used applying the `stnet` command (Coviello & al, 2015) for life-table estimation of net survival, with monthly life-table intervals. National general population life table by sex, year and age (annual) was used in calculation of expected survival. Age standardisation was performed using the Brenner method (Brenner & al, 2004) applying individual weights (Rutherford & al, 2020). The weights used were based on the age distribution of the group to be analysed in the last five-year period, 2015–2019. For all sites combined, sex specific weights were used, while for all other sites, weights were based on the combined male and female age distribution.

From five to three age groups were used for defining weights. The following preference rules were used to derive weights depending on data:

1. Weights based on age distribution quintiles if minimum three patients at start follow-up in each age group.
2. Weights based on age distribution quartiles if minimum three patients at start follow-up in each age group.
3. Weights based on age distribution tertiles if minimum three patients at start follow-up in each age group.

Estimation was not done if failing the last criterion above, or the group to be analysed had less than 30 patients at start follow-up.

When plotting estimates without confidence intervals:

1. Estimates based on < 20 patients were not plotted.
2. For the age group 80–89 estimates were plotted up to 10 years only.
3. In addition, ad hoc masking of long term survival (year 14 and 15) estimates was applied for Figure 8.1–K: Melanoma of the skin (ICD-10 C43), Relative survival by sex and conditional 5-year relative survival by sex.

All survival analyses were performed using the Stata (Stata/MP 16.1) program `stnet` (version 1.0.8).

## 2 References

Doll R, Payne P, Waterhouse J. (Eds) Cancer Incidence in Five Continents: A Technical Report. Springer-Verlag (for UICC), Berlin, 1966.

Perme P, Stare M, Estève J. On estimation in relative survival, *Biometrics* 2012 Mar; 68(1):113-20.

Coviello E, Seppä K, Dickman P W, Pokhrel A, Estimating net survival using a life-table approach, 2015, *The Stata Journal*, StataCorp LP, vol. 15(1), pages 173-185.

Brenner H, Arndt V, Gefeller O, Hakulinen T. An alternative approach to age adjustment of cancer survival rates *Eur. J. Cancer*, 40 (15) 2004, pp. 2317-2322

Rutherford M J, Dickman P W, Coviello E, Lambert P C. Estimation of age-standardized net survival, even when age-specific data are sparse. *Cancer Epidemiology* 2020;67:101745.

StataCorp. 2019. *Stata Statistical Software: Release 16*. College Station, TX: StataCorp LLC (Stata/MP 16.1).

*Statistical Methods in Cancer Research. Volume IV - Descriptive Epidemiology* IARC Scientific Publications No. 128 Edited by Jacques Esteve, Ellen Benhamou, Luc Raymond. Lyon, 1994. [http://publications.iarc.fr/\\_publications/media/download/3552/d7b5950a320bdfab86b18a7dd79678d88e9bbde2.pdf](http://publications.iarc.fr/_publications/media/download/3552/d7b5950a320bdfab86b18a7dd79678d88e9bbde2.pdf)

Statistics Norway, Statistics Norway provides statistics on population size each year, [www.ssb.no/befolkning/statistikker/folkemengde](http://www.ssb.no/befolkning/statistikker/folkemengde).

**Return Address:**

Kreftregisteret  
P.O. box 5313 Majorstuen  
N-0304 Oslo  
Norway

**Cancer Registry of Norway**

Institute of Population-based Cancer Research

<https://www.kreftregisteret.no/cin-2019>

<https://www.kreftregisteret.no/globalassets/cancer-in-norway/2019/cin-2019supmeth.pdf>