

# Trends in melanoma tumour thickness in Norway, 1983–2019

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## Background

The incidence of cutaneous melanoma has increased in fair-skinned populations during the past decades [1]. Tumour thickness at diagnosis is an important prognostic factor and forms the basis for staging and tumour classification (T) [2].

**Aim:** Describe the trends in melanoma tumour thickness in Norway by T category, overall and in important subgroups such as sex, age, anatomic site, and histopathological subtype, over 35-year.

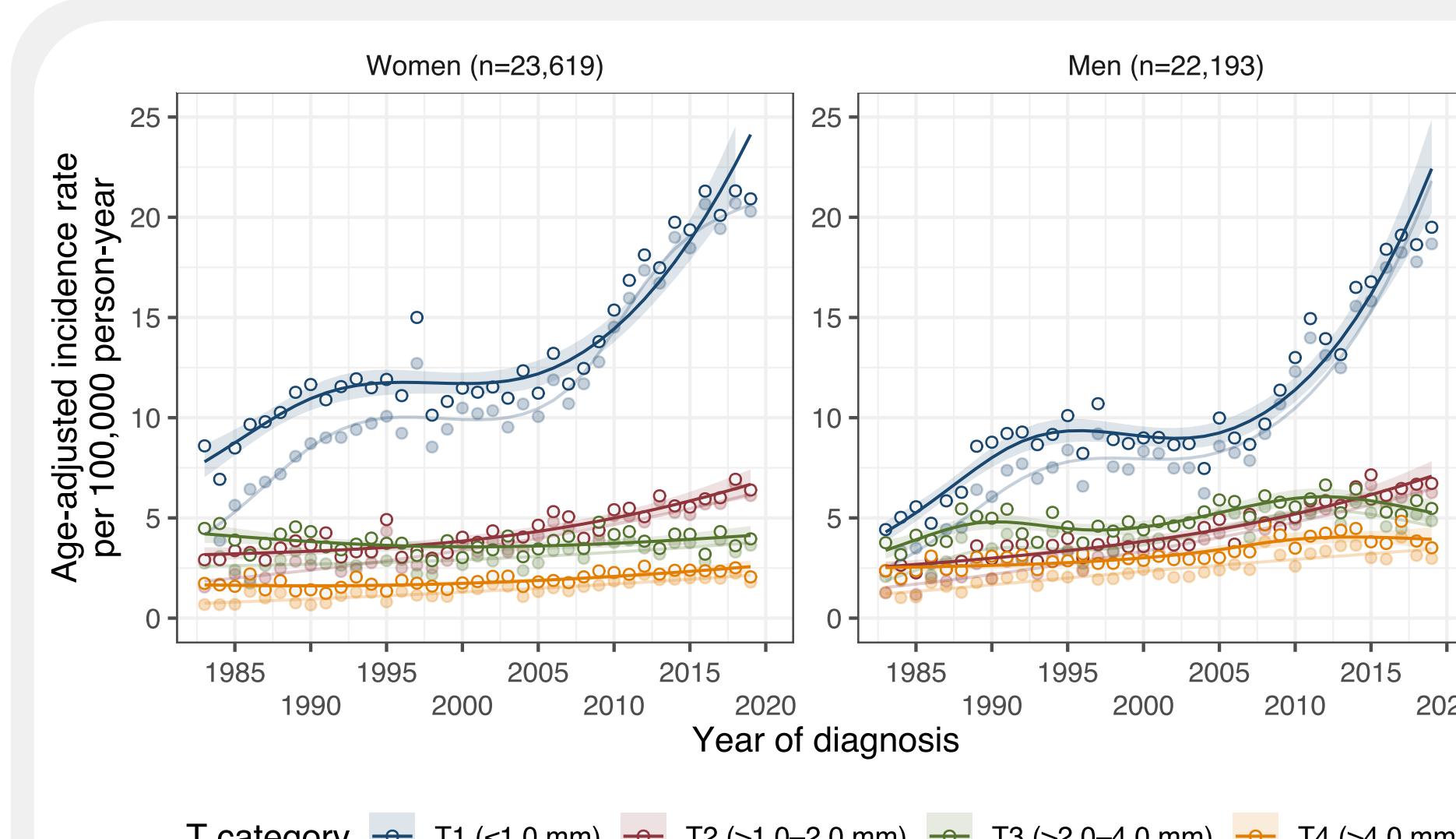


Figure 1: Age-adjusted melanoma incidence rate in Norway, 1983–2019 by sex and T category. Transparent curves represent the complete case analysis and the opaque curves the imputed data.

## Data & Methods

Data for all invasive melanoma cases diagnosed in 1983–2019 were obtained from the Cancer Registry of Norway (CRN). Tumour thickness is included in the Norwegian Melanoma Registry from 2008, and thickness for the cases diagnosed in 1983–2007 were extracted from CRN paper archives. In total 45,812 cases were included. The tumour thickness was categorized as T1 ( $\leq 1.0$  mm), T2 ( $>1.0\text{--}2.0$  mm), T3 ( $>2.0\text{--}4.0$  mm), and T4 ( $>4.0$  mm).

Missing thickness, anatomic site, and histopathological subtype were imputed using multiple imputations. The European standard population was used for age standardization. For each T category, annual percentage change (APC) and average annual percentage change (AAPC) with 95% confidence intervals (CIs) were obtained using segmented regression.

## Results

Table 1: Characteristics of melanoma cases in Norway before 2000 and after 2008 (n = 45,812 for 1983–2019)

Characteristic	Women (n=23,619)		Men (n=22,193)	
	1983–1999 n=7,720	2008–2019 n=11,267	1983–1999 n=6,578	2008–2019 n=11,465
Age at diagnosis, median	56	63	59	67
Tumour thickness, median	1.0	0.9	1.3	1.0
T category, n (%)				
T1 ( $\leq 1.0$ mm)	3,037.0 (53)	6,101.0 (58)	2,150.0 (44)	5,266.0 (50)
T2 ( $>1.0\text{--}2.0$ mm)	1,290.0 (23)	2,223.0 (21)	1,113.0 (23)	2,266.0 (22)
T3 ( $>2.0\text{--}4.0$ mm)	860.0 (15)	1,222.0 (12)	916.0 (19)	1,650.0 (16)
T4 ( $>4.0$ mm)	498.0 (9)	967.0 (9)	676.0 (14)	1,287.0 (12)
Unspecified	2,035	754	1,723	996

% does not include the unspecified cases

In both men and women, the median age at diagnosis increased while the median tumour thickness decreased from 1983–1999 to 2008–2019 (Table 1). In 1983–2019, the age-standardized incidence rate of melanoma increased from 17.7 to 33.3 in women and from 12.9 to 35.2 in men.

Melanomas in the T1 category had the largest increase in incidence and a plateau was found for both sexes (Figure 1). The APCs (95% CIs) showed an increase in T1 melanomas until 1989 (6.4, 3.1–9.9) followed by a plateau (-0.0, -1.0–1.0) and a subsequent increase in 2005–2019 (5.0, 3.9–6.1). A similar trend was found in men with APC (95% CI) of (10.1, 7.5–12.7) in 1983–1990, (-1.0, -2.4–0.3) in 1991–2003 and (6.3, 5.1–7.5) in 2004–2019. No plateau was seen for the other T categories.

Table 2: Average annual percentage change in age-adjusted melanoma incidence rate

T category	Women (n = 23619)	Men (n = 22193)
T1 ( $\leq 1.0$ mm) (n = 22733)	3.1 (2.7, 3.5)	4.5 (4.1, 4.9)
T2 ( $>1.0\text{--}2.0$ mm) (n = 8409)	2.0 (1.6, 2.5)	2.9 (2.5, 3.3)
T3 ( $>2.0\text{--}4.0$ mm) (n = 8964)	-0.1 (-0.5, 0.3)	1.3 (0.8, 1.8)
T4 ( $>4.0$ mm) (n = 5706)	0.9 (0.4, 1.4)	1.3 (0.9, 1.7)

T2 melanomas increased over the whole period: AAPC (95% CI) was 2.0 (1.6–2.5) in women and 2.9 (2.5–3.3) in men (Table 2). The incidence of T3 melanomas was stable in women and slightly increased in men. T4 melanomas also slightly increased in both sexes.

In T1 melanomas, the highest incidence was found for the trunk in both sexes, followed by the lower limbs in women. A plateau was found during the 1990s–2000 for all sites in men and the trunk and lower limb in women.

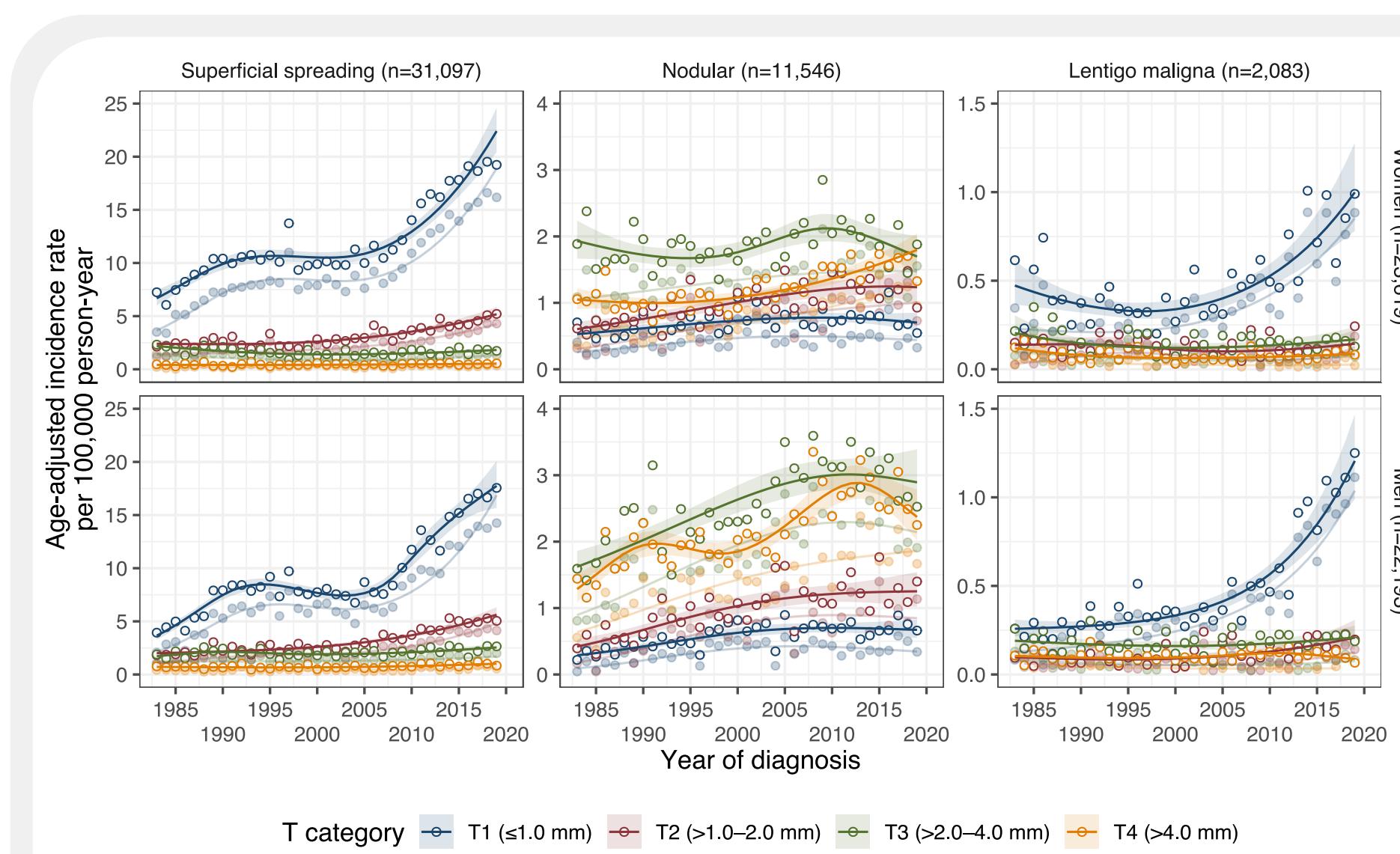


Figure 2: Age-adjusted melanoma incidence rate in Norway, 1983–2019 by sex, T category and histopathological sub-type. Transparent curves represent the complete case analysis and the opaque curves the imputed data.

In superficial spreading melanomas, T1 melanomas showed a similar pattern as for T1 overall, but T2 melanomas showed an increasing trend in both sexes (Figure 2). For nodular melanomas, thicker tumours, particularly T3 melanomas, were dominating over the whole period (Figure 2).

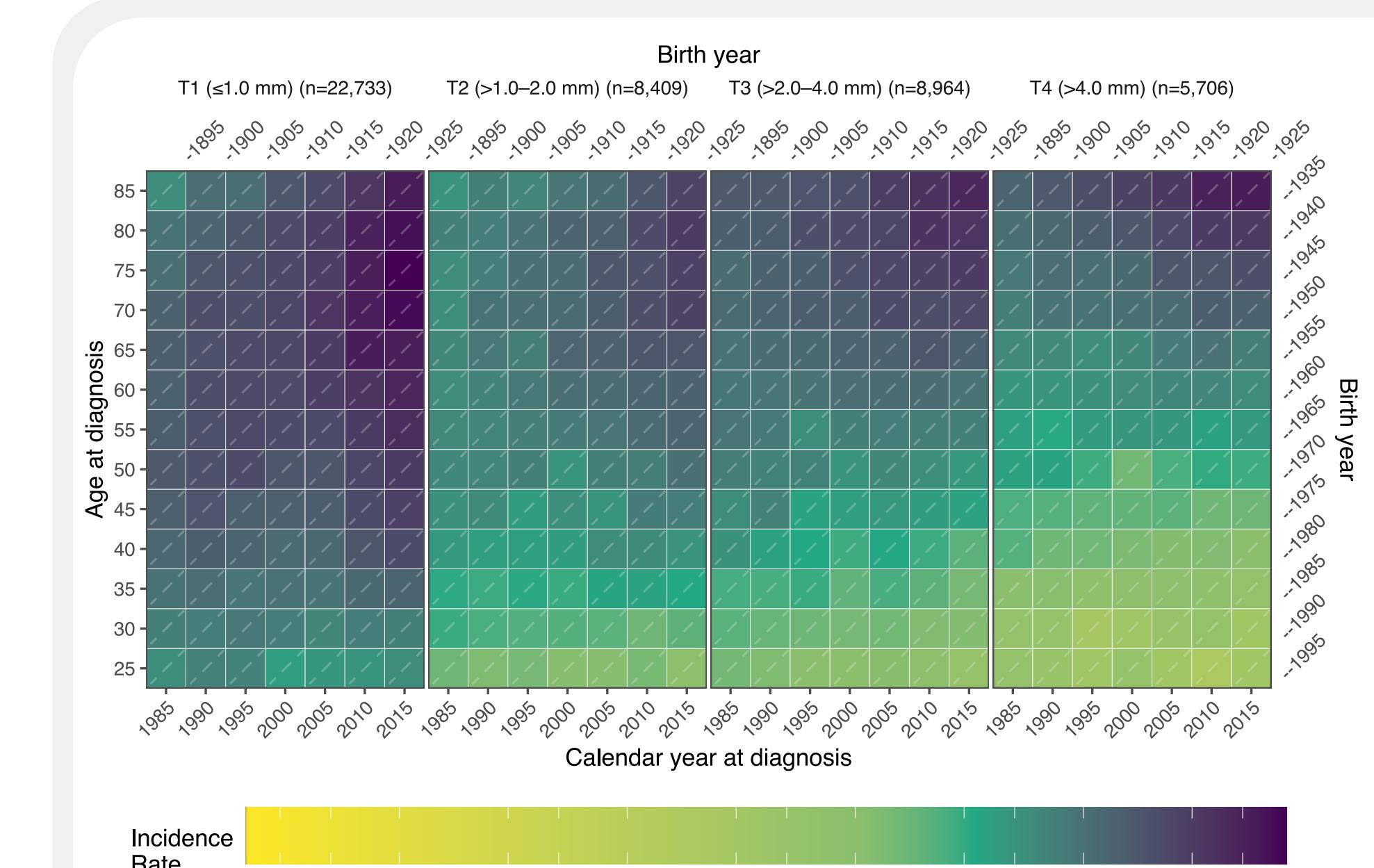


Figure 3: Age-specific melanoma incidence rate by age at diagnosis and period in Norway, 1983–2019 by T category

The difference in incidence rates between the youngest and oldest age-groups was larger in thicker melanomas as compared to thinner melanomas. The highest incidence rates of T1 melanomas occurred around the ages 60–80 while for T3 and T4 melanomas the highest incidence rates were seen among the oldest (80+) (Figure 3).

## Conclusions

- Distinct increase in T1 melanoma incidence found before and after a plateau may indicate the increasing awareness. Increasing trend found in thicker tumours (T2–T4), in overall, suggest a melanoma epidemic in Norway.
- Higher incidence of thicker melanomas in men and increasing incidence of thicker melanomas in women demands for intervention through risk stratification.
- Further studies are required to understand the reasons for the plateau in the incidence rate.

**Funding:** This project is funded by the Norwegian Research Council (project no. 302048) and UNIFORFRIMED (2019).

## Reference

- Whiteman DC, Green AC, Olsen CM. The Growing Burden of Invasive Melanoma: Projections of Incidence Rates and Numbers of New Cases in Six Susceptible Populations through 2031. *The Journal of Investigative Dermatology* 2016;136:1161–71. doi:[10.1016/j.jid.2016.01.035](https://doi.org/10.1016/j.jid.2016.01.035)
- Gershenwald JE, Scolyer RA, Hess KR, et al. Melanoma of the skin. In: MB A, ed. *AJCC cancer staging manual*. Chicago: Springer 2017. 563–85.



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