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Cancer overdiagnosis and surveillance bias: *a case study of melanoma*

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The troubling global rise in melanoma

BBC

Melanoma skin cancer cases rising in UK

27 May 2024

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Smitha Mundasad
Health reporter

The Guardian

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Skin cancer

This article is more than **3 years old**

Skin cancers on the rise in Australia as sun damage catches up with ageing population

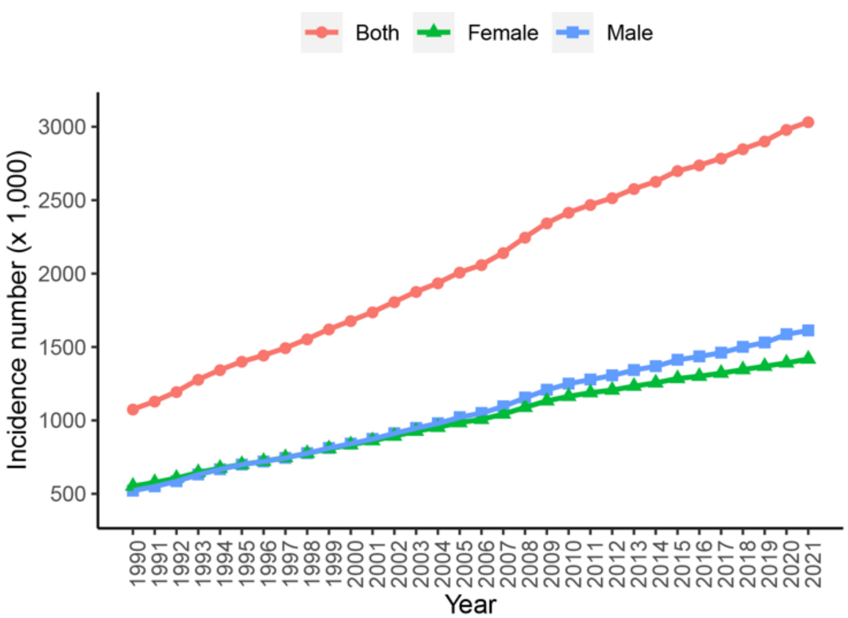
yahoo!life

Melanoma Rates Are on the Rise, New Data Shows

Korin Miller, Writer
Thu, December 22, 2016 at 7:33 PM GMT+1

The troubling global rise in melanoma

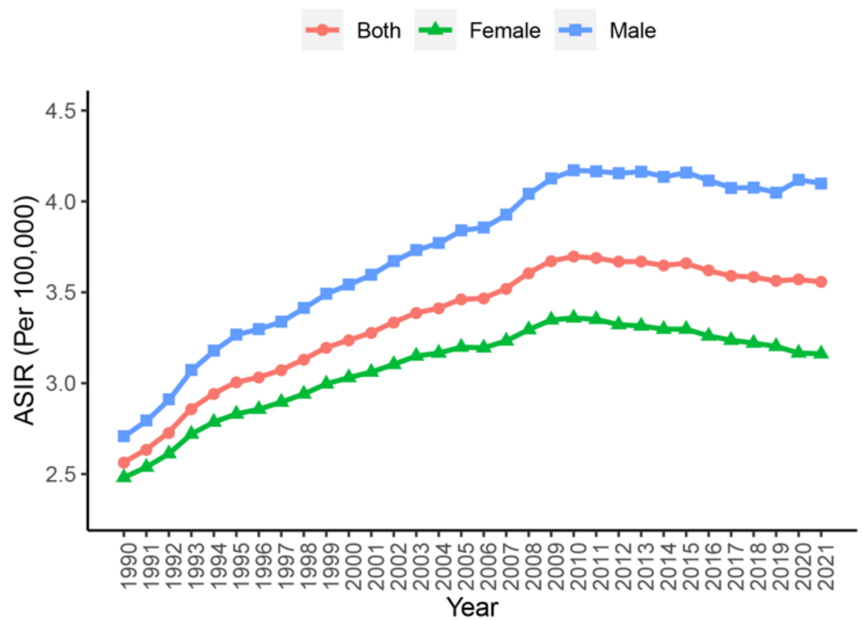
Incidence



(Sun et al, J Am Acad Dermatol 2025)

+182%

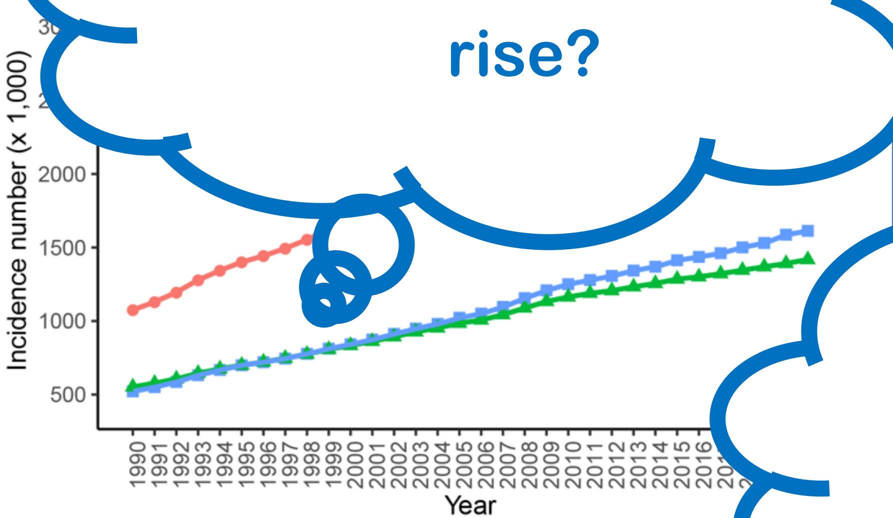
Age-standardized incidence



+39%

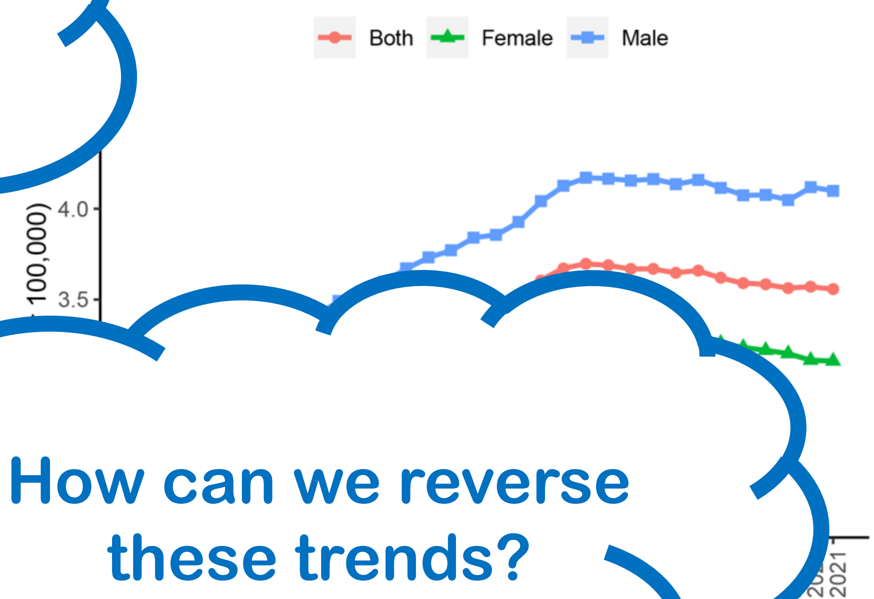
The troubling global rise in melanoma

What has caused such a dramatic rise?



+182%

Age-standardized incidence



How can we reverse these trends?

(Sun et al, J Am Acad Dermatol 2025)

Surveillance bias

Definition: Surveillance bias occurs when variations in the frequency of an outcome result from differences in the modality or intensity of detection, rather than actual changes in its underlying risk. These differences often arise from varying screening and diagnostic strategies over time or across populations, care settings, and types of patients. As a result, surveillance indicators, such as disease incidence or quality-of-care metrics, are biased, leading to misinterpretations and potentially wrong public health decisions. This bias can also lead to incorrect estimates of the association between an exposure and an outcome due to differences in detection modalities of outcomes across exposure subgroups.

This definition proposed by Stefano Tancredi and Arnaud Chiolero will appear in the upcoming ***7th edition of the Dictionary of Epidemiology***

Surveillance bias occurs when variations in cancer incidence **are the result of changes in screening or diagnostic practices** rather than changes in the **true occurrence of cancer.**

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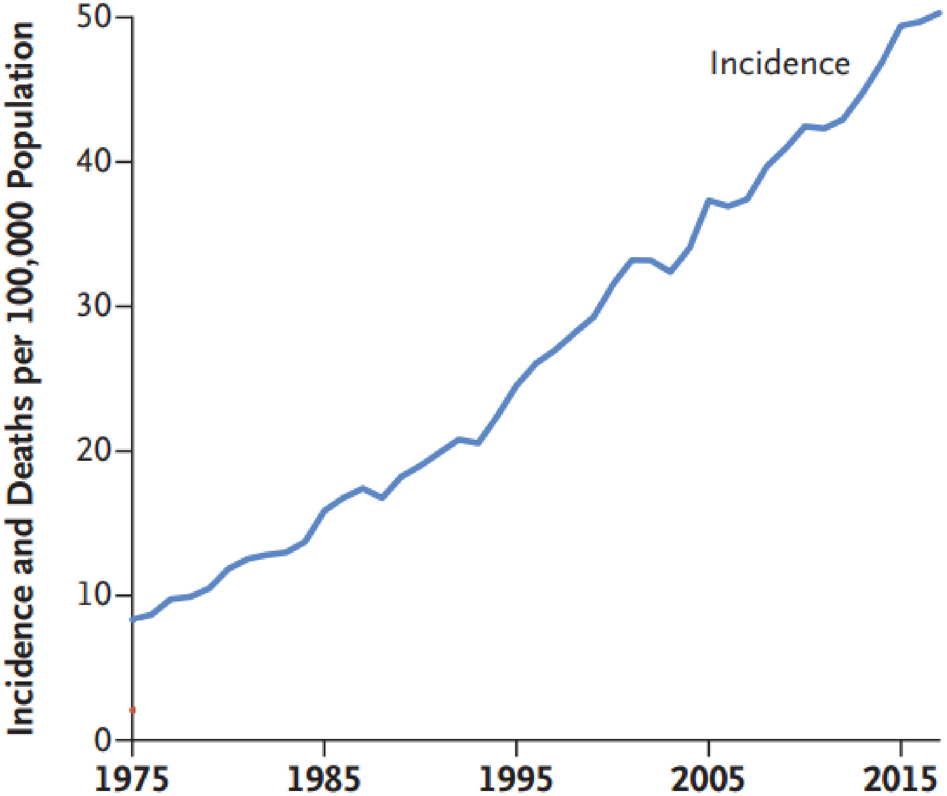
Surveillance bias occurs when variations in cancer incidence **are the result of changes in screening or diagnostic practices** rather than changes in the **true occurrence of cancer.**

"The more you look, the more you find"

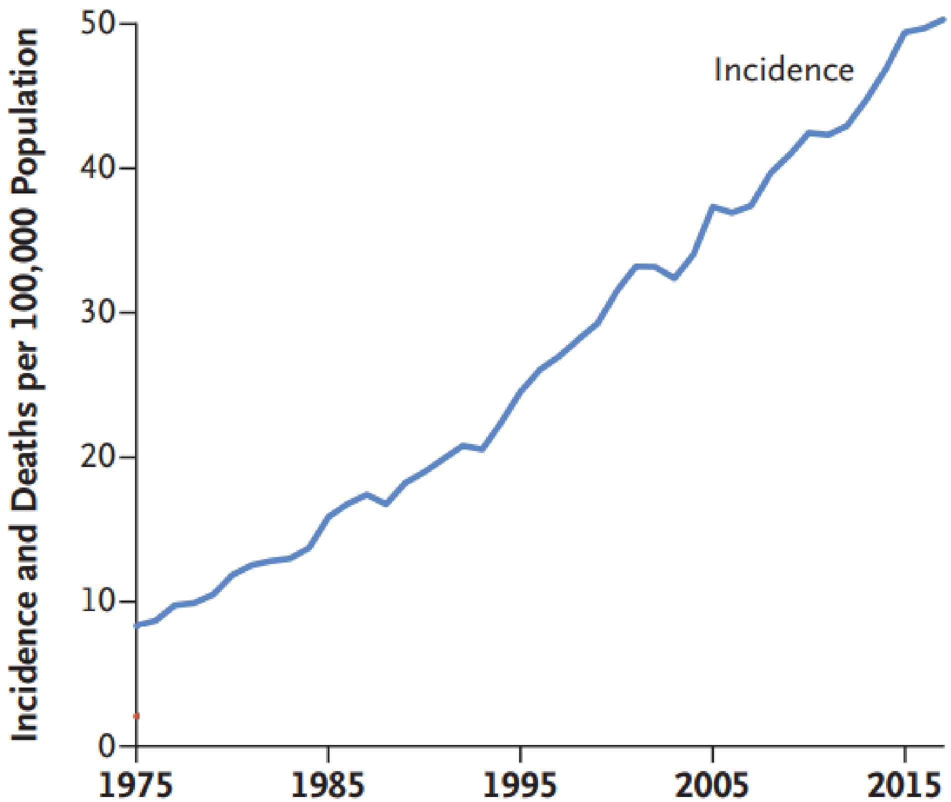
[Haut 2011]

Surveillance bias in melanoma trends



(adapted from: *Welch et al, NEJM 2021)*

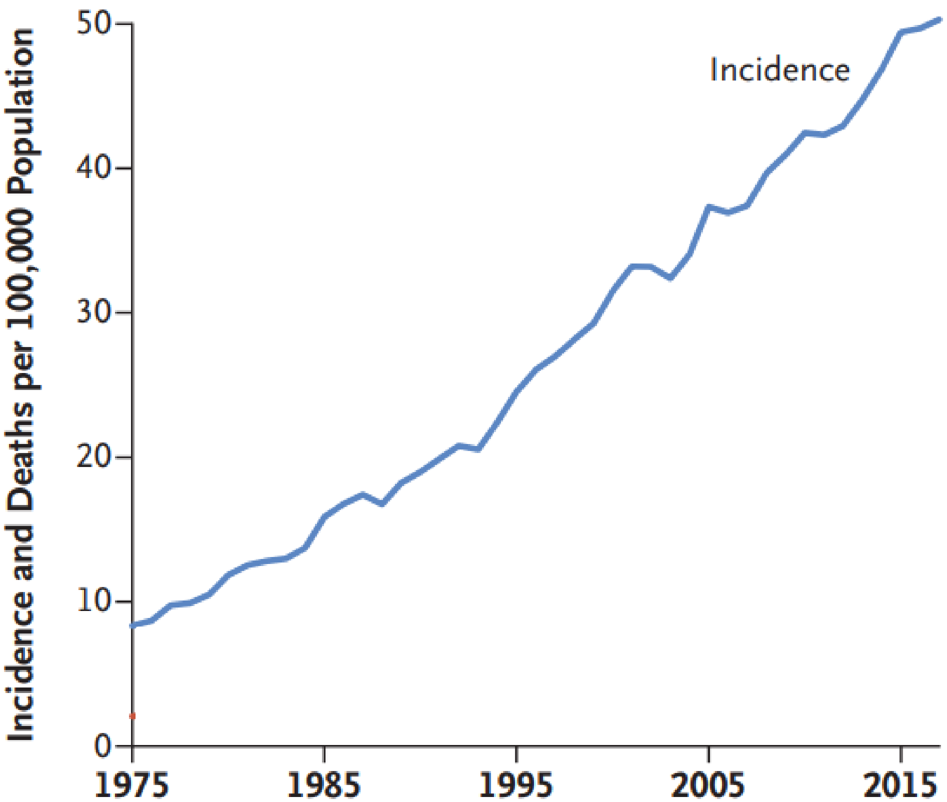
Surveillance bias in melanoma trends



(adapted from: *Welch et al, NEJM 2021)*

How much of this increase has actually been caused by an increase in the true risk of melanoma?

Surveillance bias in melanoma trends



(adapted from: *Welch et al, NEJM 2021)*

How much of this increase has actually been caused by an increase in the true risk of melanoma?

How much of this increase has been caused by changes in the modality, frequency, and intensity of melanoma detection practices?

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We could be making **wrong public health decisions** if we base them on incidence trends that **do not reflect the true cancer occurrence** and are **artificially inflated by changes in detection practices**.

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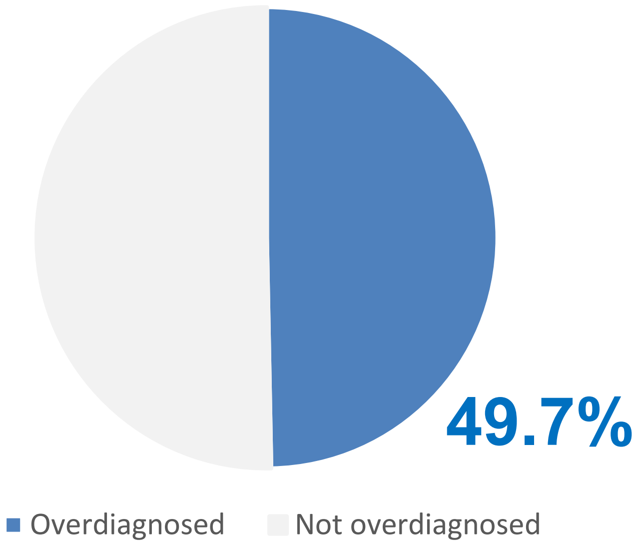
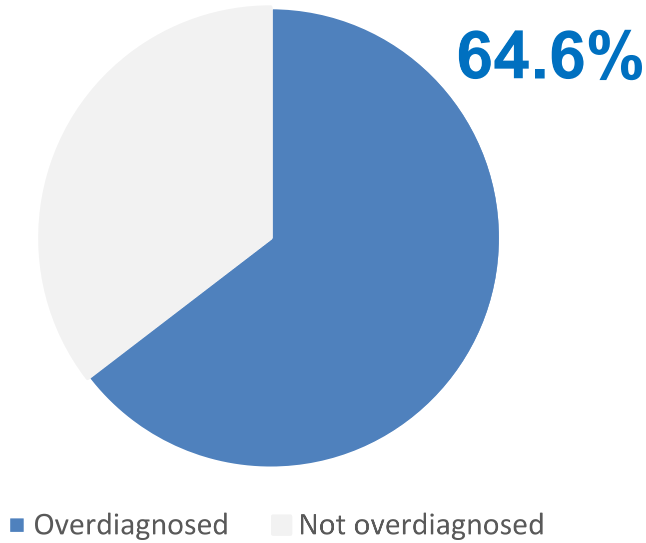
Estimates of melanoma overdiagnosis

United States

White Men



White Women



(Adamson et al, BMJ EBM 2024)

Surveillance bias <u>does not </u>only impact surveillance

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Surveillance bias does not only impact surveillance

Differences in detection practices across exposure subgroups can lead to **inaccurate estimates of effect/association** between an exposure and cancer incidence

(Tancredi et al, Epidemiologia 2023)

Surveillance bias <u>does not</u> only impact surveillance

Differences in detection practices across exposure subgroups can lead to **inaccurate estimates of effect/association** between an exposure and cancer incidence

(Tancredi et al, Epidemiologia 2023)

Risk prediction **can be biased and falsely assign higher cancer risk scores** to the types of individuals who have historically engaged more in detection practices

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Population attributable fraction

The population attributable fraction (PAF) represents the proportion of cases of a disease in a population that are attributable to a specific cause.

Population attributable fraction

The population attributable fraction (PAF) represents the proportion of cases of melanoma in a population that are attributable to ultraviolet radiation (UVR) exposure.

Full Paper | Open access | Published: 06 December 2011

13. Cancers attributable to solar (ultraviolet) radiation exposure in the UK in 2010

D M Parkin, D Mesher & P Sasieni

British Journal of Cancer **105**, S66–S69 (2011) | Cite this article

IJC INTERNATIONAL JOURNAL of CANCER | UICC

Cancer Epidemiology

Global burden of cutaneous melanoma attributable to ultraviolet radiation in 2012

Melina Arnold, Esther de Vries, David C. Whiteman, Ahmedin Jemal, Freddie Bray, Donald Maxwell Parkin, Isabelle Soerjomataram

First published: 16 April 2018 | https://doi.org/10.1002/ijc.31527 | Citations: 135

IJC INTERNATIONAL JOURNAL of CANCER | UICC

RESEARCH ARTICLE | Free to Read

Global burden of cutaneous melanoma incidence attributable to ultraviolet radiation in 2022

Oliver Langselius, Harriet Rumgay, Esther de Vries, David C. Whiteman, Ahmedin Jemal, D. Maxwell Parkin, Isabelle Soerjomataram

First published: 27 May 2025 | https://doi.org/10.1002/ijc.35463 | Citations: 3

ELSEVIER

Australian and New Zealand Journal of Public Health

Volume 39, Issue 5, October 2015, Pages 471-476

Commentary

Cancers in Australia attributable to exposure to solar ultraviolet radiation and prevented by regular sunscreen use

Catherine M. Olsen [1,2], Louise F. Wilson [1], Adele C. Green [1,2,3], Christopher J. Bain [1,4], Lin Fritschi [5], Rachel E. Neale [1,2], David C. Whiteman [1,2]

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Population attributable fraction

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$$PAF = 82.7\%$$

Population attributable fraction

Excess risk model:

$$PAF = \frac{I_O - I_E}{I_O}$$

I_O = Observed incidence (of melanoma) in study population.

I_E = Expected incidence (of melanoma) that would have occurred without exposure to (UVR).

(Shield et al, Curr Epidemiol Rep 2016)

Population attributable fraction

Excess risk model:

$$PAF = \frac{I_O - I_E}{I_O}$$

I_O = Observed incidence (of melanoma) in study population.

I_E = Expected incidence (of melanoma) that would have occurred if exposure (UVR) were at theoretical-minimum level.

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(Shield et al, Curr Epidemiol Rep 2016)

Population attributable fraction

Excess risk model:

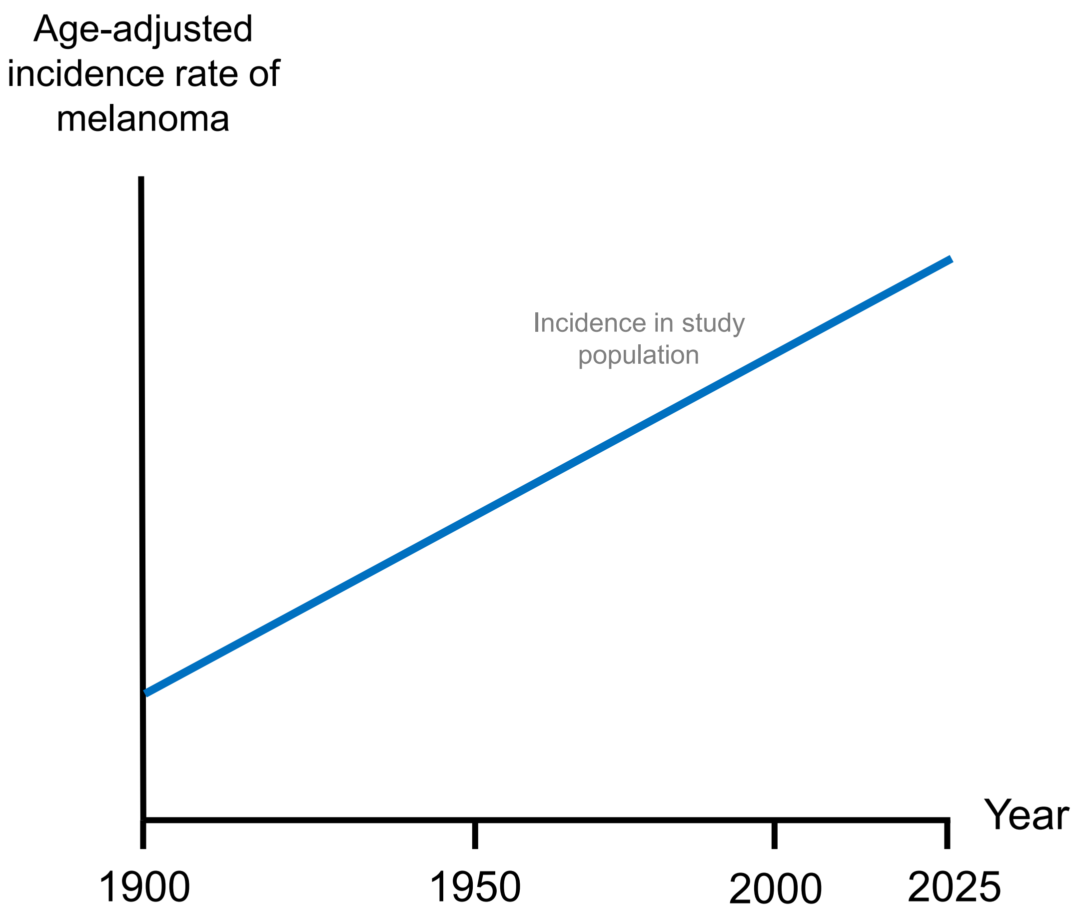
$$PAF = \frac{I_O - I_E}{I_O}$$

I_O = Observed incidence (of melanoma) in study population.

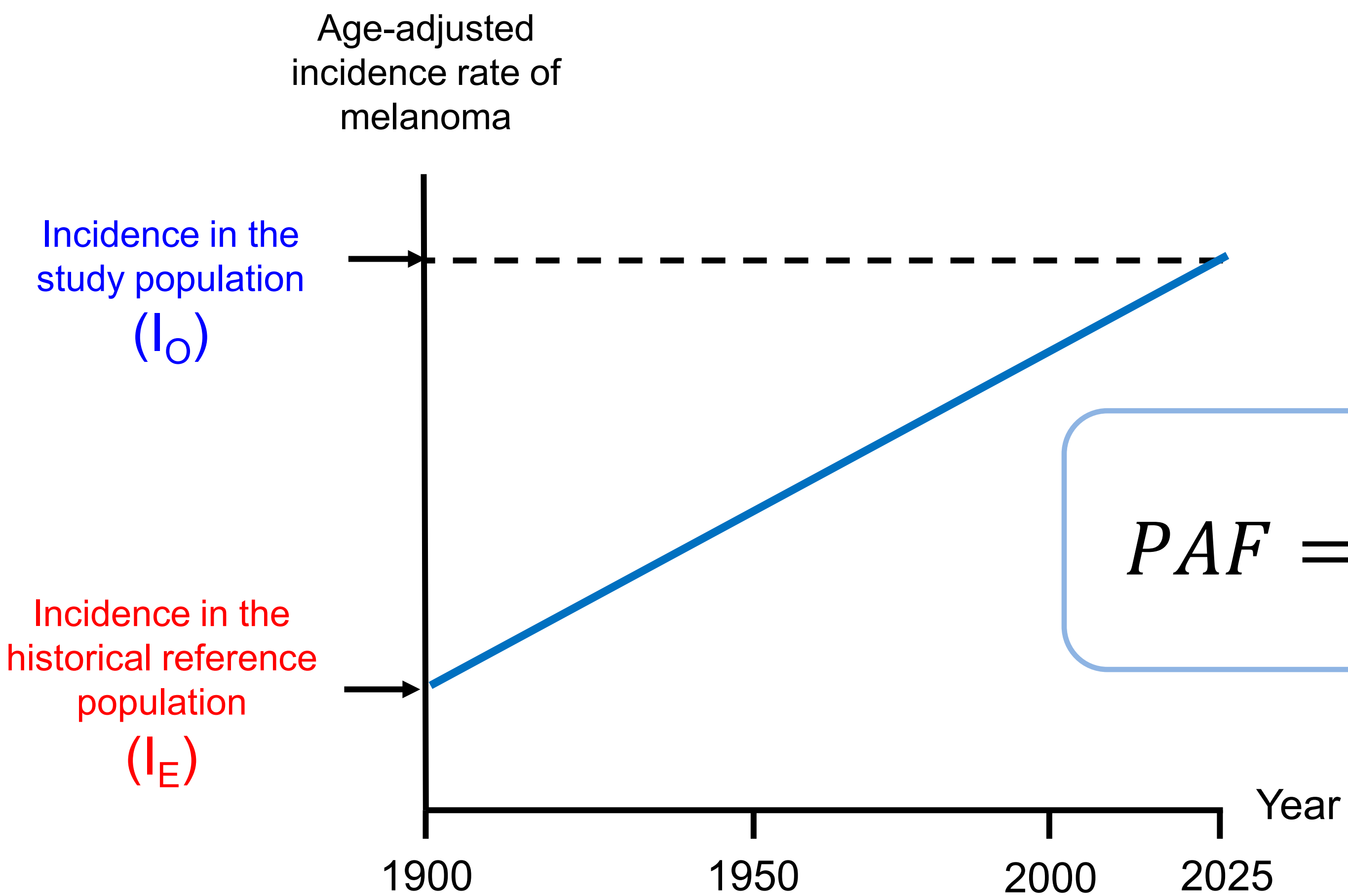
I_E = Observed incidence (of melanoma) in reference population.

(Shield et al, Curr Epidemiol Rep 2016)

Population attributable fraction



Population attributable fraction



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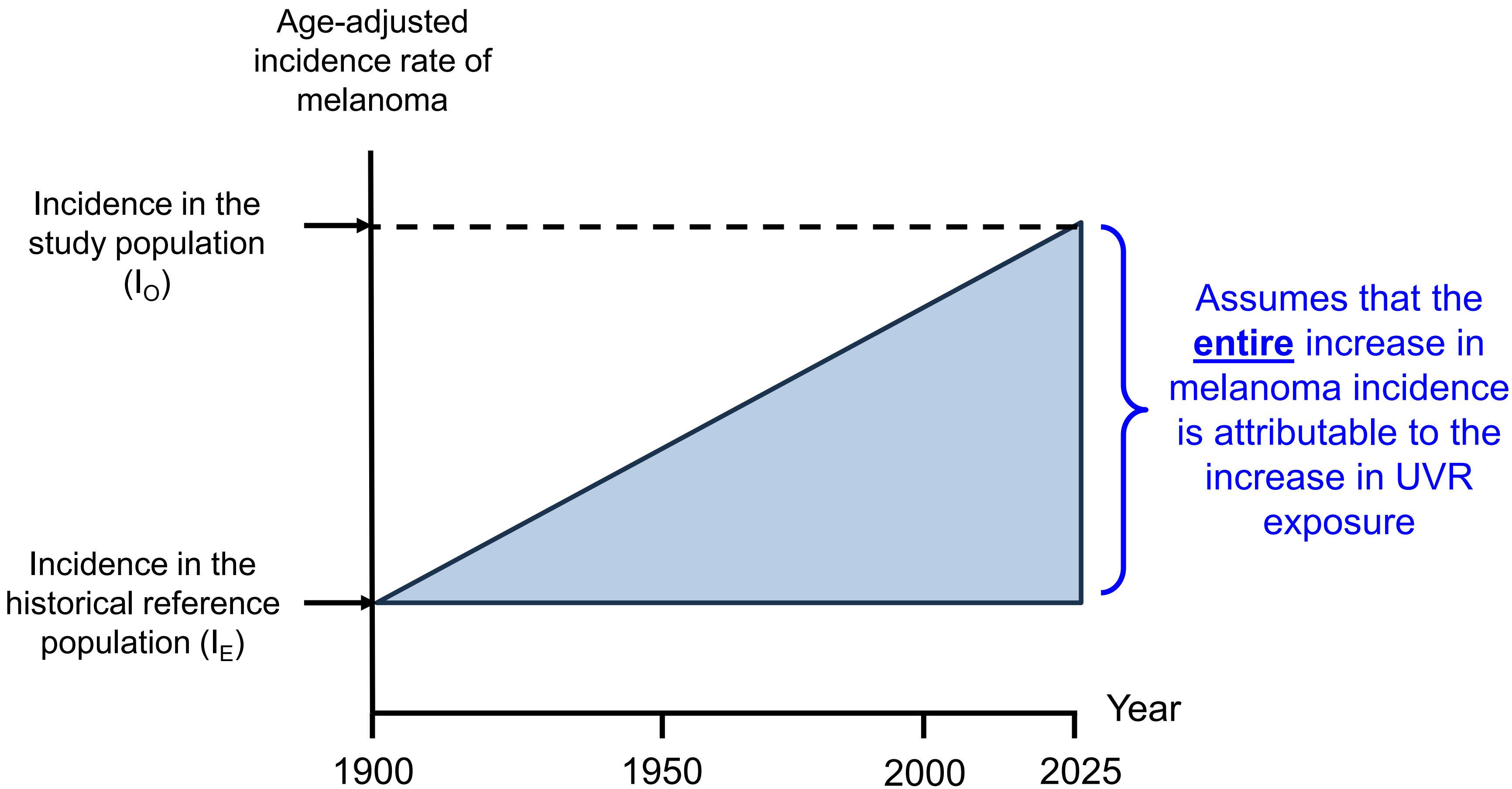
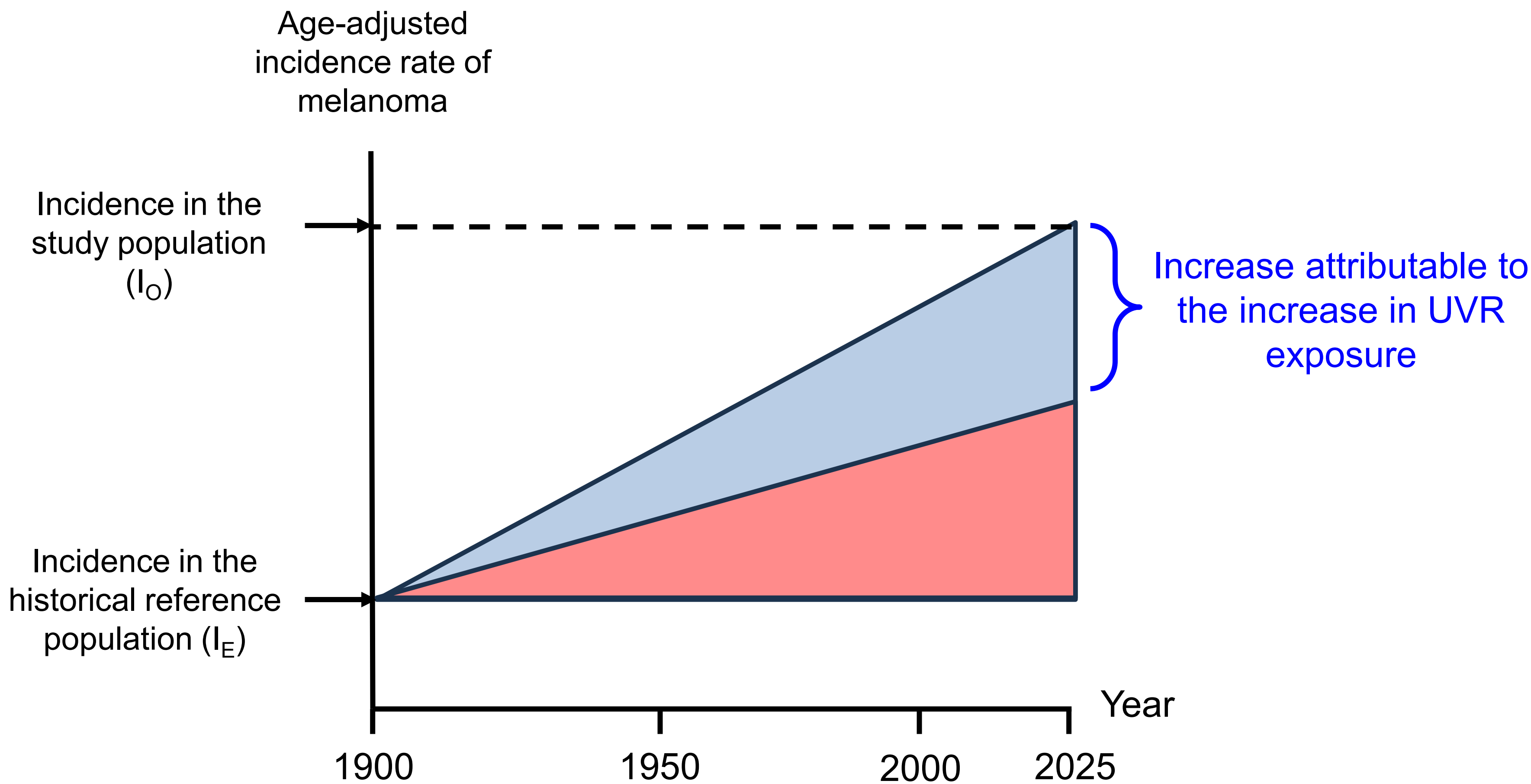


(adapted from: *Smit et al, Int J Cancer 2025)*

Population attributable fraction



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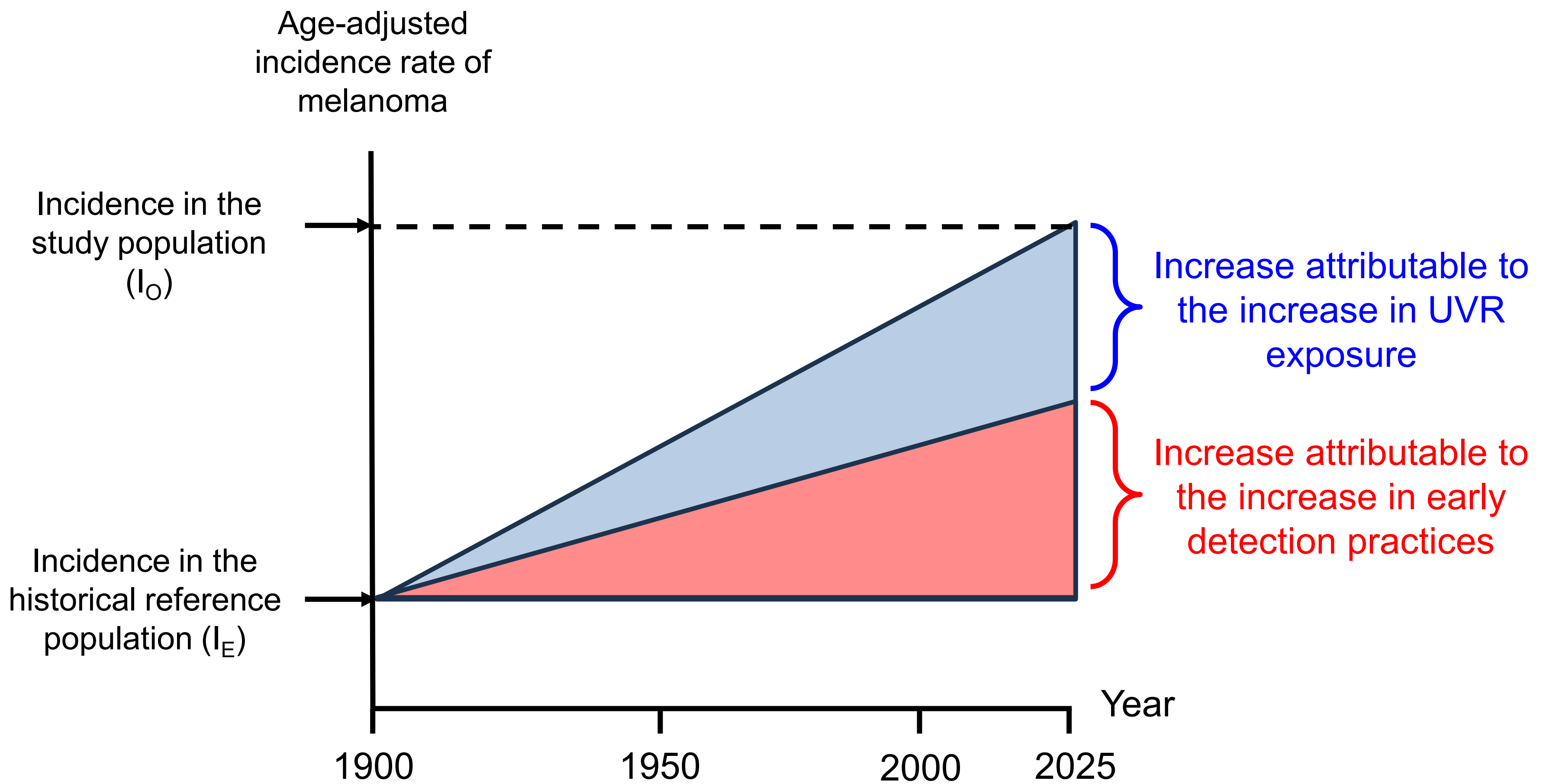

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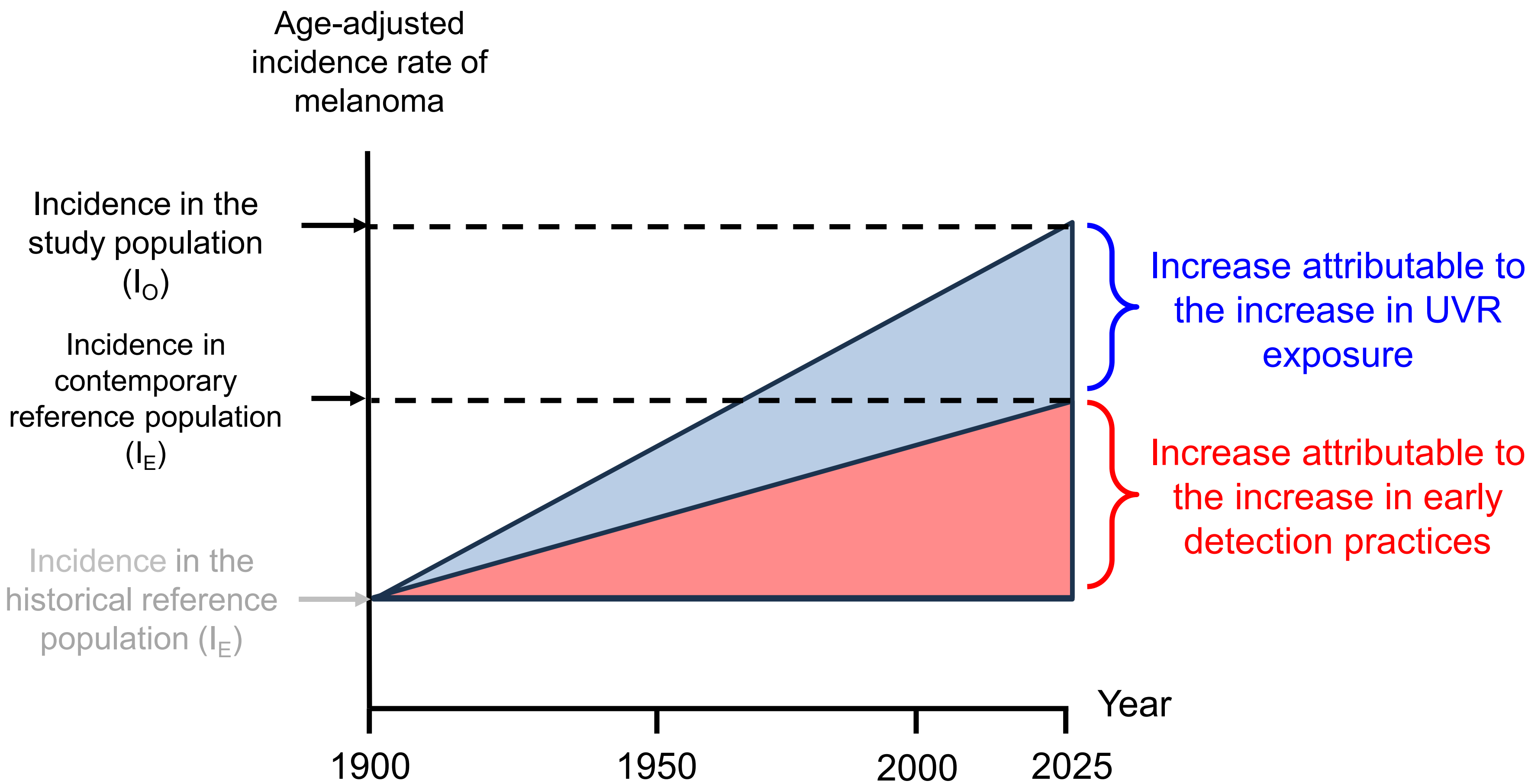
Population attributable fraction



(adapted from: *Smit et al, Int J Cancer 2025)*

Population attributable fraction

$$PAF = \frac{I_O - I_E}{I_O}$$

$$\uparrow I_E = \downarrow PAF$$

$$\downarrow I_E = \uparrow PAF$$

Population attributable fraction

The PAF estimate will automatically be inflated unless the **entire** difference in incidence between the study population and the reference population is attributable to the difference in UVR exposure

$$\uparrow I_E = \downarrow PAF$$

$$\downarrow I_E = \uparrow PAF$$

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Historical reference population

$$PAF = 95\%$$

Contemporary reference population

$$PAF = 63\%$$

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LETTER TO THE EDITOR

Population attributable fractions for scrutiny-dependent cancers

Frerik Smit, Stefano Tancredi, Arnaud Chiolero

First published: 19 August 2025 | https://doi.org/10.1002/ijc.70098

Key takeaways

- Detection/screening activities can skew cancer data and lead to surveillance bias.

- It is important to distinguish real changes in the risk of cancer and related outcomes to avoid misinterpretation of cancer burden and wrong public health actions.

- The impact of surveillance bias on cancer epidemiology is widespread, impacting:
  - Effect/association estimation
  - Risk prediction modelling

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Thank you for your interest

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