

# Konference NZIP & NZIS Open 2025

10. prosince 2025

Název sekce: Zdravotnická data – technologie, využití, perspektivy II.

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# Czech ecological study to evaluate efficacy of anti-smoking intervention against lung cancer incidence and/or mortality

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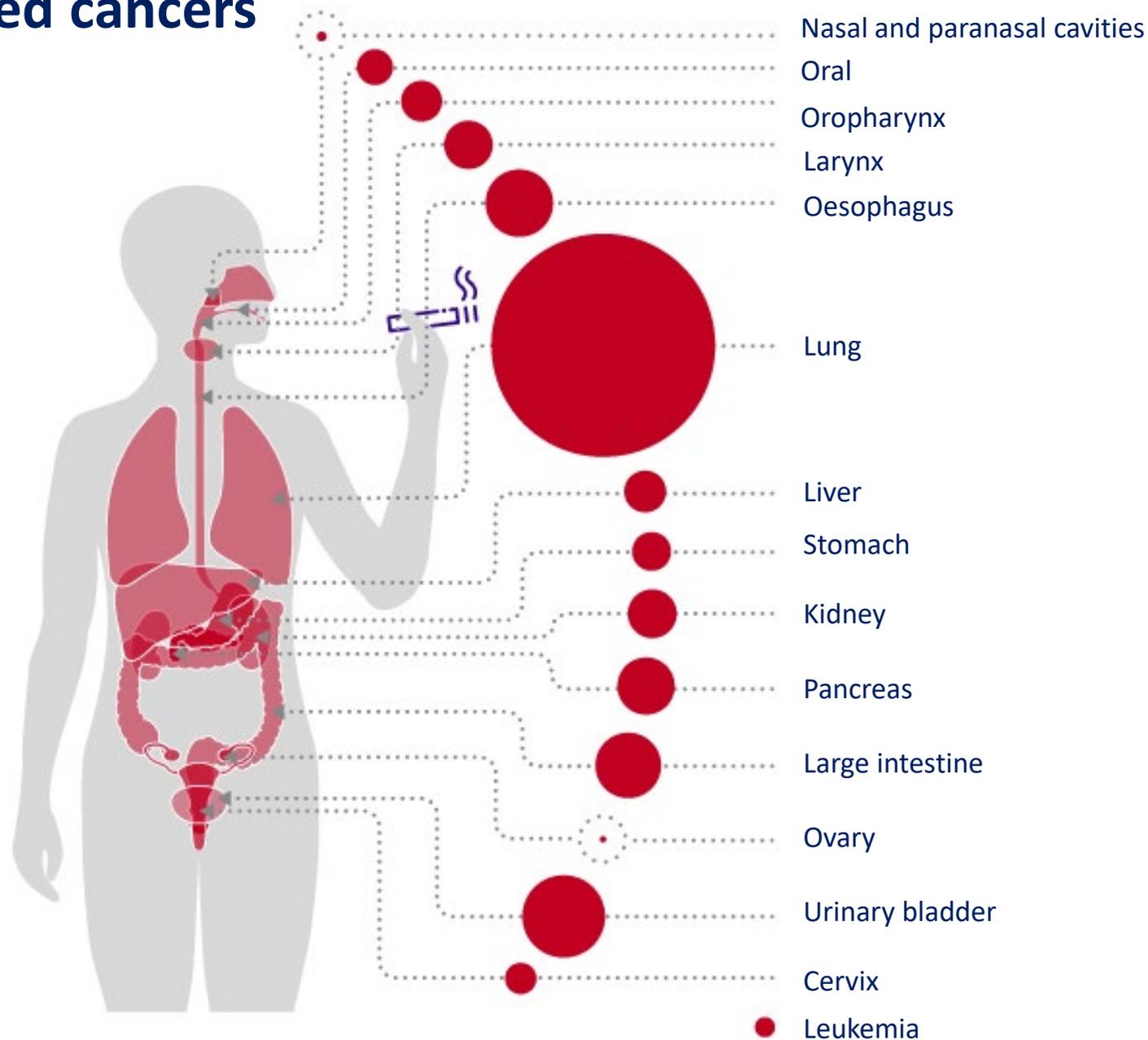
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# Smoking related cancers

**Smoking is responsible for approx. 1.000.000 cancer deaths worldwide**

**Alcohol is responsible for approx. 600.000 cancer deaths worldwide**



# Classification of tobacco/nicotine products

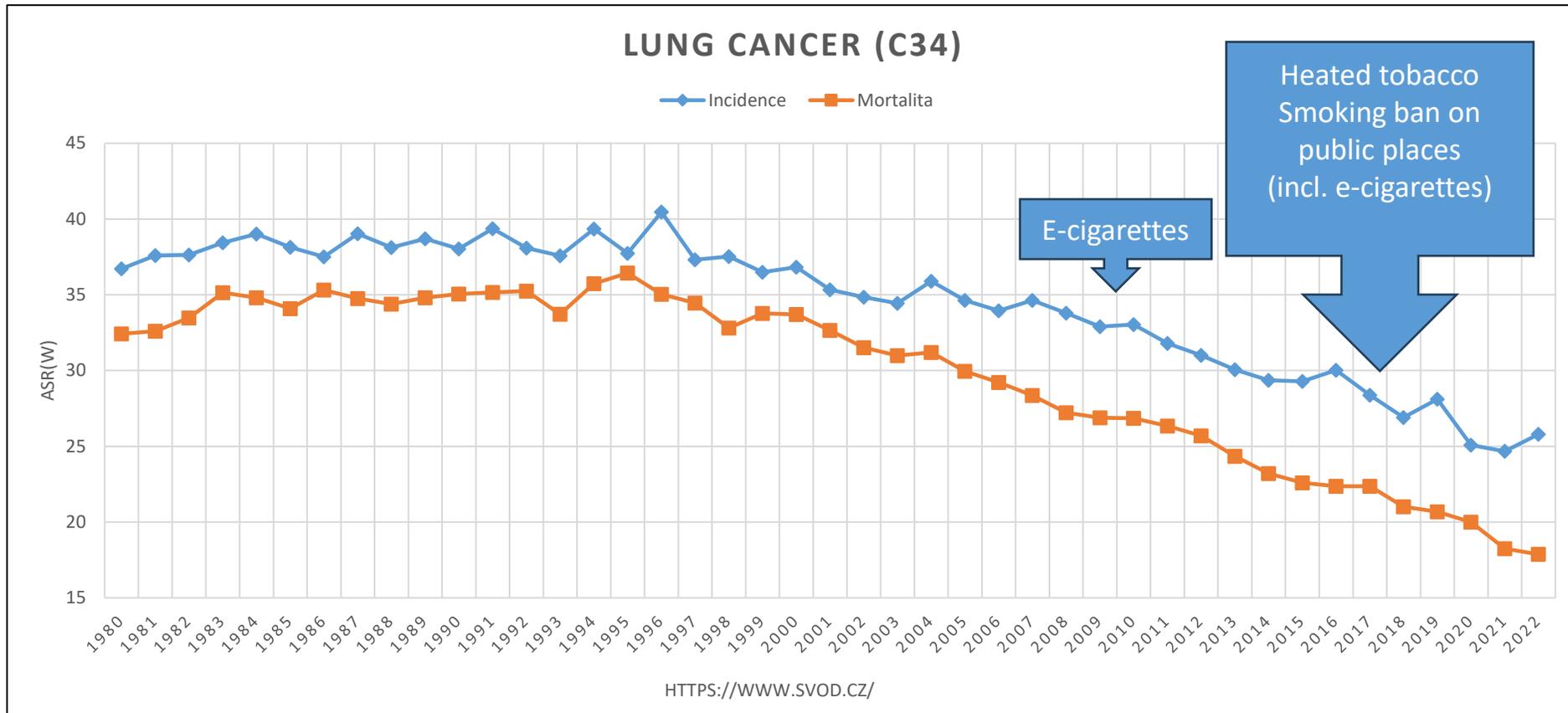
## 1. Combustible Tobacco Products

- **Cigarettes:** Shredded tobacco wrapped in paper.
- **Cigars:** Whole-leaf tobacco (large cigars, cigarillos, little cigars).
- **Roll-Your-Own (RYO):** Shredded tobacco rolled manually.
- **Pipe Tobacco:** Smoked using a pipe and waterpipes.

## 2. Smokeless Tobacco/Nicotine Products

- **Chewing Tobacco:** Placed between gum and cheek.
- **Snuff:** Moist (lip placement) or dry (inhaled through the nose).
- **Snus:** Pouch placed under the lip.
- **Dissolvables:** Lozenges, strips, sticks dissolving in the mouth.
- **Novel products:** E-cigarettes, patches, heated tobacco, etc.
- **Nicotine replacement therapies**

# Anti-tobacco interventions and “harm reduction approaches” decrease lung cancer incidence and mortality in the Czech Republic



## Input data

- Data from the National Cancer Registry (1/2010-12/2022)
- Number of new lungCa cases (with age, sex and histology) – monthly data
- Number of residents (with age, sex) – yearly data
- Data cleaning (aggregation of duplicated records)
- Summarization into age and sex, resp. histological subgroup
- analysis included 85.065 lung cancer cases (55.709 men, 29.356 women)
- Crude Incidence rates (CIR) = #lungCa per 100.000 residents

## Changepoint estimation (time point, TP)

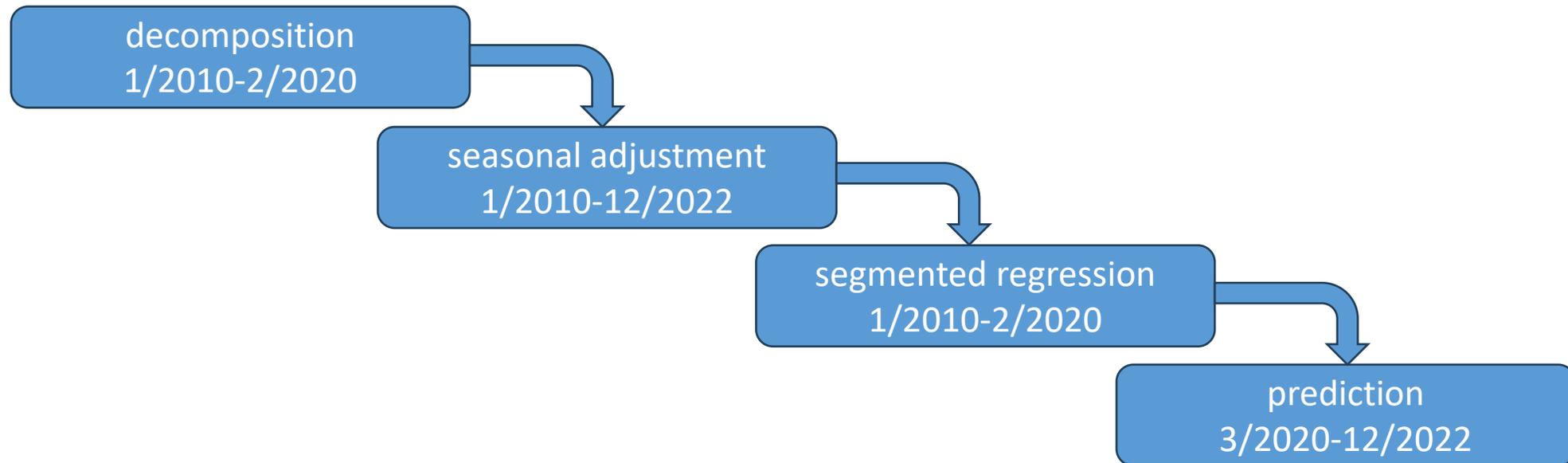
- seasonal adjustment of monthly CIR based on the preCovid period (decomposition of 1/2010 – 2/2020 CIR time series)
- changepoint estimation based on simple linear regression model with month number in preCovid period (1/2010-2/2020) as a regressor, i.e. *month* = (1:122)

*CIR (#lungCa cases per 100.000 residents) ~ month*

- the number of changepoints (max. 2, 0 incl.) and the changepoints themselves estimated by segmentation regression as is implemented by Muggeo\* in *segmented::selgmented()* function
- prediction (point + interval estimation) for 3/2020 – 12/2022, i.e. *month* = (123:156)

\* Muggeo, V.M.R. (2008) *Segmented: an R package to fit regression models with broken-line relationships*. *R News* 8/1, 20–25.

# Linear interrupted time series (ITS) model for seasonally adjusted data

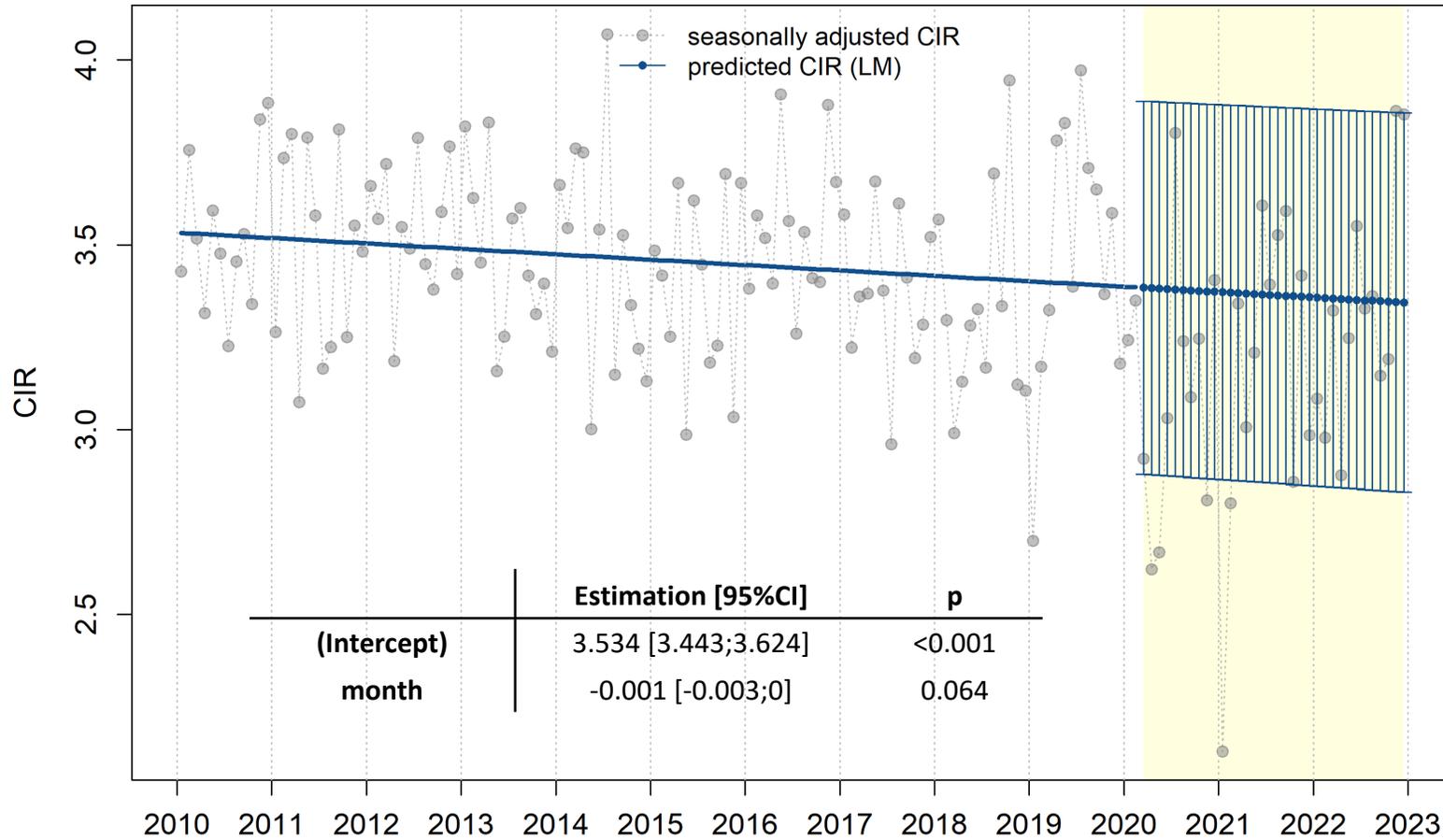


# Men and Women

NSCLC, SCLC subgroups

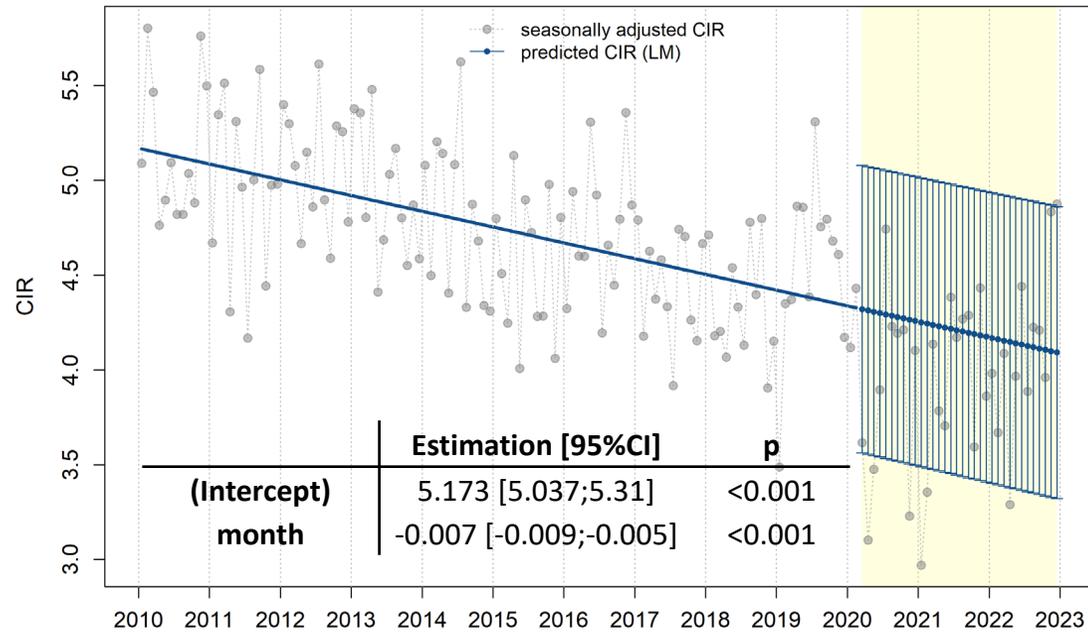
NSCLC subgroups: AC and SQCC

# Linear interrupted time series (ITS) model for seasonally adjusted data – NSCLC

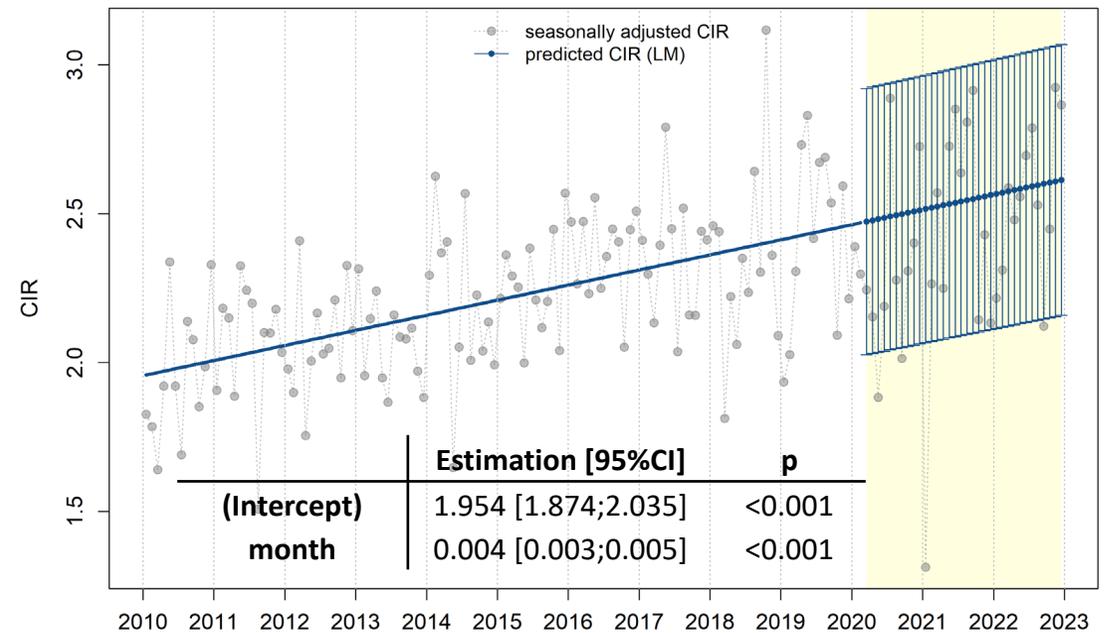


# Men and women by sex – NSCLC

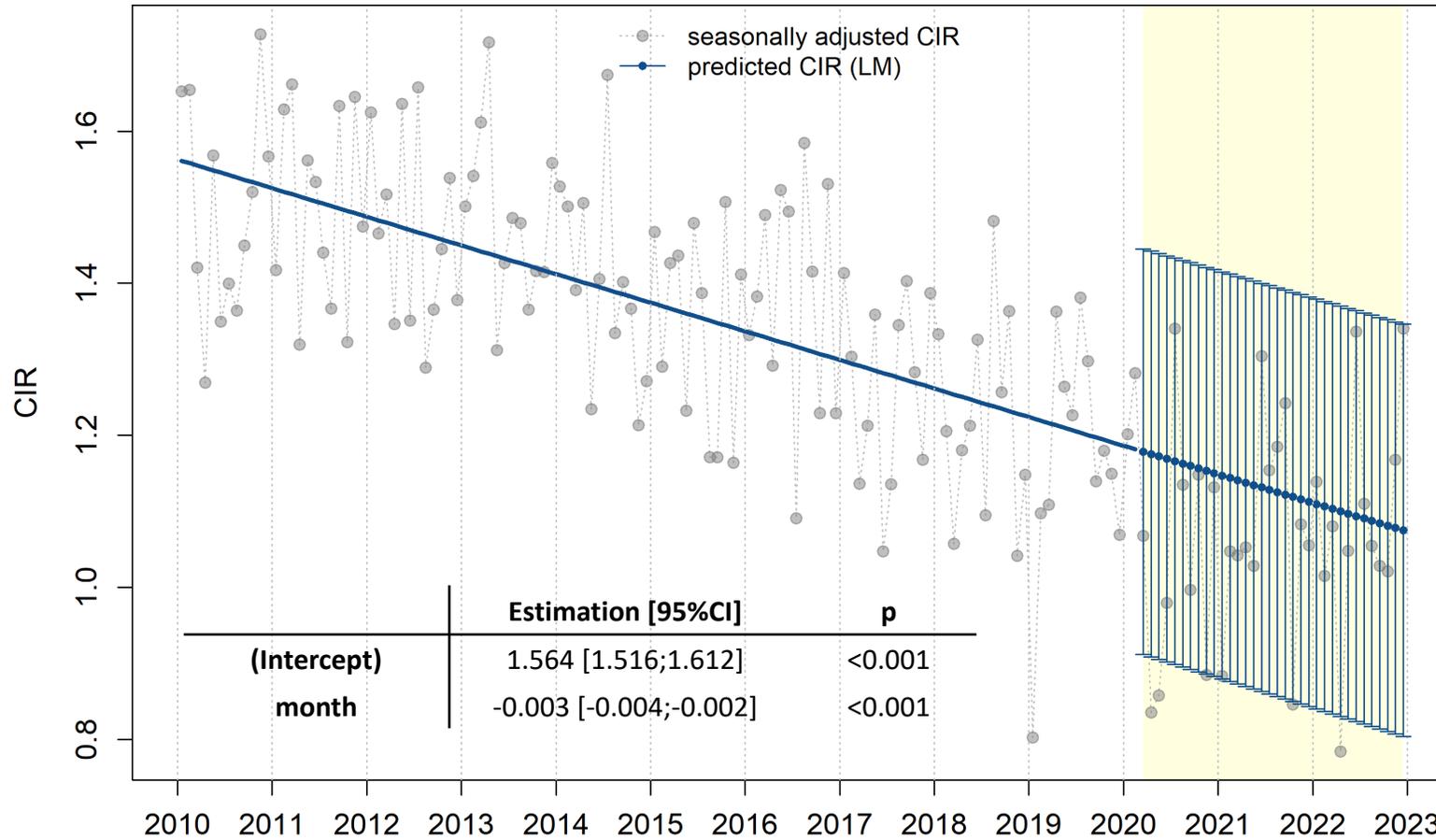
## MEN



## WOMEN

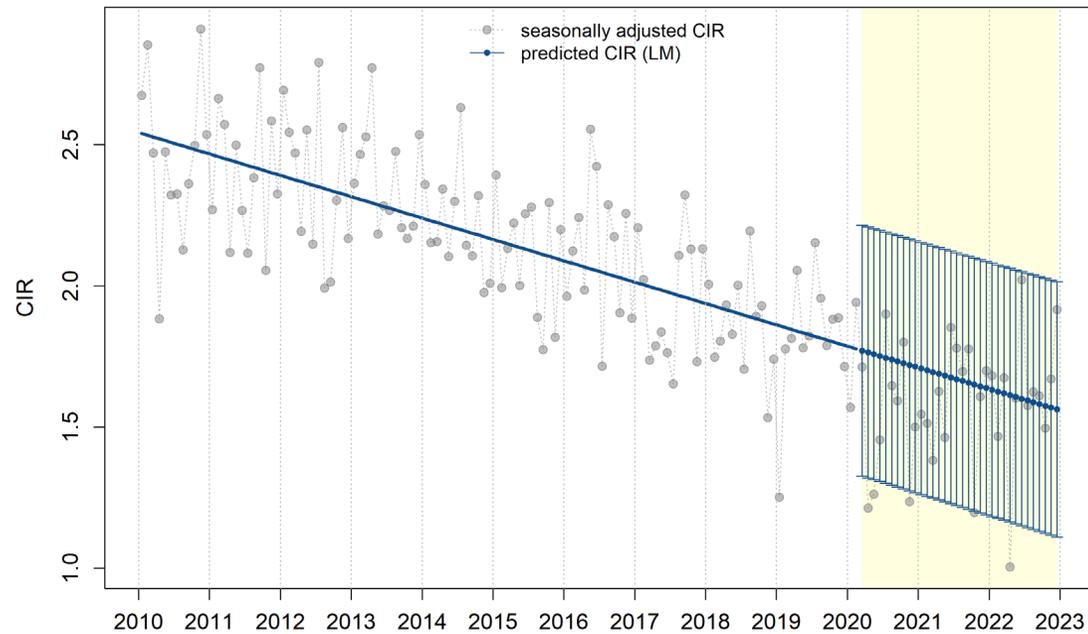


# Linear interrupted time series (ITS) model for seasonally adjusted data – SQCC



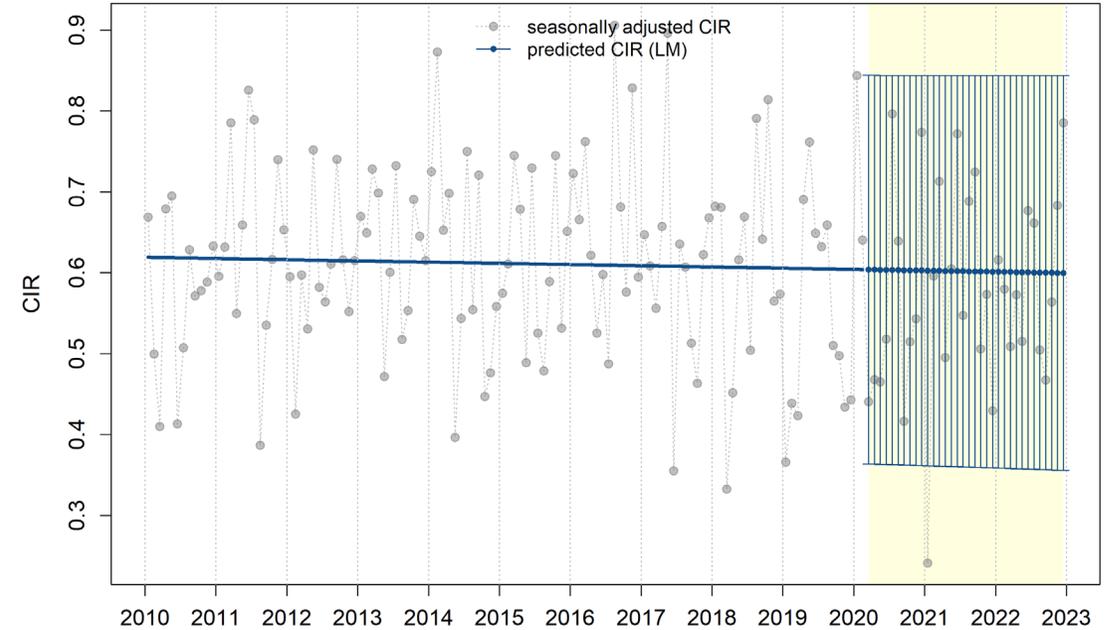
# Men and women by sex – SQCC

## MEN



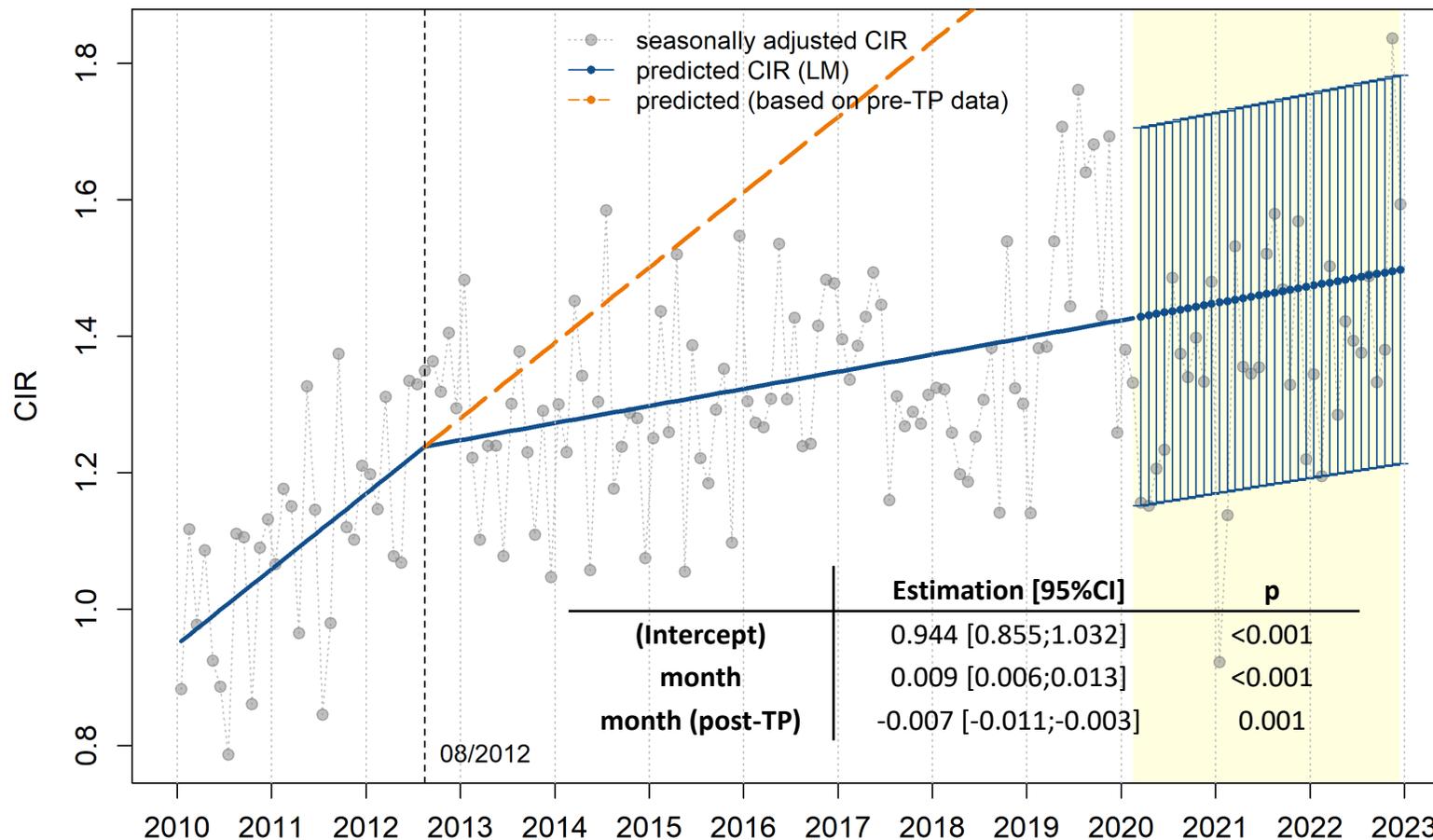
	Estimation [95%CI]	p
<b>(Intercept)</b>	2.546 [2.466;2.626]	<0.001
<b>month</b>	-0.006 [-0.007;-0.005]	<0.001

## WOMEN



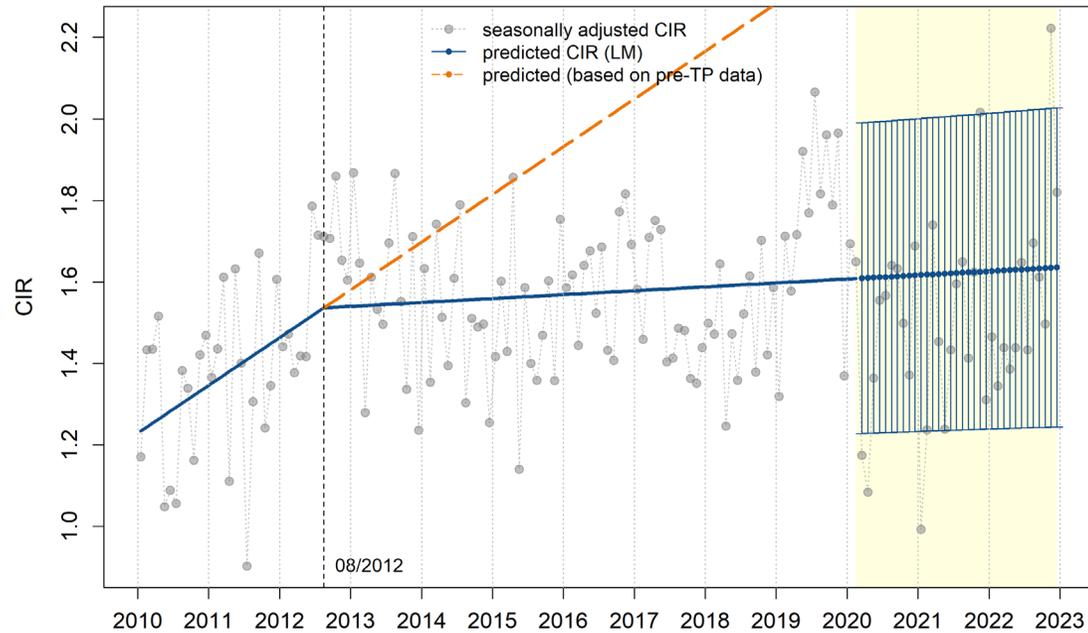
	Estimation [95%CI]	p
<b>(Intercept)</b>	0.619 [0.576;0.662]	<0.001
<b>month</b>	0.0001 [-0.0007;0.0005]	0.689

# Linear interrupted time series (ITS) model for seasonally adjusted data – AC



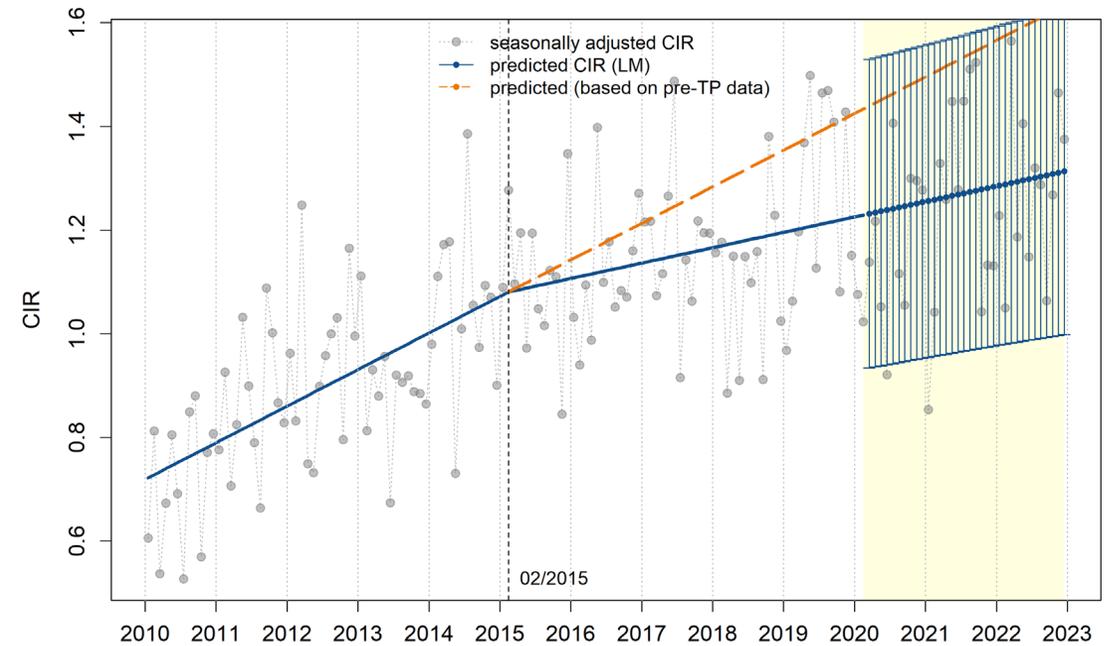
# Men and women by sex – AC

## MEN



	Estimation [95%CI]	p
<b>(Intercept)</b>	1.224 [1.102;1.346]	<0.001
<b>month</b>	0.01 [0.005;0.015]	<0.001
<b>month (post-TP)</b>	-0.009 [-0.015;-0.003]	0.002

## WOMEN



	Estimation [95%CI]	p
<b>(Intercept)</b>	0.716 [0.646;0.786]	<0.001
<b>month</b>	0.006 [0.004;0.008]	<0.001
<b>month (post-TP)</b>	-0.003 [-0.006;0]	0.027

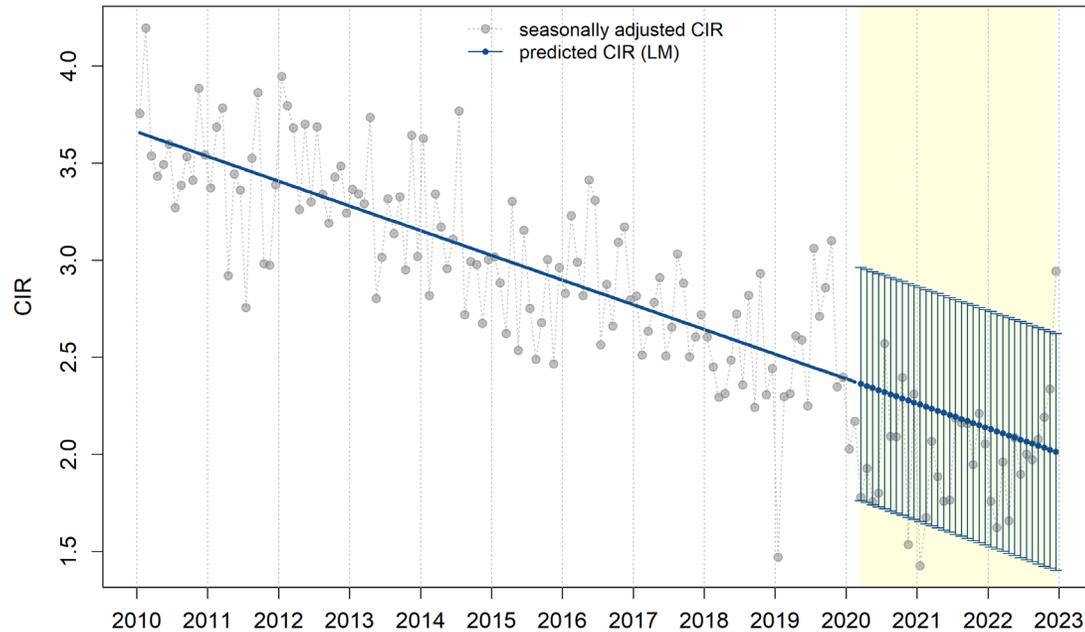
# Men by Age

NSCL

NSCLC subgroups: AC and SQCC

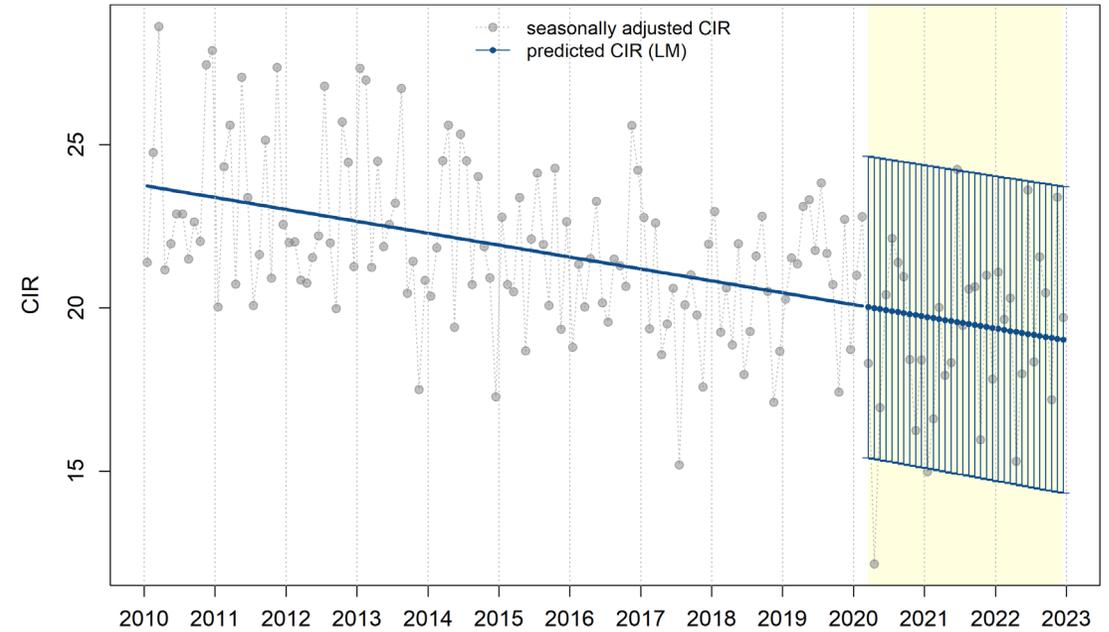
# Men by age – NSCLC

## UNDER 70 YEARS



	Estimation [95%CI]	p
<b>(Intercept)</b>	3.667 [3.559;3.775]	<0.001
<b>month</b>	-0.011 [-0.012;-0.009]	<0.001

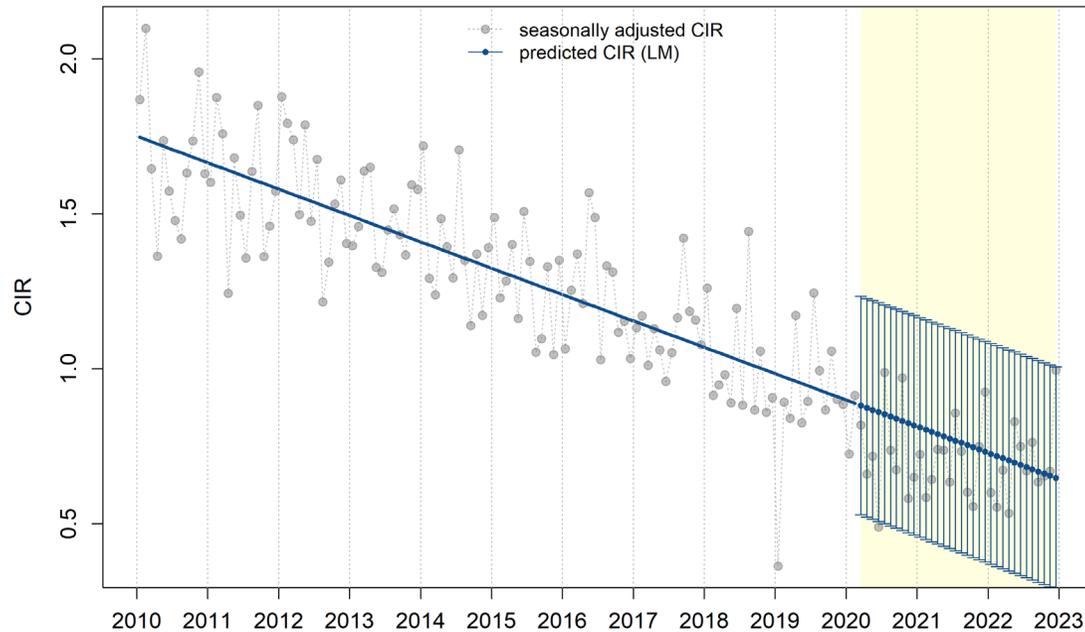
## 70+ YEARS



	Estimation [95%CI]	p
<b>(Intercept)</b>	23.763 [22.932;24.593]	<0.001
<b>month</b>	-0.03 [-0.042;-0.019]	<0.001

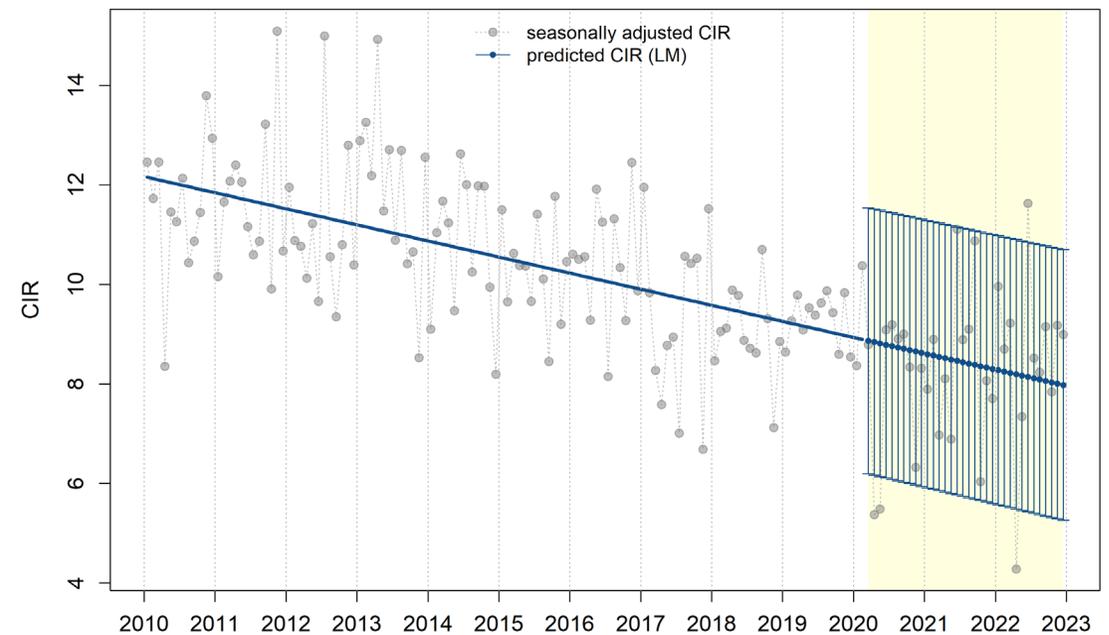
# Men by age – SQCC

## UNDER 70 YEARS



	Estimation [95%CI]	p
<b>(Intercept)</b>	1.753 [1.69;1.817]	<0.001
<b>month</b>	-0.007 [-0.008;-0.006]	<0.001

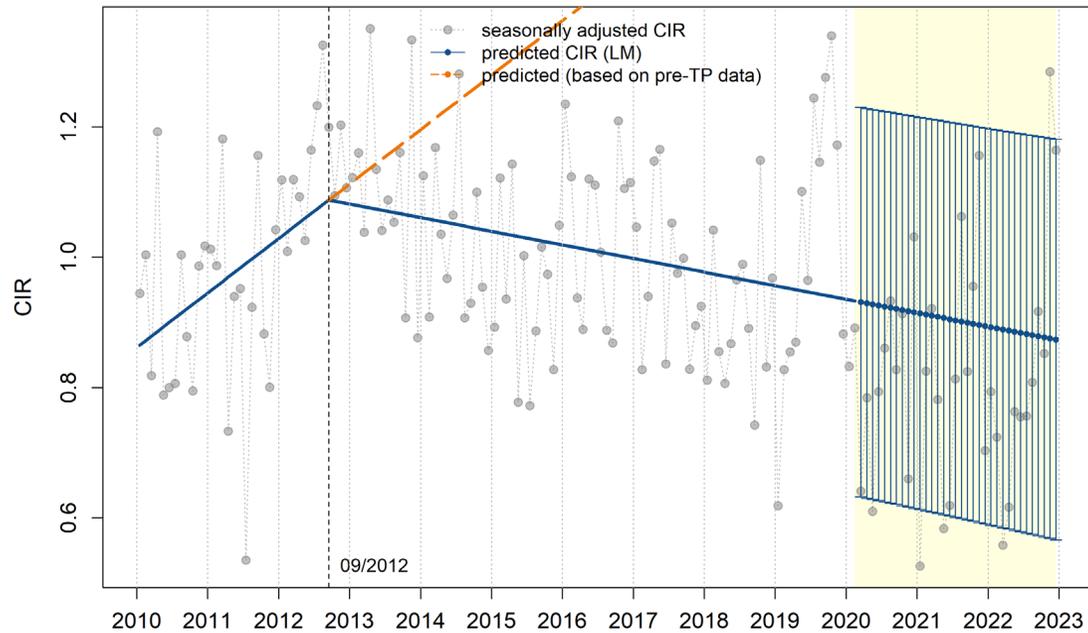
## 70+ YEARS



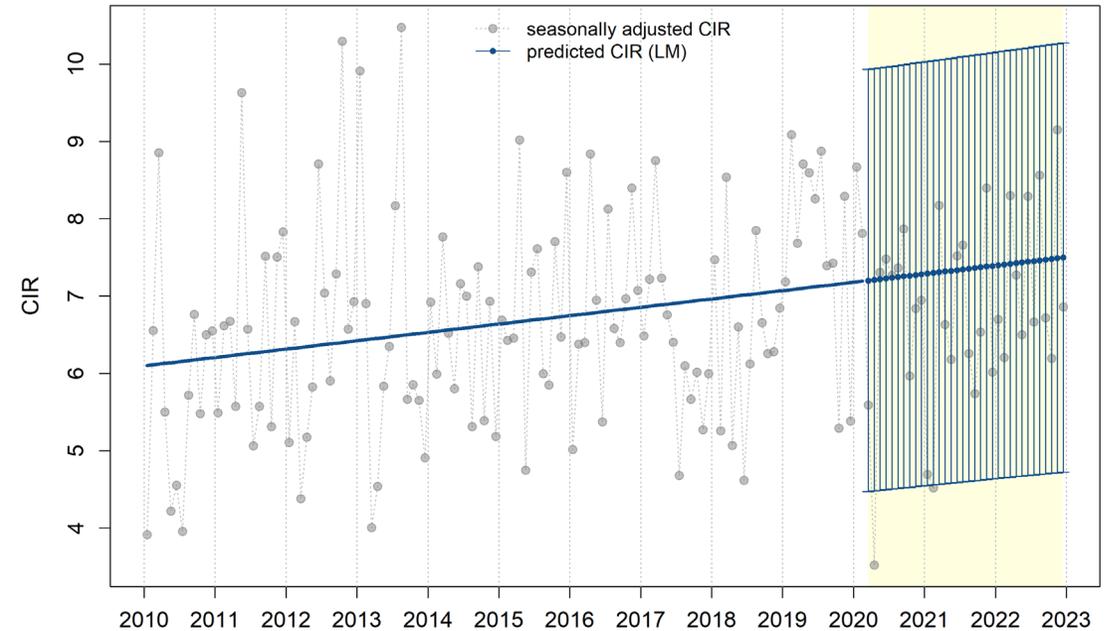
	Estimation [95%CI]	p
<b>(Intercept)</b>	12.182 [11.701;12.663]	<0.001
<b>month</b>	-0.027 [-0.034;-0.02]	<0.001

# Men by age – AC

## UNDER 70 YEARS



## 70+ YEARS



	Estimation [95%CI]	p
<b>(Intercept)</b>	0.858 [0.764;0.952]	<0.001
<b>month</b>	0.007 [0.003;0.011]	<0.001
<b>month (post-TP)</b>	-0.009 [-0.013;-0.004]	<0.001

	Estimation [95%CI]	p
<b>(Intercept)</b>	6.093 [5.602;6.584]	<0.001
<b>month</b>	0.009 [0.002;0.016]	0.012

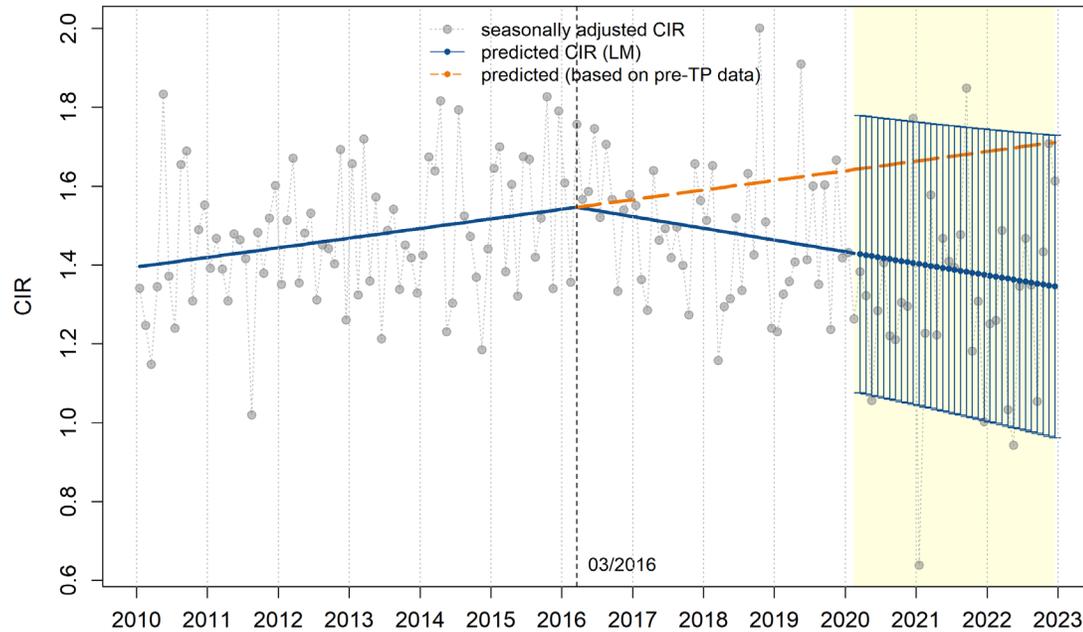
# Women by Age

NSCL subgroup

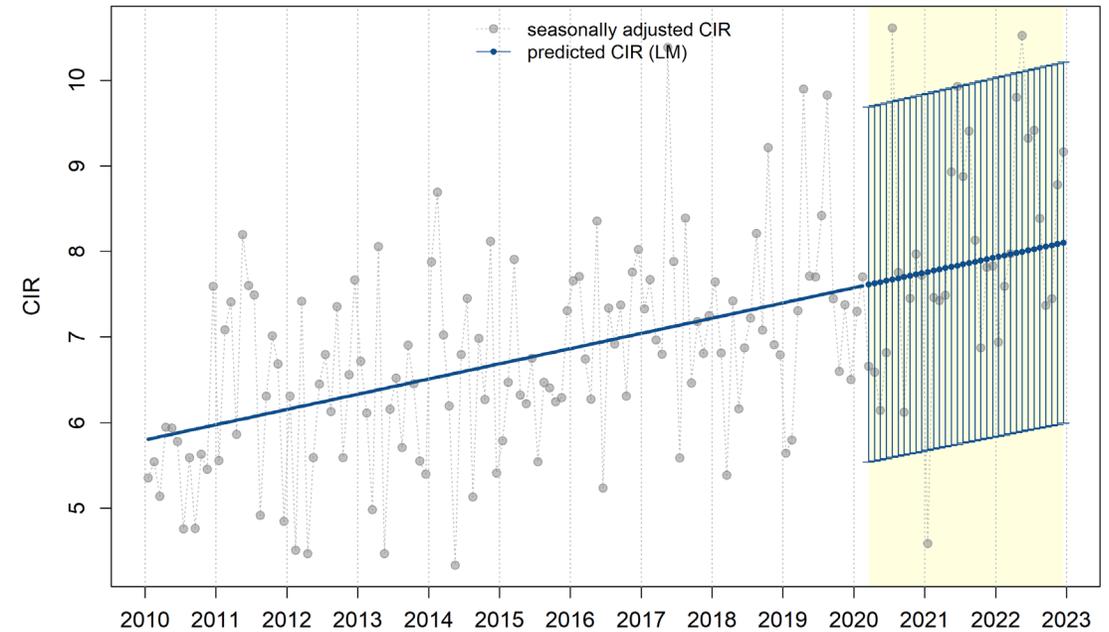
NSCLC subgroups: AC and SQCC

# Women by age – NSCLC

## UNDER 70 YEARS



## 70+ YEARS

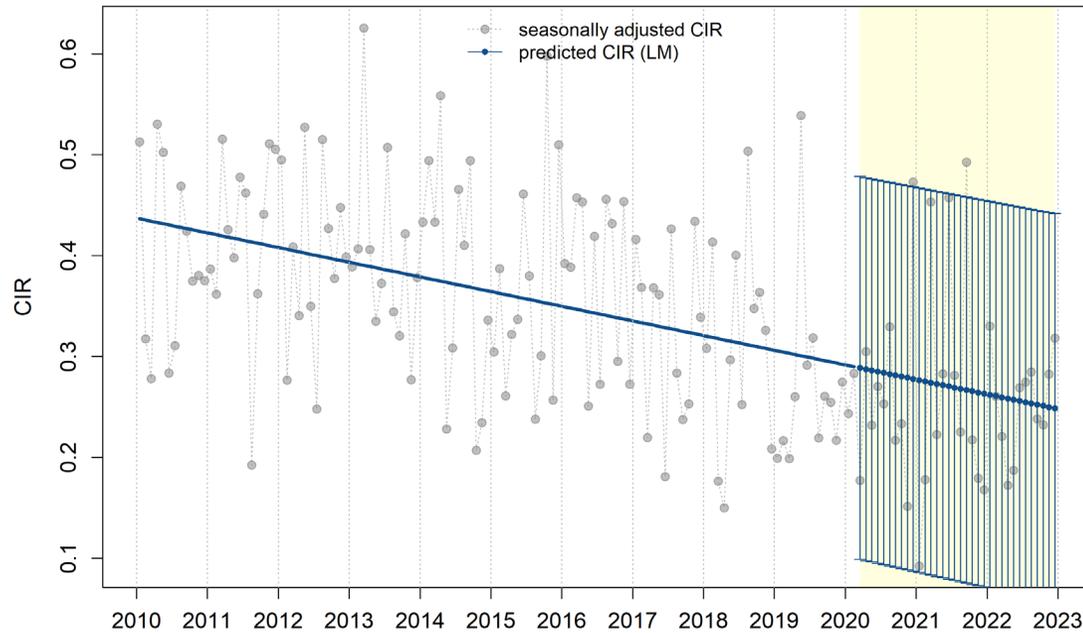


	Estimation [95%CI]	p
(Intercept)	1.394 [1.318;1.469]	<0.001
month	0.002 [0;0.004]	0.010
month (post-TP)	-0.005 [-0.008;-0.001]	0.021

	Estimation [95%CI]	p
(Intercept)	5.791 [5.418;6.165]	<0.001
month	0.015 [0.01;0.02]	<0.001

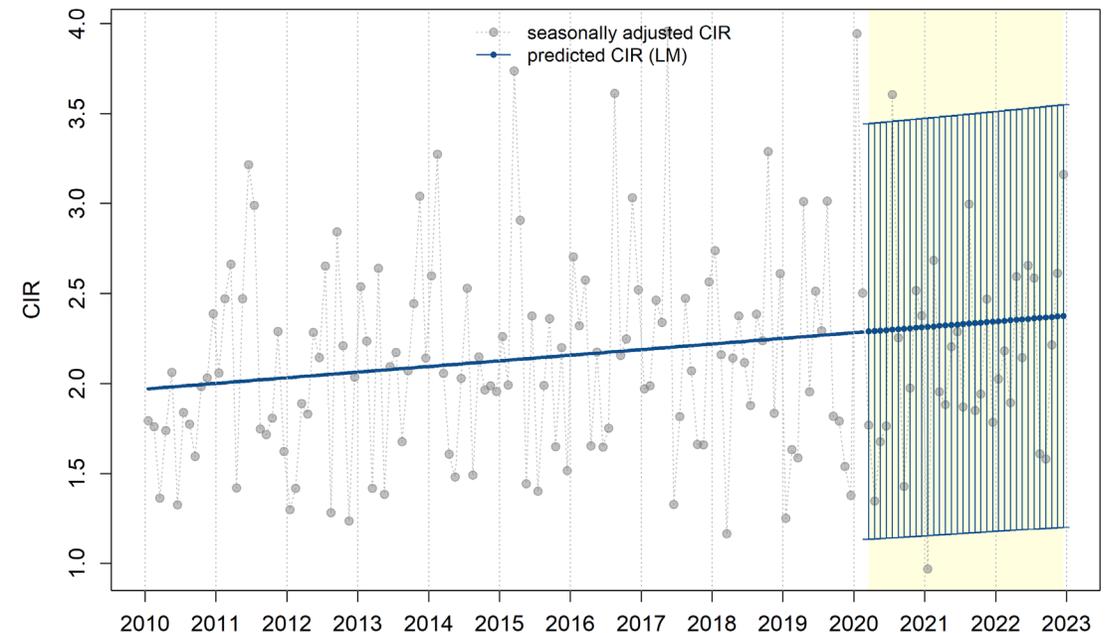
# Women by age – SQCC

## UNDER 70 YEARS



	Estimation [95%CI]	p
(Intercept)	0.438 [0.404;0.472]	<0.001
month	-0.001 [-0.002;-0.001]	<0.001

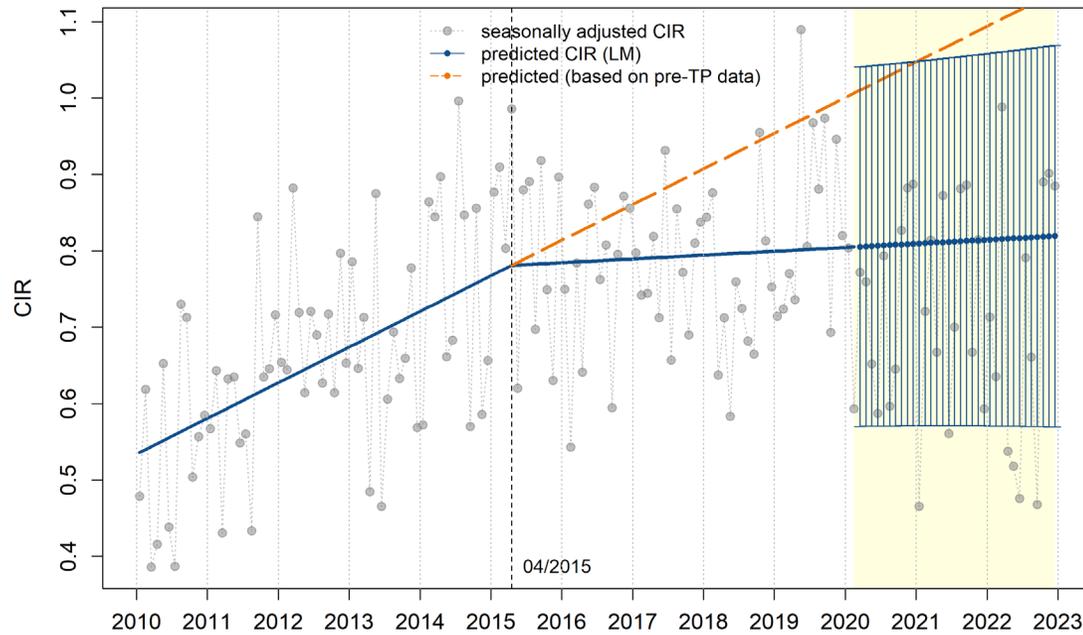
## 70+ YEARS



	Estimation [95%CI]	p
(Intercept)	1.968 [1.761;2.176]	<0.001
month	0.003 [0.0003;0.006]	0.083

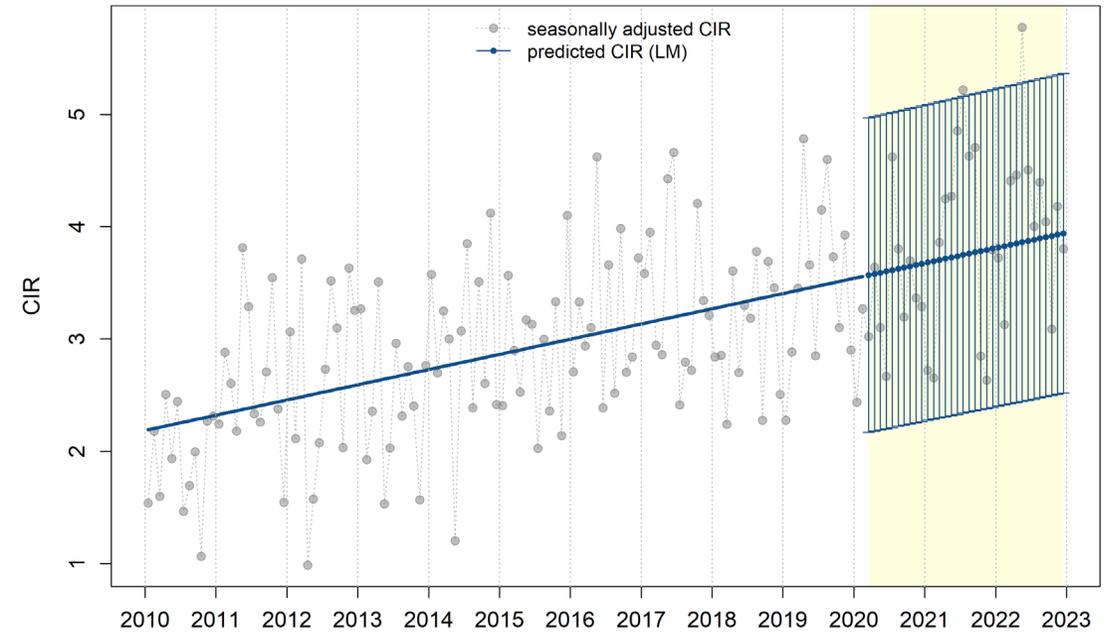
# Women by age - AC

## UNDER 70 YEARS



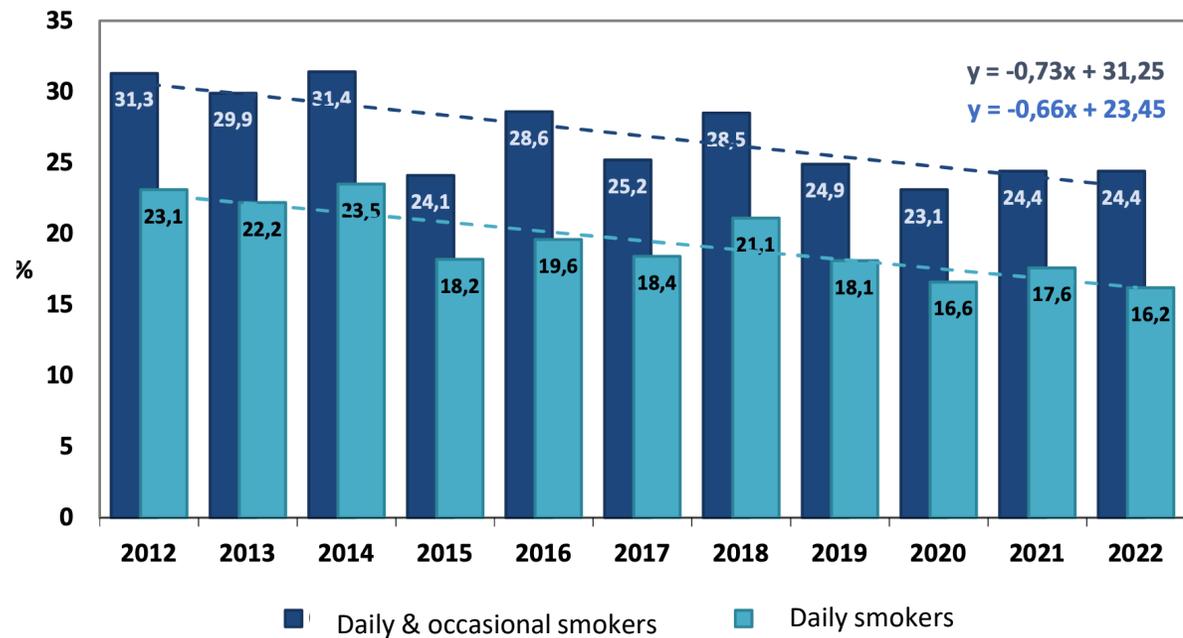
	Estimation [95%CI]	p
<b>(Intercept)</b>	0.532 [0.478;0.586]	<0.001
<b>month</b>	0.004 [0.003;0.005]	<0.001
<b>month (post-TP)</b>	-0.003 [-0.006;-0.001]	0.005

## 70+ YEARS

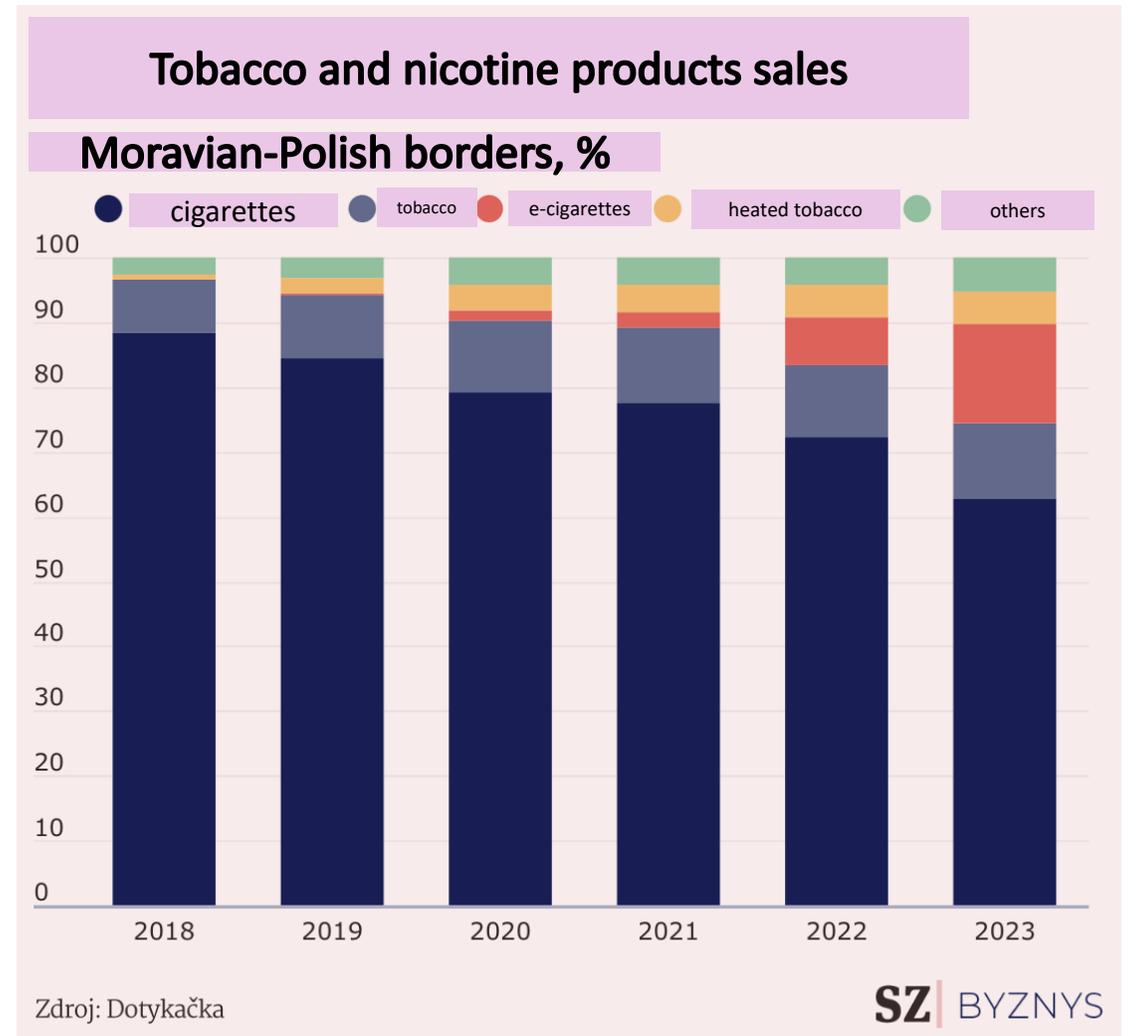


	Estimation [95%CI]	p
<b>(Intercept)</b>	2.18 [1.928;2.432]	<0.001
<b>month</b>	0.011 [0.008;0.015]	<0.001

# Smoking and consumption of tobacco and nicotine products in the Czech Republic



Study NAUTA 2022, SZU Praha cigarettes



# Why Smoking Affects AC and SQCC differently?

## 1. At least two types of carcinogenesis in AC (smoking dependent and independent)

Both AC and SQCC strongly increase with cumulative cigarette smoke exposure, but SQCC historically shows the strongest associations (classical central “smoker’s cancers”).

## 2. Changes in cigarette design shifted deposition of carcinogens

- Introduction of **filters and low-tar cigarettes** changed puff topography: smokers inhale **more deeply**, delivering **fine particulates and carcinogens** to the **peripheral lung**, where adenocarcinoma arises. Moreover, Clara cells and type II pneumocytes (AC precursors) are highly sensitive to NNK-induced DNA damage.

## 3. Evidence from epidemiology

Several large prospective and pooled analyses show:

- **Relative risks for heavy smokers vs. never smokers** (*numbers vary by cohort, but the pattern is consistent*):
  - **Adenocarcinoma**: excess risk > **200**, Time to 50% risk reduction = **14,44 years**
  - **Squamous cell carcinoma**: excess risk ~ **120**, Time to 50% risk reduction = **11,47 years**

This indicates that **AC is more strongly affected by current/intense exposure than recognized earlier**, particularly after the shift to modern cigarette types.

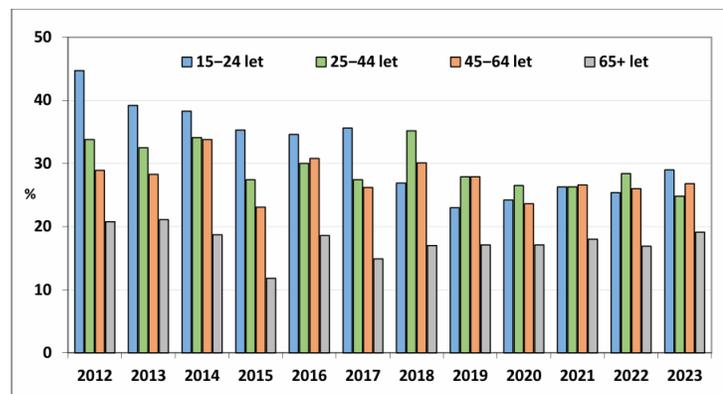
<https://doi.org/10.1016/j.yrtph.2015.02.010>; <https://doi.org/10.1093/aje/kwf153>

# Why Decreased Incidence in Younger Individuals?

The observed lung cancer incidence among younger males and females (<70 years of age) has significantly and consistently declined compared to the expected incidence, with a notable change point around 2015/2016.

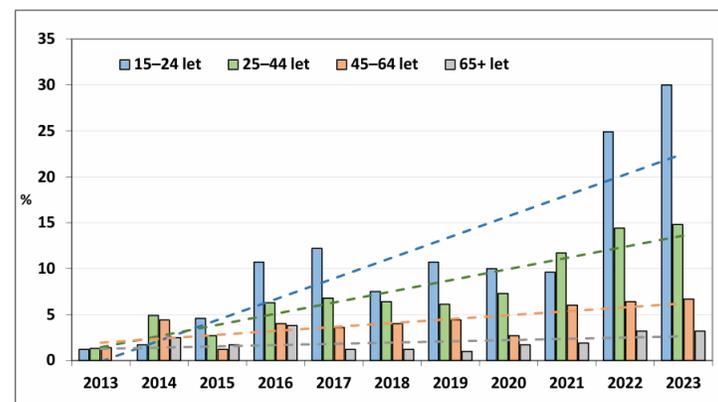
This trend may suggest a potential impact of the introduction of e-cigarettes and other nicotine smoke free alternatives on the market.

Graf 3: Prevalence kuřáctví v ČR podle věkových skupin



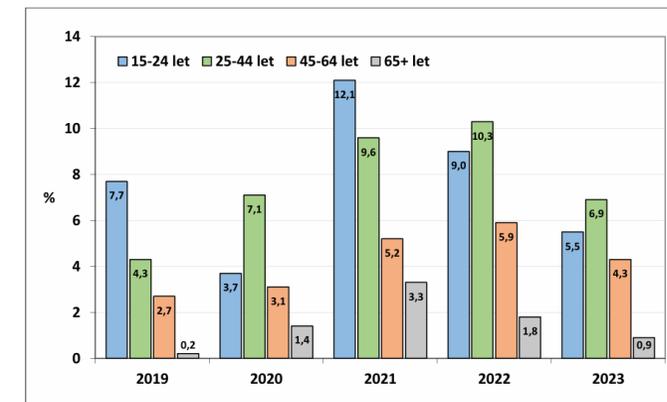
Pozn.: Graf zahrnuje kuřáky tabákových výrobků celkem (denní a příležitostní, tj. kouří méně často než denně, ale alespoň jednou měsíčně).

Graf 9: Uživatelé elektronických cigaret podle věkových skupin



Pozn.: Graf zahrnuje uživatele elektronických cigaret celkem (denní a příležitostní, tj. užívají elektronické cigarety méně často než denně, ale alespoň jednou měsíčně).

Graf 16: Uživatelé zahříváných tabákových výrobků podle věkových skupin



Pozn.: Graf zahrnuje uživatele zahříváných tabákových výrobků celkem (denní a příležitostní, tj. užívají zahříváné tabákové výrobky méně často než denně, ale alespoň jednou měsíčně).

## Anti-tobacco interventions and “harm reduction approaches” decrease lung cancer incidence and mortality in the Czech Republic

Data suggest significant role of harm reduction approaches in reduction of lung cancer incidence.

Data must be monitored and analyzed in longer time series to see effects of more recent interventions and eliminate COVID-19 pandemic effects.

# Acknowledgements

## Proteomics core facility

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 Patrik Flodr  
 Pavla Flodrová  
 Zdeněk Kolář  
 Jiří Ehrmann  
 Jiří Mareš  
 and others

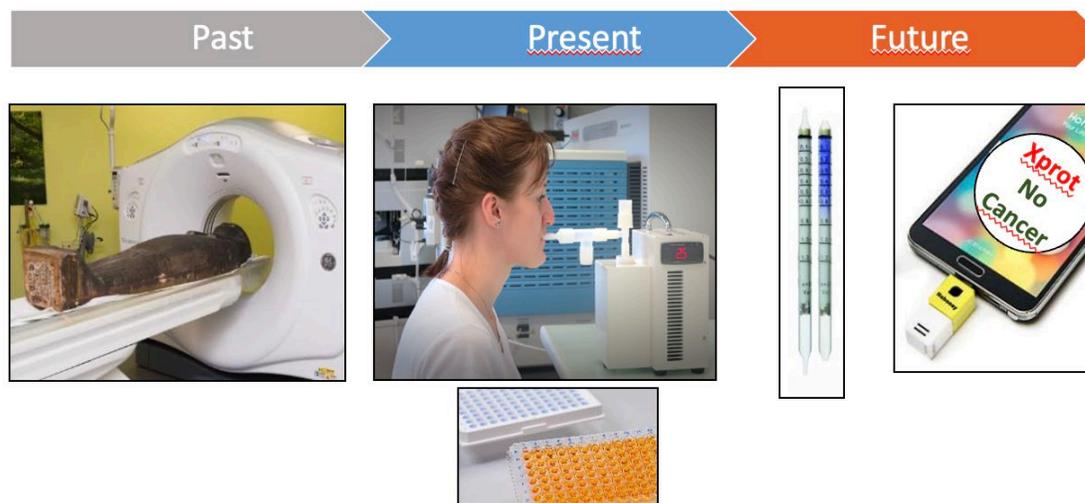
## Institute of Health Information and Statistics, Czech Republic

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Michaela Cvanová  
 Jan Mužík  
 Ondřej Májek  
 Ladislav Dušek

# THANK YOU FOR ATTENTION!

## ULTIMATE GOAL

*point-of-care non-invasive diagnostic of respiratory disorders*



RECRUITING 

**Study of Early Cancer Biomarkers in Breath Condensate in Population of Individuals With High-Risk of Lung Cancer Undergoing LDCT Screening.**

ClinicalTrials.gov ID  NCT06016569

Sponsor  The Institute of Molecular and Translational Medicine, Czech Republic

Information provided by  The Institute of Molecular and Translational Medicine, Czech Republic (Responsible Party)

Last Update Posted  2023-08-29

Open positions available for clinical collaborators, doctoral students and postdocs: [www.imtm.cz](http://www.imtm.cz); [marian.hajduch@upol.cz](mailto:marian.hajduch@upol.cz)

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10.-11. prosince 2025

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