

Impact of COVID-19 lockdown on emergency admissions and deaths due to asthma and COPD

National interrupted time series analyses
for Scotland and Wales

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On behalf of Gwyneth Davies, Shanya Sivakumaran, Eleftheria Vasileiou, Sharon Kennedy, Ronan Lyons, Chris Robertson, Aziz Sheikh, EAVE II Collaborators

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Original research


Impact of COVID-19 lockdown on emergency asthma admissions and deaths: national interrupted time series analyses for Scotland and Wales

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Impact of COVID-19 lockdown on the incidence and mortality of acute exacerbations of chronic obstructive pulmonary disease: national interrupted time series analyses for Scotland and Wales

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Background

Concerns SARS-CoV-2 may trigger exacerbations of asthma and COPD

Limited health care access and utilisation during lockdown

Avoidance of healthcare settings

Concerns declined access to healthcare might have increased mortality due to asthma and COPD

Background

On the other hand:

Better outdoor air quality and reduction in transmission of other viruses may have led to an overall improvement in outcomes of asthma and COPD

Research question

What was the impact of the first COVID-19 lockdown on **severe exacerbations of asthma** and COPD leading to **emergency hospitalisations** or **deaths** in Scotland and Wales?

Methods – outcomes and data source

We accessed data from Public Health Scotland and SAIL for the entire populations of Scotland and Wales.

		Scotland	Wales
Primary outcomes	Emergency hospitalisation Primary diagnosis of asthma/COPD; ICD-10 = J45, J46 / J43, J44	SMR01	PEDW (SAIL)
	Deaths Asthma/COPD as underlying cause ICD-10 = J45, J46 / J43, J44	Deaths database (NRS)	ADDE (SAIL)
Secondary outcomes	ED attendances Primary diagnosis; code = 14A / 14B		EDDS (SAIL)
	GP prescriptions (ICS, OCS) GP-recorded AECOPD		WLGP

Methods – interrupted time series analyses

Counts of AE visits, admissions, days in hospital, deaths

First 18 (asthma) and 30 (COPD) weeks of 2020 and 2015-2019 average

Single change point: week 13 (23 March)

Poisson model of weekly event count against

- Week number
- A binary variable to differentiate 2015-2019 from 2020
- A binary variable to differentiate weeks 1-12 from weeks 13-18 / 13-30

Three-way interaction to compare the following in 2020 vs 2015-2019

- Change in pre-lockdown slope
- Change in level at week 13
- Change in slope after week 13

$n \sim \text{year} + \text{week} + \text{change} + \text{weekpostchange} + \text{year}:(\text{week} + \text{change} + \text{weekpostchange})$

Methods

Weeks 13-30:

Proportion of COPD admissions per week during which patients died due to COPD

2020 vs 2015-2019

Beta regression

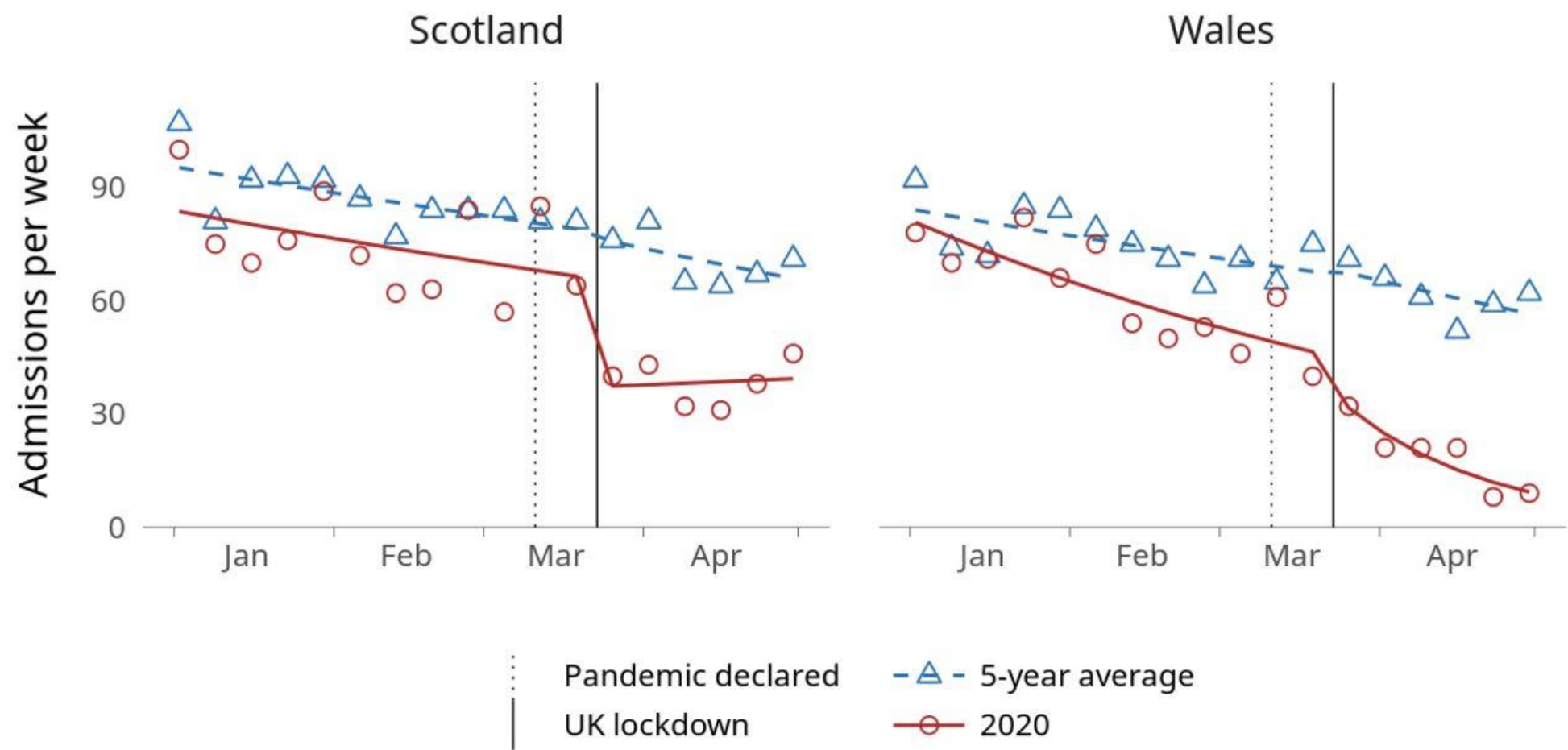
Methods – notes

Disclosure control: counts < 5 were masked

Scotland: We excluded two Health Boards, Forth Valley and Greater Glasgow and Clyde, from the analysis of admissions due to data incompleteness in 2020

Deaths were analysed using weekly count – but were presented monthly due to small numbers

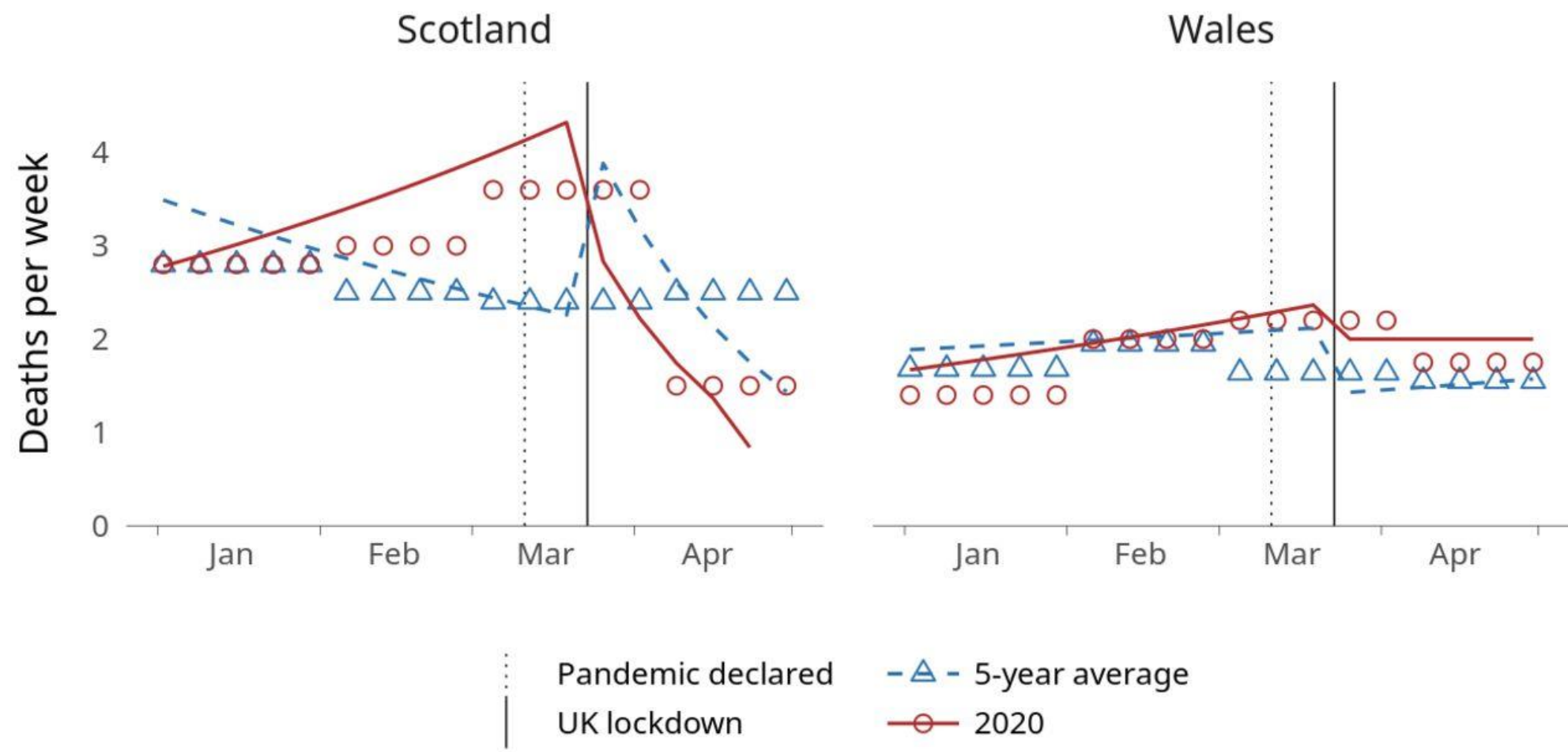
Results - asthma emergency admissions



Results – asthma emergency admissions

	Scotland		Wales	
	IRR (95% CI)	p-value	IRR (95% CI)	p-value
Pre-lockdown intercept in 2020 compared to 5-year average	0.84 (0.69 to 1.02)	0.076	0.67 (0.53 to 0.83)	< 0.001
Slope in weeks 1-12				
5-year average	0.98 (0.97 to 1.00)	0.059	0.98 (0.96 to 1.00)	0.042
2020	0.97 (0.96 to 1.00)	0.032	0.95 (0.93 to 0.97)	< 0.000
2020 relative to 5-year average	1.00 (0.97 to 1.02)	0.768	0.97 (0.94 to 1.00)	0.033
Change in level at week 13				
5-year average	0.97 (0.79 to 1.20)	0.800	1.01 (0.81 to 1.27)	0.905
2020	0.57 (0.44 to 0.75)	< 0.001	0.71 (0.51 to 0.98)	0.042
2020 relative to 5-year average	0.59 (0.42 to 0.83)	0.003	0.70 (0.47 to 1.04)	0.082
Change in slope after week 13				
5-year average	0.99 (0.93 to 1.05)	0.724	0.99 (0.93 to 1.05)	0.636
2020	1.03 (0.95 to 1.12)	0.432	0.82 (0.73 to 0.92)	0.001
2020 relative to 5-year average	1.04 (0.95 to 1.15)	0.400	0.84 (0.73 to 0.95)	0.008

Results - asthma deaths

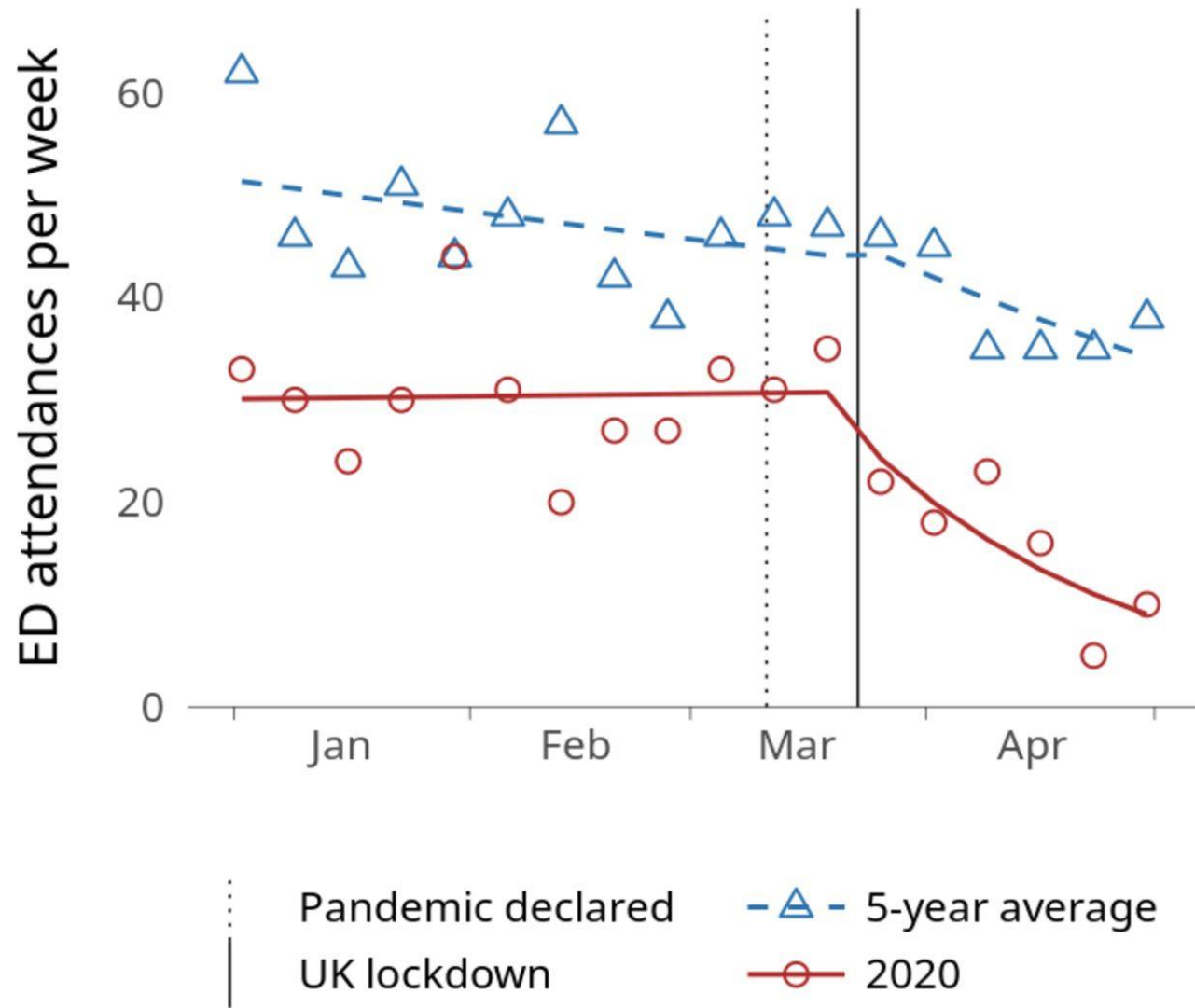


Results – asthma deaths

	Scotland		Wales	
	IRR (95% CI)	p-value	IRR (95% CI)	p-value
Pre-lockdown intercept in 2020 compared to 5-year average	2.07 (0.78 to 5.50)	0.143	1.14 (0.35 to 3.74)	0.826
Slope in weeks 1-12				
5-year average	0.96 (0.87 to 1.06)	0.428	1.01 (0.90 to 1.14)	0.859
2020	1.04 (0.95 to 1.14)	0.372	1.03 (0.92 to 1.16)	0.595
2020 relative to 5-year average	1.08 (0.95 to 1.24)	0.235	1.02 (0.87 to 1.20)	0.802
Change in level at week 13				
5-year average	1.79 (0.60 to 5.32)	0.295	0.67 (0.14 to 2.66)	0.584
2020	0.63 (0.21 to 1.92)	0.417	0.82 (0.21 to 2.90)	0.763
2020 relative to 5-year average	0.35 (0.07 to 1.68)	0.189	1.23 (0.18 to 9.01)	0.836
Change in slope after week 13				
5-year average	0.85 (0.62 to 1.78)	0.333	1.01 (0.67 to 1.52)	0.967
2020	0.75 (0.49 to 1.17)	0.207	0.97 (0.68 to 1.38)	0.860
2020 relative to 5-year average	0.88 (0.51 to 1.52)	0.656	0.96 (0.56 to 1.64)	0.883

IRR: incidence rate ratio; CI: confidence interval

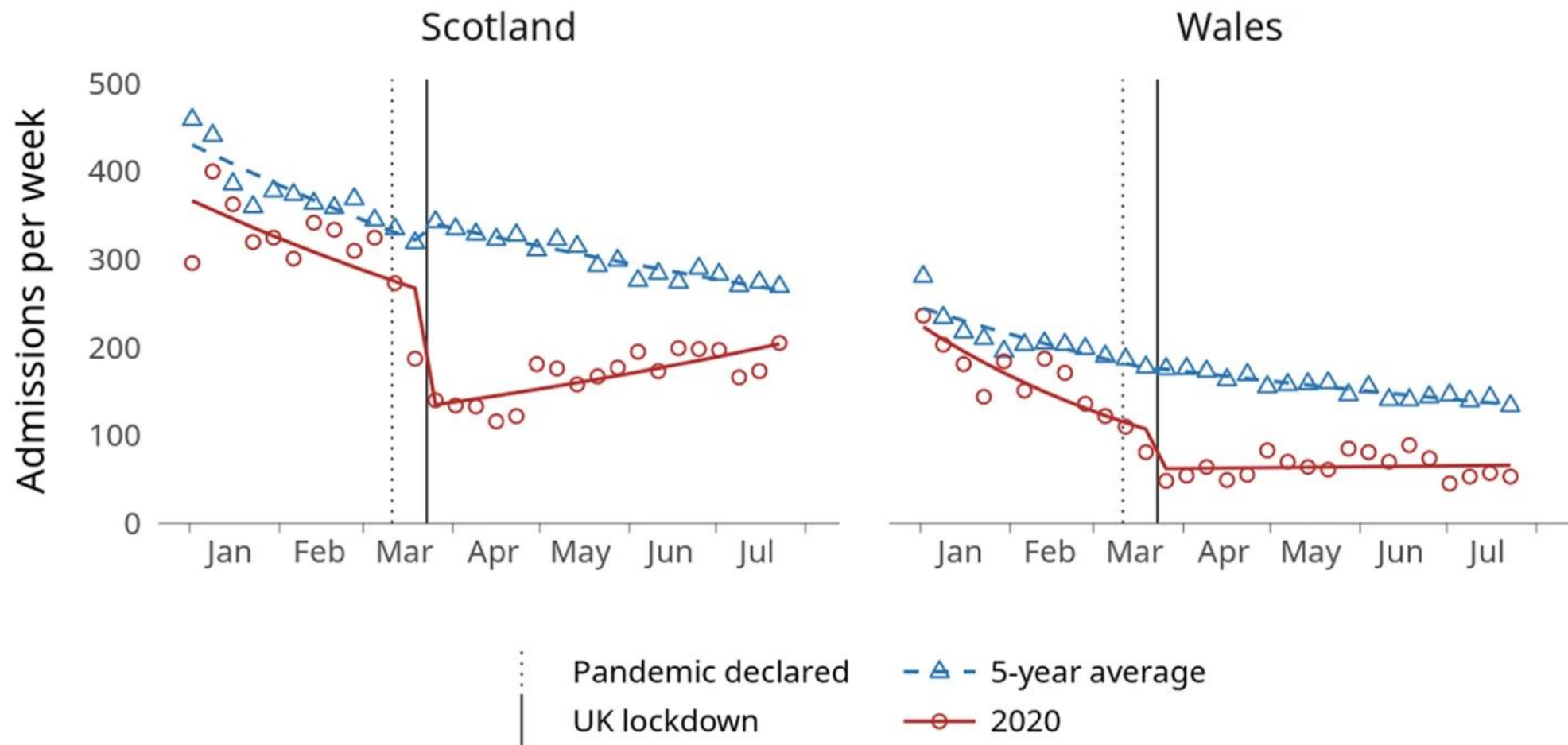
Results - asthma ED attendances (Wales)



Results – asthma ED attendances (Wales)

	IRR (95% CI)	p-value
Pre-lockdown intercept in 2020 compared to 5-year average	0.71 (0.53 to 0.94)	0.016
Slope in weeks 1-12		
5-year average	0.99 (0.96 to 1.01)	0.255
2020	1.00 (0.97 to 1.03)	0.897
2020 relative to 5-year average	1.02 (0.98 to 1.06)	0.417
Change in level at week 13		
5-year average	1.01 (0.76 to 1.34)	0.919
2020	0.79 (0.53 to 1.15)	0.221
2020 relative to 5-year average	0.78 (0.48 to 1.24)	0.296
Change in slope after week 13		
5-year average	0.96 (0.89 to 1.04)	0.351
2020	0.82 (0.72 to 0.93)	0.002
2020 relative to 5-year average	0.85 (0.73 to 0.99)	0.033

Results - COPD emergency admissions



Results – COPD emergency admissions

	Scotland		Wales		Pooled estimates	
	IRR (95% CI)	p-value	IRR (95% CI)	p-value	IRR (95% CI)	p-value
Pre-lockdown intercept in 2020 compared to 5-year average	0.83 (0.75, 0.91)	< 0.001	0.59 (0.51, 0.67)	< 0.001	0.74 (0.68, 0.80)	< 0.001
Slope in weeks 1-12						
5-year average	0.97 (0.97, 0.98)	< 0.001	0.97 (0.96, 0.98)	< 0.001	0.97 (0.97, 0.98)	< 0.001
2020	0.97 (0.96, 0.98)	< 0.001	0.94 (0.92, 0.95)	< 0.001	0.96 (0.95, 0.97)	< 0.001
2020 relative to 5-year average	1.00 (0.98, 1.01)	0.686	0.96 (0.95, 0.98)	< 0.001	0.99 (0.98, 1.00)	0.006
Change in level at week 13						
5-year average	1.08 (1.00, 1.18)	0.056	1.02 (0.92, 1.15)	0.666	1.06 (0.99, 1.13)	0.072
2020	0.52 (0.47, 0.58)	< 0.001	0.62 (0.53, 0.72)	< 0.001	0.55 (0.50, 0.60)	< 0.001
2020 relative to 5-year average	0.48 (0.42, 0.55)	< 0.001	0.60 (0.50, 0.73)	< 0.001	0.52 (0.46, 0.58)	< 0.001
Change in slope after week 13						
5-year average	1.01 (1.00, 1.02)	0.023	1.01 (1.00, 1.03)	0.034	1.01 (1.00, 1.02)	0.002
2020	1.05 (1.04, 1.07)	< 0.001	1.07 (1.05, 1.09)	< 0.001	1.06 (1.05, 1.07)	< 0.001
2020 relative to 5-year average	1.04 (1.03, 1.06)	< 0.001	1.06 (1.03, 1.08)	< 0.001	1.05 (1.03, 1.06)	< 0.001

IRR: incidence rate ratio; CI: confidence interval.

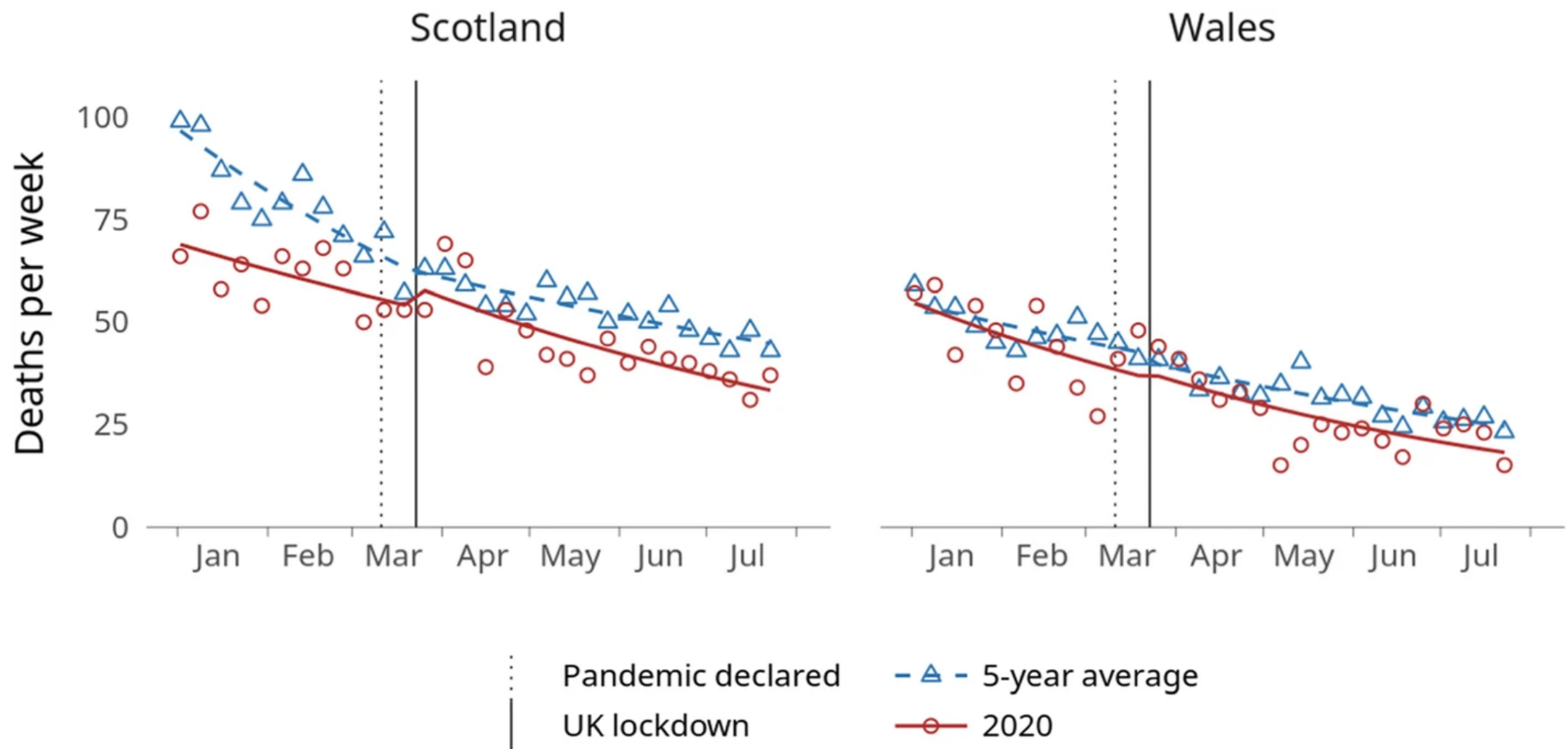
Results – COPD admissions with death (Wales)

Proportion of COPD admissions during which patients died due to COPD in weeks 13-30:

No evidence of difference between 2020 and 2015-2019

OR = 1.05 [0.77, 1.43] $p = 0.756$

Results - COPD deaths

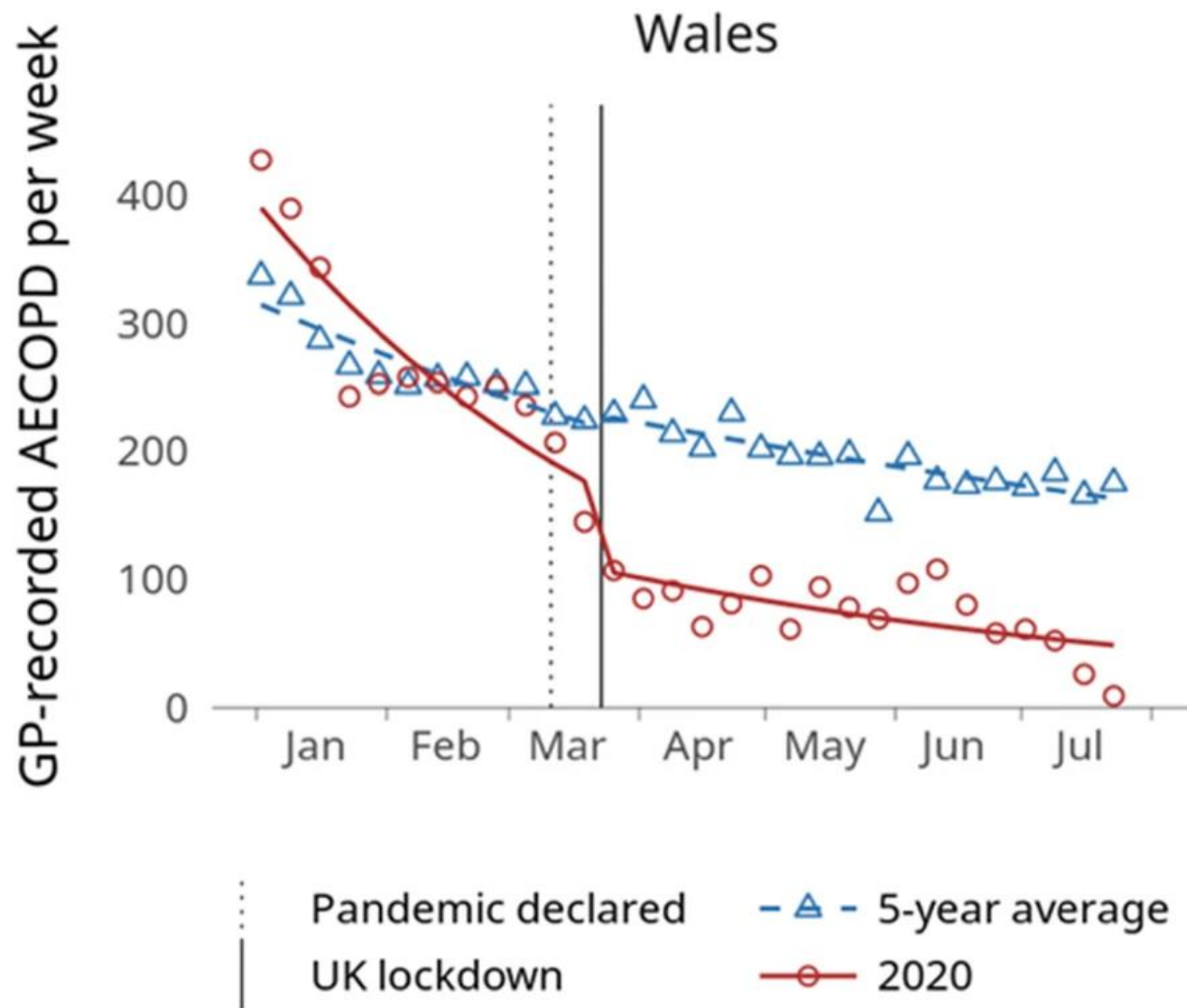


Results – COPD deaths

	Scotland		Wales		Pooled estimates	
	IRR (95% CI)	p-value	IRR (95% CI)	p-value	IRR (95% CI)	p-value
Pre-lockdown intercept in 2020 compared to 5-year average	0.87 (0.70, 1.08)	0.206	0.85 (0.66, 1.11)	0.234	0.86 (0.73, 1.02)	0.083
Slope in weeks 1-12						
5-year average	0.96 (0.94, 0.98)	< 0.001	0.98 (0.96, 1.00)	0.063	0.97 (0.95, 0.98)	< 0.001
2020	0.98 (0.96, 1.00)	0.042	0.97 (0.94, 0.99)	0.004	0.97 (0.96, 0.99)	0.001
2020 relative to 5-year average	1.02 (0.99, 1.05)	0.24	0.99 (0.95, 1.02)	0.446	1.00 (0.98, 1.03)	0.673
Change in level at week 13						
5-year average	1.02 (0.84, 1.22)	0.869	0.95 (0.75, 1.20)	0.657	0.99 (0.86, 1.14)	0.883
2020	1.09 (0.89, 1.33)	0.417	1.03 (0.81, 1.32)	0.803	1.06 (0.91, 1.24)	0.432
2020 relative to 5-year average	1.07 (0.81, 1.41)	0.627	1.09 (0.78, 1.53)	0.627	1.08 (0.87, 1.33)	0.494
Change in slope after week 13						
5-year average	1.02 (1.00, 1.04)	0.084	0.99 (0.97, 1.02)	0.687	1.01 (0.99, 1.03)	0.266
2020	0.99 (0.97, 1.01)	0.411	0.99 (0.96, 1.02)	0.699	0.99 (0.97, 1.01)	0.379
2020 relative to 5-year average	0.97 (0.94, 1.00)	0.078	1.00 (0.96, 1.04)	0.997	0.98 (0.96, 1.01)	0.169

IRR: incidence rate ratio; CI: confidence interval.

Results - AECOPD GP consultations (Wales)

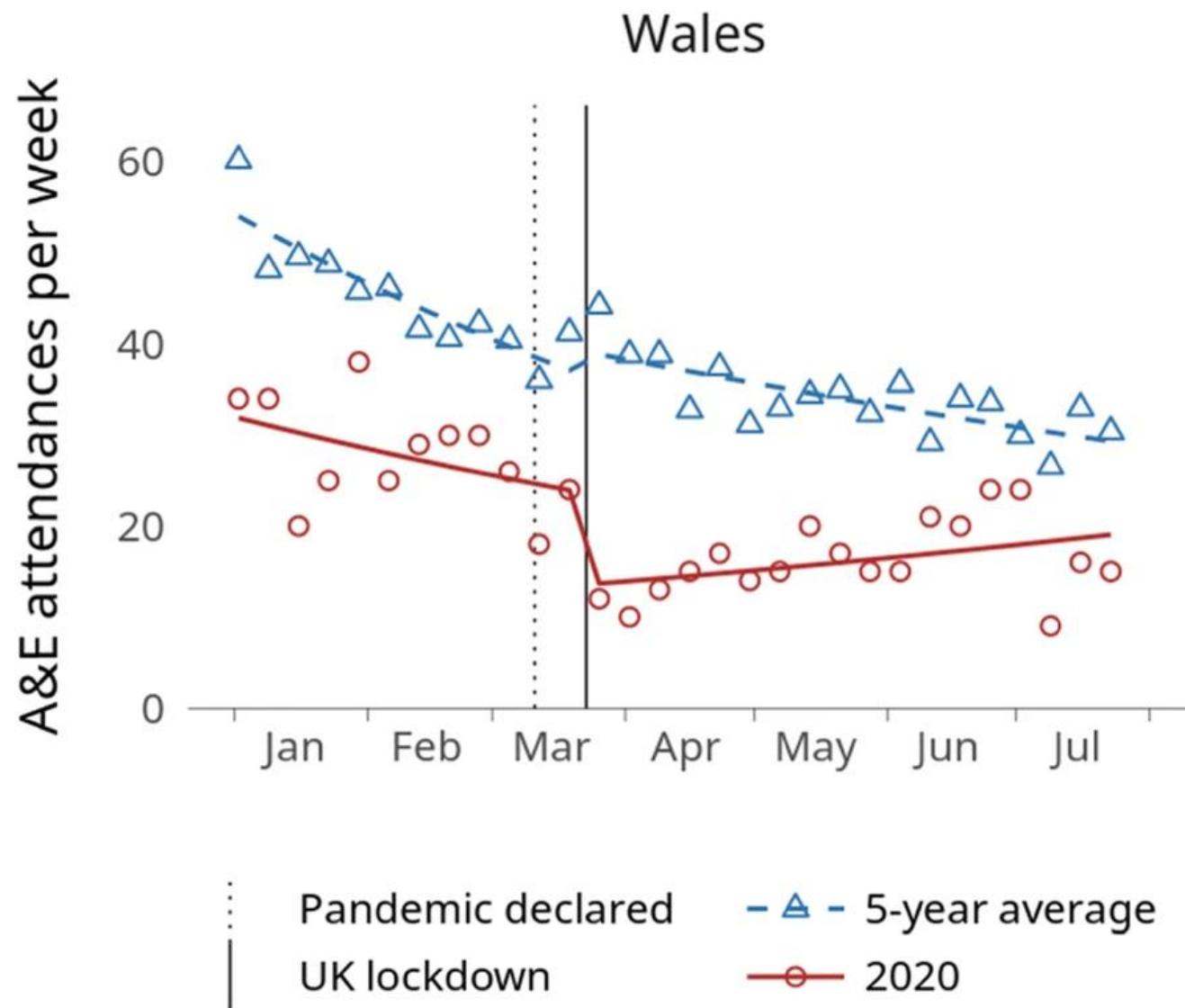


Results – AECOPD GP consultations (Wales)

	IRR (95% CI)	p-value
Pre-lockdown intercept in 2020 compared to 5-year average	0.76 (0.68, 0.86)	< 0.001
Slope in weeks 1-12		
5-year average	0.97 (0.96, 0.98)	< 0.001
2020	0.93 (0.92, 0.94)	< 0.001
2020 relative to 5-year average	0.96 (0.95, 0.97)	< 0.001
Change in level at week 13		
5-year average	1.05 (0.95, 1.16)	0.322
2020	0.64 (0.56, 0.72)	< 0.001
2020 relative to 5-year average	0.61 (0.52, 0.71)	< 0.001
Change in slope after week 13		
5-year average	1.01 (1.00, 1.02)	0.043
2020	1.03 (1.01, 1.04)	< 0.001
2020 relative to 5-year average	1.01 (1.00, 1.03)	0.147

IRR: incidence rate ratio; CI: confidence interval.

Results - COPD ED attendances (Wales)

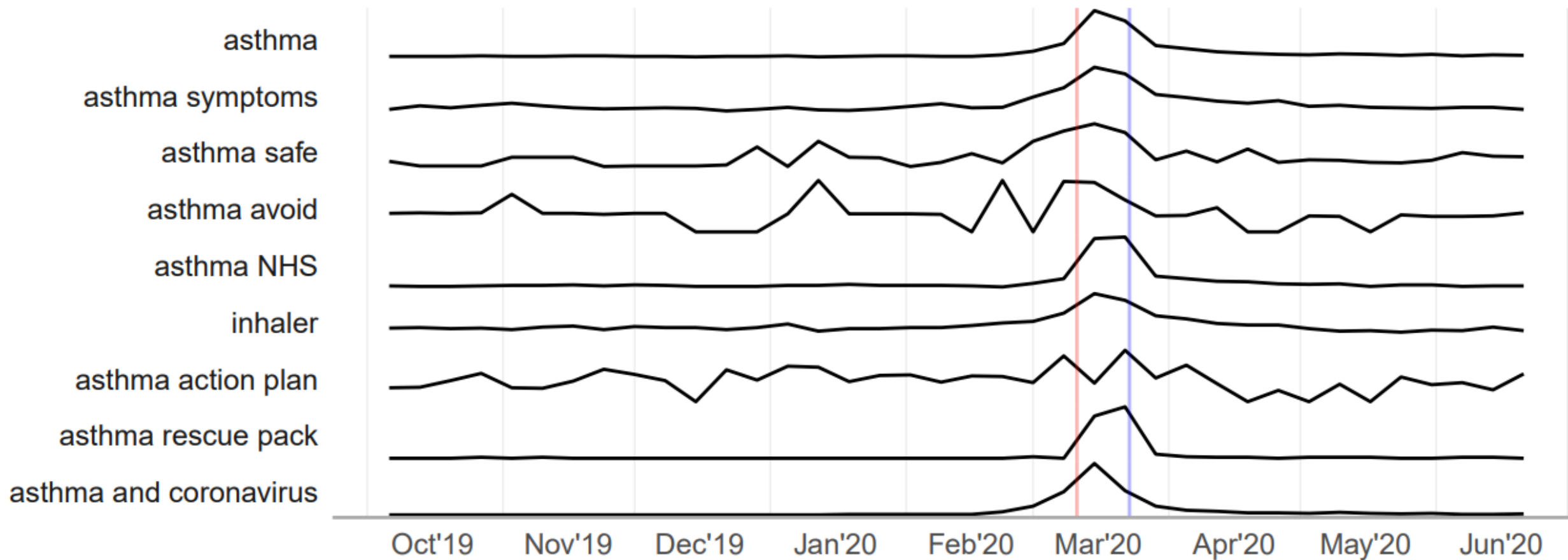


Results – COPD ED attendances (Wales)

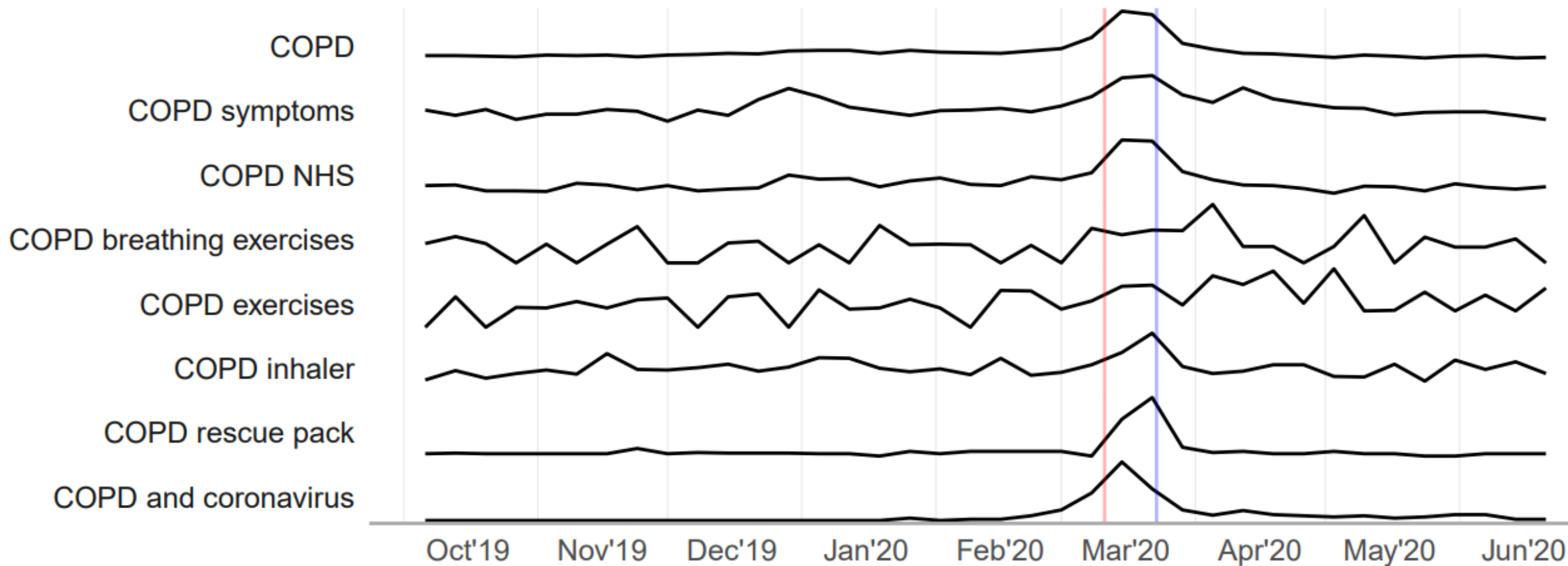
	IRR (95% CI)	p-value
Pre-lockdown intercept in 2020 compared to 5-year average	0.65 (0.48, 0.88)	0.006
Slope in weeks 1-12		
5-year average	0.97 (0.94, 0.99)	0.006
2020	0.97 (0.94, 1.01)	0.101
2020 relative to 5-year average	1.01 (0.97, 1.05)	0.686
Change in level at week 13		
5-year average	1.08 (0.85, 1.38)	0.508
2020	0.59 (0.42, 0.82)	0.002
2020 relative to 5-year average	0.54 (0.36, 0.81)	0.003
Change in slope after week 13		
5-year average	1.02 (0.99, 1.05)	0.227
2020	1.05 (1.01, 1.09)	0.019
2020 relative to 5-year average	1.03 (0.98, 1.08)	0.256

IRR: incidence rate ratio; CI: confidence interval.

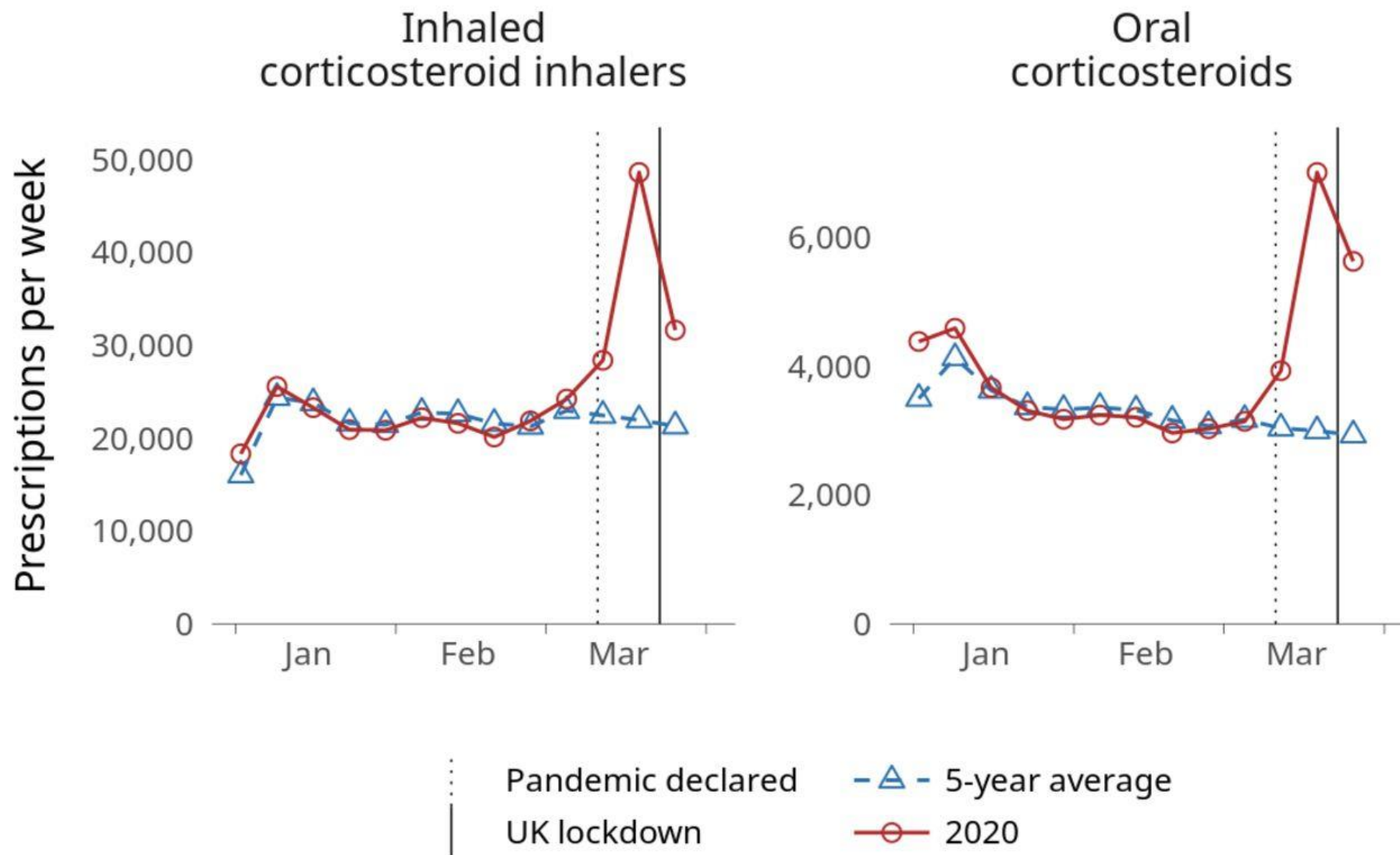
Results - Google Trends (UK): asthma



Results - Google Trends (UK): COPD



Results - asthma GP prescriptions (Wales)



Discussion

Asthma

36% pooled reduction in exacerbations resulting in admission

41% in Scotland, and 30% in Wales *

COPD

48% pooled reduction in exacerbations resulting in admission

52% in Scotland, and 40% in Wales *

* the largest ever recorded

No corresponding increase in asthma or COPD deaths

Suggests that the fall in admissions represents a **real reduction** in severe exacerbations — at least partly

Discussion

A potential explanation:

Reductions in exposure to triggers

(due to lockdown restrictions, social distancing, hygiene advice, shielding)

Less transmission of non-SARS-CoV-2 respiratory pathogens

Improved outdoor air quality

Changes in smoking behaviour

Avoidance of healthcare settings

Improved disease self-management and control

Discussion

Similar findings elsewhere (England, South Korea, Slovenia, etc)

Country-level inference (no person-level analysis)

Findings may not represent milder disease

Discussion

It is crucial to assess the **fuller impact of the pandemic on the morbidity and mortality** of chronic diseases such as asthma/COPD

Our findings will inform public health **strategies to reduce admissions** in vulnerable groups over the long term

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Editorial

Improved asthma control during the COVID-19 pandemic: are there lessons to be learnt?

Imogen P Skene,¹ Paul E Pfeffer ^{1,2}

Notes

These studies makes use of anonymised data held in the Secure Anonymised Information Linkage (SAIL) Databank. We would like to acknowledge all the data providers who make anonymised data available for research. SAIL is not responsible for the interpretation of these data.

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The anonymised person-level data supporting the conclusions of this article are held by the SAIL Databank (<https://saildatabank.com/>) and are restricted and not publicly available but can be accessed upon reasonable requests and with permission from SAIL. All proposals to use SAIL are carefully reviewed by an independent Information Governance Review Panel (IGRP) to ensure proper and appropriate use of data (<https://www.saildatabank.com/application-process>). When approved, access is then provided through the SAIL Gateway, a privacy-protecting safe haven and a secure remote access system.