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Comparative Incidence of Diabetes Following Hospital Admission for COVID-19 and Pneumonia: A Cohort Study

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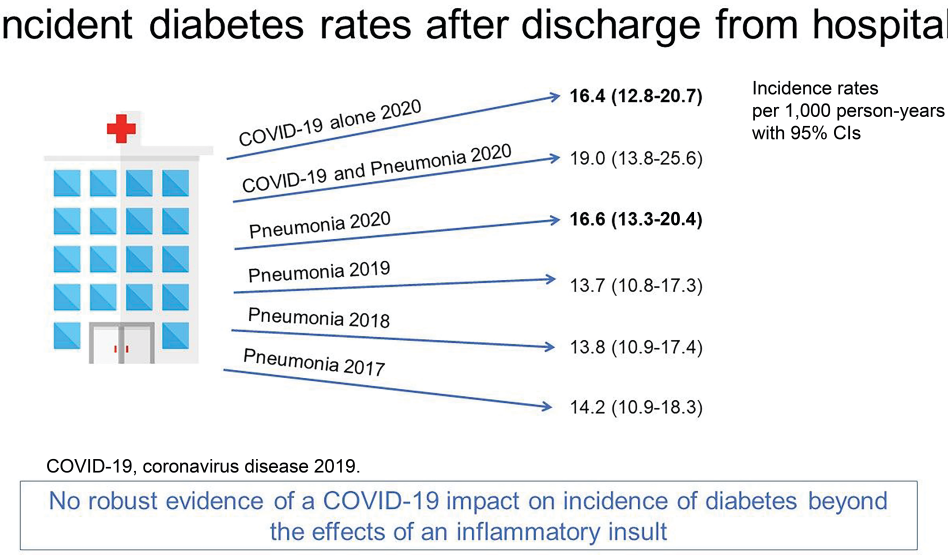

No robust evidence of a COVID-19 impact on incidence of diabetes beyond the effects of an inflammatory insult

ARTICLE HIGHLIGHTS

- A higher incidence of diabetes following acute illness with coronavirus disease 2019 (COVID-19) has been noted, but it is unclear whether this finding reflects shared risk factors, the physiological stress of an acute infection, or a specific impact of infection with the severe acute respiratory syndrome coronavirus 2 virus.
- People admitted to the hospital with COVID-19 had a higher postdischarge incidence of diabetes than the general population in 2020 and 2021.
- When compared with people who had been admitted to the hospital with a different acute infection (pneumonia) both in 2020 and in previous years, no clear evidence of a higher incidence of diabetes in those hospitalized with COVID-19 emerged.

Comparative Incidence of Diabetes Following Hospital Admission for COVID-19 and Pneumonia: A Cohort Study

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ORIGINAL ARTICLE

OBJECTIVE

The incidence of diabetes may be elevated following coronavirus disease 2019 (COVID-19), but it is unclear whether this is specific to severe acute respiratory syndrome coronavirus 2 infection, associated with shared risk factors for severe COVID-19 and diabetes, and/or a generic risk following illness.

RESEARCH DESIGN AND METHODS

People admitted to the hospital for COVID-19 and/or pneumonia between 1 April 2020 and 31 August 2020 in England were linked with the National Diabetes Audit to identify incident diabetes after discharge up to 31 March 2021. Comparator cohorts admitted with pneumonia over the same dates in 2017, 2018, and 2019 were followed until 31 March 2018, 31 March 2019, and 31 March 2020, respectively. Poisson regression models were used to calculate adjusted diabetes incidence rates.

RESULTS

Using the cohort of people discharged from the hospital following a diagnosis of COVID-19 without pneumonia in 2020 as the standard population (incidence rate 16.4 [95% CI 12.8–20.7] per 1,000 person-years), adjusting for age, sex, ethnicity, and deprivation, gave incidence rates of 19.0 (95% CI 13.8–25.6) and 16.6 (95% CI 13.3–20.4) per 1,000 person-years for those admitted for COVID-19 with pneumonia and pneumonia without COVID-19, respectively, in 2020. These rates are not significantly different from those found after hospital admission for pneumonia in 2019, 2018, and 2017, at 13.7 (95% CI 10.8–17.3), 13.8 (95% CI 10.9–17.4), and 14.2 (95% CI 10.9–18.3) per 1,000 person-years, respectively.

CONCLUSIONS

Our data do not support a clear impact of COVID-19 on the incidence of diabetes compared with risks in several comparator groups, including contemporaneously assessed risks in people hospitalized with pneumonia.

Following the spread of coronavirus disease 2019 (COVID-19) throughout the world in early 2020, there has been concern that a period of illness with COVID-19 may induce an increased incidence of new-onset diabetes. Previous studies of incidence have generally compared people who have been infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), or who have become ill with COVID-19,

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See accompanying articles, pp. 913, 921, and 953.

with contemporaries who did not become infected or severely ill (1). However, there is evidence of a higher incidence of diabetes following severe illness and admission to an intensive care unit irrespective of the reason for admission (2). Therefore, the incidence of diabetes in those who have recently experienced an acute infection, compared with those without evidence of infection, may not accurately identify specific COVID-19–related risks of incident diabetes.

The aim of this study was to assess the incidence of diabetes following acute illness with COVID-19 compared with people who had experienced a similar infectious illness by linking national administrative records on hospitalizations to the National Diabetes Audit.

RESEARCH DESIGN AND METHODS

Data Sources

Hospital Episode Statistics provides a record of all National Health Service (NHS) hospital admissions in England (3). Each episode of care is reported, and relevant diagnoses are coded with ICD-10. Each individual can be tracked with a unique NHS number that facilitates linkage to the National Diabetes Audit (NDA). The NDA has collated data on people with diagnosed diabetes registered with a primary or specialist health care provider in England and Wales since 2003 (4). Individuals are included in the NDA if they have a valid code for diabetes (excluding gestational diabetes) in their electronic health record. Demographic and clinical data are extracted from general practice electronic clinical systems using the General Practice Extraction Service (a national centralized data collection service for England) and are supplemented with data submitted by specialist diabetes services. The NDA included data from 98.2%, 97.9%, 99.2%, and 99.2% of general practices in England from 1 January 2017 to 31 March 2018, 1 January 2018 to 31 March 2019, 1 January 2019 to 31 March 2020, and 1 January 2020 to 31 March 2021, respectively (5,6). We recently outlined the legal bases for the data collections and linkages (4).

Cohorts

The aim of this analysis was to assess the incidence of diabetes following acute illness with COVID-19 and comparator groups. The latter comprised people who had been hospitalized for a similar non–COVID-19 illness. This allowed the analysis to investigate whether there may be a specific association between COVID-19 and incident diabetes or whether the incidence of diabetes following acute COVID-19 illness reflects shared risk factors and/or is linked to the stress of an acute illness. The unique and novel nature of the COVID-19 illness meant that identification of a similar illness was difficult. However, people admitted to the hospital with pneumonia were identified as the best available comparator group.

Six cohorts of people were identified. Each cohort included people aged ≥20 years admitted to NHS hospitals in England and discharged alive. The first three cohorts, all discharged between 1 April and 31 August 2020, consisted of *1*) people with a diagnosis of COVID-19 (ICD-10 codes U07.1, U07.2 and U10) but not pneumonia (ICD-10 codes J12–18) (COVID-19 without PNA 2020); *2*) people with a diagnosis of pneumonia without COVID-19 (PNA without COVID-19 2020); or *3*) people with a diagnosis of COVID-19 and pneumonia (COVID-19+PNA 2020). People who had a diagnosis of diabetes prior to discharge (n = 52,437), or within 14 days of discharge, (n = 550) were excluded from the analysis.

Three further cohorts of people admitted to the hospital for pneumonia with a diagnosis of pneumonia (ICD-10 codes J12–18) and discharged alive were identified: *4*) between 1 April 2019 and 31 August 2019 (PNA-2019); *5*) between 1 April 2018 and 31 August 2018 (PNA-2018); and *6*) between 1 April 2017 and 31 August 2017 (PNA-2017). People who had a diagnosis of diabetes prior to discharge (n = 27,960 for those admitted in 2019, n = 25,700 for those admitted in 2018, and n = 22,390 for those admitted in 2017), or within 14 days of discharge (n = 125 for those admitted in 2019, n = 125 for those admitted in 2018, and n = 130 for those admitted in 2017), were excluded from the analysis.

Outcomes

The outcome was diagnosis of diabetes newly recorded in the NDA at least 2 weeks after hospital discharge and by 31 March 2021 in those hospitalized in 2020, by 31 March 2020 for those discharged following pneumonia in 2019, by 31 March 2019 for those discharged following pneumonia in 2018, and by 31 March 2018 for those discharged following pneumonia in 2017. The primary outcome was a diagnosis of diabetes of any type, but as the physiological pathways for the development of type 1 and type 2 diabetes vary, supplementary analyses were conducted for each. The first supplementary analysis presented data for those who had a diagnosis of type 2 diabetes recorded in the observation period. However, because there may be uncertainty about the type of diabetes at diagnosis, a second supplementary outcome was included of diabetes unlikely to be type 1, comprising only individuals who did not receive a prescription for insulin in the 26 weeks following diagnosis. A sensitivity analysis including all diagnoses recorded after the date of discharge from hospital was undertaken.

Statistical Analysis

Incidence rates per 1,000 person-years were calculated for all people by sex, by ethnicity, and by quintiles of deprivation. CIs were calculated using the Bryar method. Incidence rates, standardized to the age profile of the 59,605 people discharged alive following hospitalization for COVID-19 without PNA, were calculated. To simultaneously adjust for the influences of age, sex, deprivation, and ethnicity on the incidence of diabetes, Poisson regression models were created. Resulting rate ratios and the age-, sex-, deprivation-, and ethnicity-adjusted incidence of diabetes per 1,000 person-years for a cohort matching the characteristics of people discharged alive following a hospital admission for COVID-19, without a concurrent diagnosis of pneumonia, between 1 April and 31 August 2020 are reported.

RESULTS

The analysis followed 58,091 people discharged alive in 2020 following hospitalization with COVID-19 without PNA, 99,951 people discharged following hospitalization with PNA without COVID-19, and 29,006 discharged following hospitalization with COVID-19+PNA. The comparator cohorts were people discharged alive following hospitalization with pneumonia, comprising 117,148 people in 2019, 110,489 people in 2018, and 102,733 people in 2017.

People in the 2020 cohorts were younger than those discharged following an admission for pneumonia in previous years. They were also more likely to be of Asian or Black ethnicity, but the

distribution by socioeconomic deprivation was similar across all six groups (see Table 1).

The unadjusted incidence of diabetes following discharge from hospital was 16.7 (95% CI 15.5–17.8) per 1,000 person-years in the COVID-19 without PNA 2020 cohort and 20.6 (95% CI 18.8–22.4) per 1,000 person-years in the COVID-19+PNA 2020 cohort for the period ending on 31 March 2020 (Supplementary Table 1). The unadjusted incidence of diabetes in the PNA without COVID-19 2020 cohort was similar to that of those discharged following COVID-19 without PNA (15.3 [95% CI 14.4–16.2] per 1,000 person-years). These incidence rates were higher than in those found in the PNA-2019 (12.6; 95% CI 11.8–13.3), PNA-2018 (12.3; 95% CI 11.6–13.1), and PNA-2017 (12.9; 95% CI 12.1–13.8) cohorts.

Across all six cohorts (COVID-19 without PNA 2020, COVID-19+PNA 2020, PNA without COVID-19 2020, PNA-2019, PNA-2018, and PNA-2017) considered in this analysis, the incidence of diabetes following hospitalization was statistically significantly higher in those living in the more deprived areas and in people from Asian and Black race/ethnic groups compared with White race/ethnic groups (see Table 2 and Supplementary Table 1). Age-standardized incidence rates were similar across each of the six cohorts hospitalized for either COVID-19 and/or pneumonia when stratified by ethnicity and by deprivation (see Table 2). There were, however, no statistically significant differences by deprivation or ethnicity for any of the six groups in the rate ratios associated with incident diabetes following hospitalization (Supplementary Table 2).

Using the COVID-19 without PNA 2020 cohort of people as the standard population (incidence rate 16.4 [95% CI 12.8–20.7] per 1,000 person-years) and adjusting for age, sex, ethnicity, and deprivation gave the following incidence rates: 19.0 (95% CI 13.8–25.6) for those in the COVID-19+PNA 2020 cohort and 16.6 (95% CI 13.3–20.4) per 1,000 person-years for the PNA without COVID-19 2020 cohort. These adjusted incidence rates per 1,000 person-years are numerically higher but not significantly different from those found in the PNA-2019 (13.7, 95% CI 10.8–17.3), PNA-2018 (13.8, 95% CI 10.9–17.4), and PNA-2017 (14.2, 95% CI 10.9–18.3) cohorts (Fig. 1).

Limiting the outcome to diabetes that was recorded as type 2 diabetes in the period following diagnosis gave an age-, sex-, social deprivation-, and ethnicity-adjusted incidence of 11.6 (95% CI 8.9–14.9) per 1,000 person-years for those in the COVID-19 without PNA-2020 cohort. After standardizing to the COVID-19 without PNA-2020 cohort, the incidence of diabetes recorded as type 2 diabetes was 13.8 (95% 9.8–19.0) per 1,000 person-years for those in the COVID-19+PNA 2020 and 11.2 (95% CI 8.9–14.1) per 1,000 person-years for the PNA without COVID-19 2020 cohort. These rates are not statistically different from those seen in the PNA-2017, PNA-2018, and PNA-2019 cohorts. The incidence of diabetes where insulin was not prescribed

Table 1—Characteristics of cohort discharged alive following hospitalization for COVID-19 and pneumonia

	2020						2019		2018		2017	
	COVID-19 without PNA		PNA without COVID-19		COVID-19+PNA		PNA		PNA		PNA	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
People	58,091		99,951		29,006		117,148		110,489		102,733	
Men	29,687	51.1	52,921	52.9	16,251	56.0	57,826	49.4	55,098	49.9	51,227	49.9
Women	28,404	48.9	47,030	47.1	12,755	44.0	59,322	50.6	55,391	50.1	51,506	50.1
Age (years)												
20–29	2,559	4.4	1,999	2.0	648	2.2	2,938	2.5	2,625	2.4	2,651	2.6
30–39	4,346	7.5	4,184	4.2	1,692	5.8	4,747	4.1	4,197	3.8	4,043	3.9
40–49	6,042	10.4	7,319	7.3	3,218	11.1	6,531	5.6	6,290	5.7	5,689	5.5
50–59	8,850	15.2	12,490	12.5	5,015	17.3	11,258	9.6	10,561	9.6	9,556	9.3
60–69	8,515	14.7	15,040	15.0	4,767	16.4	17,020	14.5	16,551	15.0	15,291	14.9
70–79	10,611	18.3	22,214	22.2	5,439	18.8	27,883	23.8	26,412	23.9	24,149	23.5
≥80	17,168	29.6	36,705	36.7	8,227	28.4	46,771	39.9	43,853	39.7	41,354	40.3
Median (IQR)	68 (51–82)		74 (59–84)		68 (53–81)		75 (62–85)		75 (63–85)		76 (63–85)	
Ethnicity												
White	42,573	73.3	80,844	80.9	20,496	70.7	99,998	85.4	95,534	86.5	89,190	86.8
Mixed	475	0.8	504	0.5	215	0.7	464	0.4	349	0.3	385	0.4
Asian	2,679	4.6	2,383	2.4	1,428	4.9	2,342	2.0	2,169	2.0	1,989	1.9
Black	2,255	3.9	2,382	2.4	1,333	4.6	1,700	1.5	1,563	1.4	1,464	1.4
Other	3,292	5.7	3,384	3.4	1,993	6.9	2,481	2.1	2,149	1.9	1,953	1.9
Missing	6,817	11.7	10,454	10.5	3,541	12.2	10,163	8.7	8,725	7.9	7,752	7.5
Deprivation												
Most deprived	13,738	23.6	23,014	23.0	6,838	23.6	26,115	22.3	25,290	22.9	23,547	22.9
2nd most deprived	12,886	22.2	21,308	21.3	6,615	22.8	24,480	20.9	23,076	20.9	21,561	21.0
3rd most deprived	11,388	19.6	19,916	19.9	5,675	19.6	23,236	19.8	22,123	20.0	20,468	19.9
2nd least deprived	10,264	17.7	18,653	18.7	5,041	17.4	22,369	19.1	20,599	18.6	19,287	18.8
Least deprived	9,391	16.2	16,481	16.5	4,637	16.0	19,696	16.8	18,326	16.6	16,918	16.5
Missing	424	0.7	579	0.6	200	0.7	1,252	1.1	1,075	1.0	952	0.9
Incident diagnoses	815		1,150		510		1,105		1,025		890	

IQR, interquartile range.

Table 2—Age-standardized incidence of diabetes following hospitalization for COVID-19 and/or pneumonia per 1,000 person-years (95% CI)

	2020			2019	2018	2017
	COVID-19 without PNA	PNA without COVID-19	COVID-19+PNA	PNA	PNA	PNA
People	16.3 (15.2–17.5)	16.1 (15.2–17.1)	19.4 (17.8–21.2)	13.1 (12.3–14)	12.8 (11.9–13.6)	13 (12.1–14)
Men	16.5 (15–18.1)	16 (14.8–17.3)	17.8 (15.8–20.1)	13.6 (12.5–14.8)	14 (12.8–15.2)	13.8 (12.6–15.2)
Women	16.2 (14.6–18)	16.2 (14.8–17.8)	21.1 (18.4–24)	12.7 (11.5–13.9)	11.6 (10.5–12.8)	12.2 (11–13.5)
Deprivation						
Most deprived	20.1 (17.6–22.7)	20.7 (18.6–23)	24.5 (20.9–28.7)	16 (14.2–17.9)	12.8 (11.2–14.5)	14.3 (12.5–16.4)
2nd most deprived	17.2 (14.9–19.8)	16.3 (14.3–18.4)	20.5 (17.1–24.3)	12.2 (10.6–14)	13.2 (11.4–15.2)	13.4 (11.6–15.5)
3rd most deprived	15 (12.7–17.6)	13.2 (11.3–15.2)	15.9 (12.7–19.8)	12.9 (11.1–14.9)	12.6 (10.7–14.7)	16.6 (14.3–19.1)
2nd least deprived	13.4 (11.1–16.2)	14.5 (12.3–17)	16.4 (12.7–20.8)	12.8 (10.9–15)	14.4 (12.3–16.7)	9.2 (7.6–11.1)
Least deprived	14.7 (12.1–17.7)	13.7 (11.4–16.3)	18.1 (14.1–22.9)	10.3 (8.6–12.3)	10.9 (9–13.2)	10.9 (8.8–13.2)
Ethnicity						
White	13.7 (12.5–15)	14.1 (13.1–15.2)	16.5 (14.6–18.7)	12.5 (11.6–13.4)	12.1 (11.2–13.1)	11.9 (11–12.9)
Mixed	8.2 (3.1–17.8)	12.7 (5.6–25.3)	8.5 (0.6–27.7)	12.1 (1.4–35)	31.6 (10.8–67.2)	41.9 (10.8–78.6)
South Asian	32.1 (23.4–42.3)	39.3 (29.8–50.6)	40.5 (26.9–57.3)	25.1 (18.1–33.8)	25 (17.9–34)	38.1 (28.2–50.3)
Black	24.3 (17.4–32.6)	20.5 (14.8–27.6)	22.3 (14.3–32.6)	14.5 (8.1–23.3)	19.5 (11.4–30.7)	30.7 (19.6–45.1)
Other	26.8 (20–34.8)	26 (20.1–33.1)	29.5 (21.4–39.3)	19.2 (13.5–26.5)	18.7 (12.5–13.6)	15.1 (9.1–14)
Missing	19.7 (16.4–23.4)	18.2 (15.4–21.4)	23.5 (18.8–28.9)	14.3 (11.6–17.4)	12.3 (9.6–15.4)	11.6 (8.8–15)

in the 6 months following diagnosis was similar with age-, sex-, social deprivation-, and ethnicity-adjusted incidences of 14.6 (95% CI 11.5–19.2) per 1,000 person-years for the COVID-19 without PNA 2020 cohort, 17.8 (95% CI 12.8–24.4) per 1,000 person-years in the COVID-19+PNA 2020 cohort, and 15.3 (95% CI 12.2–19.1) per 1,000 person-years in the PNA without COVID-19 2020 cohort. The corresponding incidence rates adjusted for age, sex, deprivation, and ethnicity for those in the PNA-2019, PNA-2018, and PNA-2017 cohorts were 12.4 (95% CI 9.6–15.9), 12.8 (95% CI 9.9–16.4) and 12.6 (95% CI 9.5–16.7), respectively (Table 3). The sensitivity analysis, which included all incident diabetes with a diagnosis date after discharge from the hospital, resulted in similar results to the primary analysis presented above (data available on request).

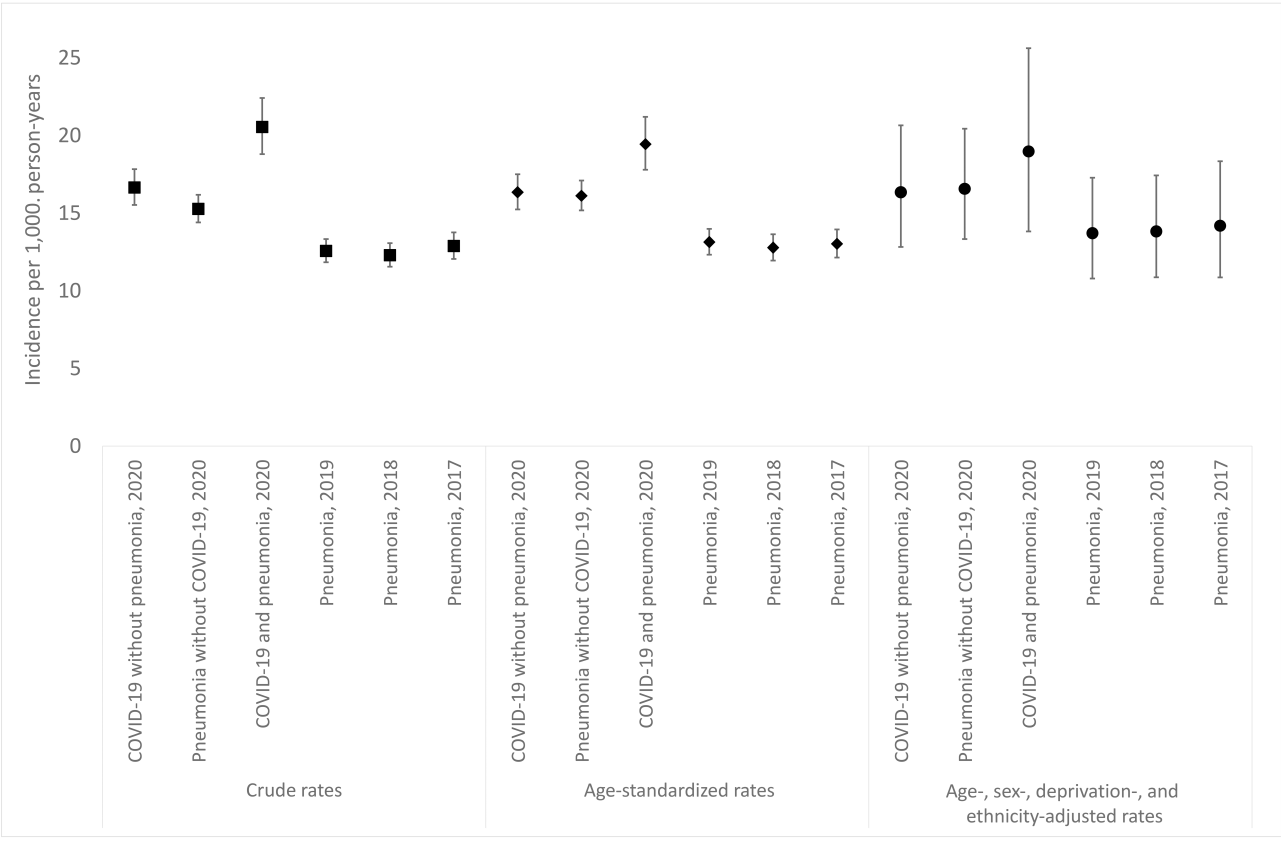

Figure 1—Crude and adjusted incidence of diabetes per 1,000 person-years following hospital admission for COVID-19 and pneumonia.

Table 3—Incidence per 1,000 person-years (95% CI) of diabetes where the initial diagnosis code was type 2 diabetes and where insulin was not prescribed in the first 6 months of diagnosis, adjusted for age, sex, social deprivation, and ethnicity

	Year	Incidence of diabetes where type 2 diabetes is recorded	Incidence of diabetes where insulin is not prescribed in the 6 months after diagnosis
COVID-19 without PNA	2020	11.6 (8.9–14.9)	14.6 (11.5–19.2)
PNA without COVID-19	2020	11.2 (8.9–14.1)	15.3 (12.2–19.1)
COVID-19 and PNA	2020	13.8 (9.8–19.0)	17.8 (12.8–24.4)
PNA	2019	9.5 (7.4–12.2)	12.4 (9.6–15.9)
PNA	2018	9.6 (7.4–12.4)	12.8 (9.9–16.4)
PNA	2017	9.7 (7.3–12.8)	12.6 (9.5–16.7)

The age-standardized incidence of diabetes per 1,000 person-years in the general population between 1 April 2020 and 31 March 2021 was lower than in previous years: 5.7 (95% CI 5.6–5.7) in 2020–2021 compared with 7.5 (95% CI 7.6–7.6) between 1 April 2019 and 31 March 2020 and 7.6 (95% CI 7.6–7.7) between 1 April 2018 and 31 March 2019.

CONCLUSIONS

Our analysis shows that the crude and age-adjusted incidence of diabetes following hospitalization with COVID-19 was similar to that found following hospitalization with pneumonia in 2020. Both of the 2020 crude incidence rates were higher than those found after hospitalization for pneumonia in 2019, 2018, and 2017. However, there were differences between the ethnicity and deprivation characteristics of people admitted to the hospital for COVID-19 in 2020 and those admitted for pneumonia in 2020, 2019, 2018, and 2017. When incidence rates were adjusted for ethnicity and social deprivation, the differences between the COVID-19 admissions and the pneumonia admissions were no longer statistically significant.

In summary, although the incidence of diabetes following hospitalization for COVID-19 in 2020 during the first wave in England was higher than found in the general population, it was similar to that following hospitalization for pneumonia without COVID-19 in April to August 2020 and only modestly higher than the incidence following hospitalization for pneumonia for the same months in 2019, 2018, and 2017. It is possible that this difference reflects a higher threshold for admission for acute illness in 2020 at a time of intense pressure on health services. This possibility is consistent with the lower total numbers admitted with pneumonia (without COVID-19) in 2020 (see Supplementary Table 2).

In the general population, the incidence of diabetes is higher in people living in more deprived areas and in those of South Asian and Black ethnicity (7), which may partially explain the higher incidence of diabetes following hospitalization in 2020. Data on BMI was not available for these cohorts, but given the association between overweight and risk of severe COVID-19, it is possible that the distribution of BMI varied between those hospitalized with COVID-19 and those with pneumonia and contributed to the small differences in incidence of diabetes in 2020 compared with previous years. We excluded diabetes diagnoses recorded during hospital admission or within 2 weeks of discharge to minimize the chances of reverse causality. In sensitivity analysis, we noted similar results when we examined patients coded for type 2 diabetes alone and for those who were not prescribed insulin in the first 6 months of diagnosis, accepting that diagnostic coding of diabetes type is often unreliable in the early months following a diabetes diagnosis, particularly in the context of a concomitant illness.

There are several potential reasons for the incidence of diabetes following hospitalization with COVID-19 and/or pneumonia being higher than in the general population. For example, we know that several risk factors for type 2 diabetes, including hypertension, sedentary lifestyle, and sarcopenic obesity, increase the risk of more severe COVID-19 or indeed pneumonia (8). In addition, the loss of muscle mass during acute illness could increase diabetes risks on the background of several risk factors, and in the case of type 2 diabetes, increased surveillance following discharge is relevant.

In establishing the potential role of COVID-19 as a risk factor for diabetes, the fact that a period of severe illness, irrespective of the cause, is associated with an elevated incidence of type 2 diabetes (2) needs to be considered. A U.S. study found that people who had tested positive for the SARS-CoV-2 virus between March 2020 and September 2021 had a higher incidence of diabetes (all types) than both a contemporary control cohort who did not test positive for the virus and a historical cohort prior to the pandemic, and the incidence of diabetes increased in proportion to the severity of COVID-19 illness (9). A German study showed a higher incidence of type 1, but not type 2, diabetes in adults who had COVID-19 compared with those who were not diagnosed with COVID-19 (10). In contrast to these observations, our study investigated specific cohorts of people who had all experienced an infection severe enough to warrant hospitalization.

One of the strengths of this study is that it uses population-wide data on hospital admissions for severe COVID-19 linked to the NDA, which collates data from almost all (>99%) general practices in England. However, at the time of analysis, it was only possible to identify incident cases of diabetes up to 31 March 2021, and it is possible that this time frame is not long enough to clearly capture differential risks of developing diabetes following severe illness with COVID-19. Longer-term follow-up of this cohort of people would provide further insight. This study follows people who were severely ill with COVID-19 during the first wave in England. Subsequent waves of infections with different variants of the virus and the widespread vaccination program have altered the severity and profile of COVID-19 illnesses. Assessment of later cohorts of people infected with SARS-CoV-2 viruses would be needed to identify the possible association between illness with COVID-19 and the incidence of diabetes in these circumstances.

There is sometimes uncertainty around the type of diabetes at diagnosis, and therefore, it was not possible to accurately distinguish between the incidence

of type 1 and type 2 diabetes. However, we used two proxies—those treated with insulin within 26 weeks of diagnosis and those who were initially identified as having type 2 diabetes— to try and distinguish between types of diabetes. We have noted that the overall recorded incidence of diabetes in the general population in 2020/2021 was lower than in previous years, probably due to the disruption to health care services and avoidance of nonurgent care during the pandemic. We cannot rule out that this distorted the findings presented here. However, we included people admitted to hospital in 2020 with pneumonia but without COVID-19 as a comparator group who would be similarly affected by these factors, and therefore, finding that the incidence of diabetes does not differ significantly supports the main findings of this analysis. There is evidence that COVID-19 illness is associated with hyperglycemia that persists after the acute stage (11) but may not always reach the diagnostic criteria for diabetes. This analysis focused on the incidence of diabetes and has not identified individuals with incident nondiabetic hyperglycemia who have a high risk of developing hyperglycemia in the diabetic range in the future. This means that it is possible that there are shifts in the glycemic profile in people who have been acutely unwell with COVID-19 that have not been fully captured by this analysis.

We conclude that while the incidence of diabetes in adults following hospitalization with COVID-19 (with or without pneumonia) is higher than found in the general population, it is not different from rates seen following pneumonia without COVID-19 either in 2020 or in preceding years. Accordingly, our data do not support a clear impact of COVID-19 on the incidence of diabetes when carefully compared with risks in several comparator groups, including contemporaneously assessed risks in those hospitalized with pneumonia, at least in the short-term. While our findings are derived from a large population-based analysis, additional similar studies with adequate power and comparable design in other national groups and longer-term follow-up of cohorts like ours would be additionally informative.

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