

The age profile of surgical patients in England during the COVID-19 pandemic

Statistical analysis plan

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Rationale

The age of the surgical population is increasing with approximately 5 million surgical procedures taking place annually in the NHS.¹ Age is the strongest risk factor associated with mortality and morbidity with SARS-CoV-2 infection.^{2,3} Many older patients were asked to shield during the COVID-19 pandemic and may not have come to hospital out of fear.⁴ There was also an element of fear and anxiety among surgical care teams treating vulnerable patients who were at risk of SARS-CoV-2 exposure in hospital.⁵ During the pandemic, there was a substantial reduction in surgical activity to accommodate for the influx of COVID-19 admissions but to also reduce potential exposure to the surgical patient. However, it is unclear if this decrease in surgical activity affected all age groups equally.

Primary objective

To investigate the effects of the COVID-19 pandemic on the age profile of the surgical population in England for both elective and emergency procedures between 1st January 2020 and 31st March 2021 and understand how this changed compared with the number of procedures performed historically for the period 1st January 2016 – 31st December 2019.

Hypothesis

- There will be a reduction in the number of elective procedures performed in the older population (≥ 70 years).
- The average age of patients undergoing elective surgeries will decrease as we reach the peak of each wave of the pandemic.

Data source

This study will be conducted in England. Data will be sourced from Hospital Episode Statistics for Admitted Patient Care (HES APC) via the NHS Digital Data Access Environment.

Cohort definition

All adults (aged ≥ 18 years) undergoing intermediate surgery in England between 1st January 2020 and 31st March 2021 will be included. 'Intermediate' surgery is defined as procedures routinely undertaken in an operating theatre and/or under general or regional anaesthesia.¹ This will be extracted using the three-character Office for Population Censuses Surveys Classification of Interventions and Procedures (OPCS) 4.7 codes.⁶ Each patient will enter the cohort on the date of surgical admission (i.e., number of episode order == 1) with an associated procedure we consider to be intermediate surgery based on our OPCS 4.7 code definition.⁶ Patients admitted for maternity care will be analysed separately in a subgroup analysis.

- Study period: 1st January 2020 – 31st March 2021
- Historical comparator: 1st January 2016 – 31st December 2019

Research Ethics Approval

This analysis of routinely collected, pseudonymised data was approved by the Health Research Authority (20/HRA/3121). Access to NHS England data was approved by the NHS Digital Independent Group Advising on the Release of Data (IGARD) (DARS-NIC-375669-J7M7F).

Eligibility

Inclusion criteria

- All residents of England that undergo an intermediate surgical procedure as defined by OPCS 4.7 codes during either the study period (1st January 2020 – 31st March 2021) or historical comparator (1st January 2016 – 31st December 2019).

Exclusion criteria

- All procedures performed outside of the study periods.
- Patients with recorded OPCS codes that do not relate to surgical procedures (e.g., CT scan).
- Patients without a recorded age.

Outcomes

The primary outcome will be the number of surgical procedures compared to a historical comparator in pre-specified age category stratified according to (1) elective or emergency surgery and (2) inpatient or day case.

Statistical analysis

The deficit of surgical procedures will be presented in Table 1, Figure 1, and Figure 2. The average age of patients undergoing surgical procedures will be described for each month between 1st January 2020 and 31st March 2021 compared against the historical comparator group in Table 2.

The number of surgical procedures that took place between 1st January 2020 and 31st March 2021 will be compared against the expected number of procedures from 1st January 2016 and 31st December 2019 based on a time series model.

The deficit of surgical procedures will be broken down into the following age category:

- 18-29
- 30-39
- 40-49
- 50-59
- 60-69
- 70-79
- ≥80

This will present whether the reduction in surgical activity disproportionately impacted certain age groups more than others and how it changed over the course of the pandemic.⁷ A chi squared test will be used to determine whether there is a statistically significant difference between the expected number of cases and observed number of cases in each age category. The null hypothesis is that of no difference between the expected number of cases and observed number of procedures in each age category. Statistical significance will be assumed where $p < 0.05$.

In Figure 1, the deficit of surgical procedures within each age category will be presented in two graphs with one showing the proportional change and another showing absolute change. A cumulative stacked bar chart of the surgical procedure deficit will provide visual representation of the age breakdown.

Continuous data will be reported as a mean with standard deviation or median with interquartile range. Categorical data will be reported as number with a proportion.

References

1. Abbott TEF, Fowler AJ, Dobbs TD, et al. Frequency of surgical treatment and related hospital procedures in the UK: a national ecological study using hospital episode statistics. *Br J Anaesth* 2017;119(2):249-57. doi: 10.1093/bja/aex137 [published Online First: 2017/09/01]
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3. Collaborative CO. Mortality and pulmonary complications in patients undergoing surgery with perioperative SARS-CoV-2 infection: an international cohort study. *Lancet* 2020;396(10243):27-38. doi: 10.1016/S0140-6736(20)31182-X [published Online First: 2020/06/02]
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6. Fowler AJ, Dobbs TD, Wan YI, et al. Resource requirements for reintroducing elective surgery during the COVID-19 pandemic: modelling study. *Br J Surg* 2021;108(1):97-103. doi: 10.1093/bjs/znaa012 [published Online First: 2021/03/01]
7. Abbott TEF, Fowler, A.J., Dobbs T.D., Gibson, J., Shahid, T., Dias, P., Akbari, A., Whitaker, I.S., Pearse R.M. . Mortality after surgery with SARS-CoV-2 infection in England: A population-wide epidemiological study. *British Journal of Anaesthesia* 2021 doi: <https://doi.org/10.1101/2021.02.17.21251928>

Tables and figures

Table 1. Patient characteristics. Data are presented as mean (SD), median (IQR) and n (%) Numbers are presented as n (%) unless otherwise stated.

| | All patients | Age category | | | | | | |
|---------------------------|--------------|--------------|-------|-------|-------|-------|-------|-----|
| | | 18-29 | 30-39 | 40-49 | 50-59 | 60-69 | 70-79 | ≥80 |
| N | | | | | | | | |
| Mean (SD) | | | | | | | | |
| Median (IQR) | | | | | | | | |
| Sex | | | | | | | | |
| Male | | | | | | | | |
| Female | | | | | | | | |
| Admission category | | | | | | | | |
| Elective | | | | | | | | |
| Emergency | | | | | | | | |
| Other | | | | | | | | |
| Maternity | | | | | | | | |

Table 2. Expected number is from 2016-2019 based on a time series model, observed is the total number of surgical admissions, stratified by the acuity of surgical procedure, expressed per 1000 members of the population of England.

| Age (years) | Expected number of procedures per 1000 population | | | Observed number per 1000 population (1 st January 2020 and 31 st March 2021) | | | Overall deficit of procedures | | |
|-------------|---|-----------|----------|--|-----------|----------|-------------------------------|-----------|----------|
| | Any | Emergency | Elective | Any | Emergency | Elective | Any | Emergency | Elective |
| 18-29 | | | | | | | | | |
| 30-39 | | | | | | | | | |
| 40-49 | | | | | | | | | |
| 50-59 | | | | | | | | | |
| 60-69 | | | | | | | | | |
| 70-79 | | | | | | | | | |
| ≥80 | | | | | | | | | |
| Overall | | | | | | | | | |

Table 3. Average age of the surgical patient from 1st January 2020 to 31st March 2021 compared against the historical average age of the surgical patient from 1st January 2016 to 31st December 2019.

| Month | Average age of surgical patient (1 st January 2016 – 31 st December 2019) | | | Average age of surgical patient (1 st January – 31 st December 2020) | | | Average age of surgical patient (1 st January – 31 st March 2021) | | |
|-----------|---|-----------|----------|--|-----------|----------|---|-----------|----------|
| | Any | Emergency | Elective | Any | Emergency | Elective | Any | Emergency | Elective |
| January | | | | | | | | | |
| February | | | | | | | | | |
| March | | | | | | | | | |
| April | | | | | | | | | |
| May | | | | | | | | | |
| June | | | | | | | | | |
| July | | | | | | | | | |
| August | | | | | | | | | |
| September | | | | | | | | | |
| October | | | | | | | | | |
| November | | | | | | | | | |
| December | | | | | | | | | |
| Overall | | | | | | | | | |

Figure 1. Deficit of the number of surgical procedures within each age category from 1st January 2020 to 31st March 2021 compared with 1st January 2016 to 31st December 2019.

Two versions of the graph will be presented with one showing proportional change and another showing absolute change.

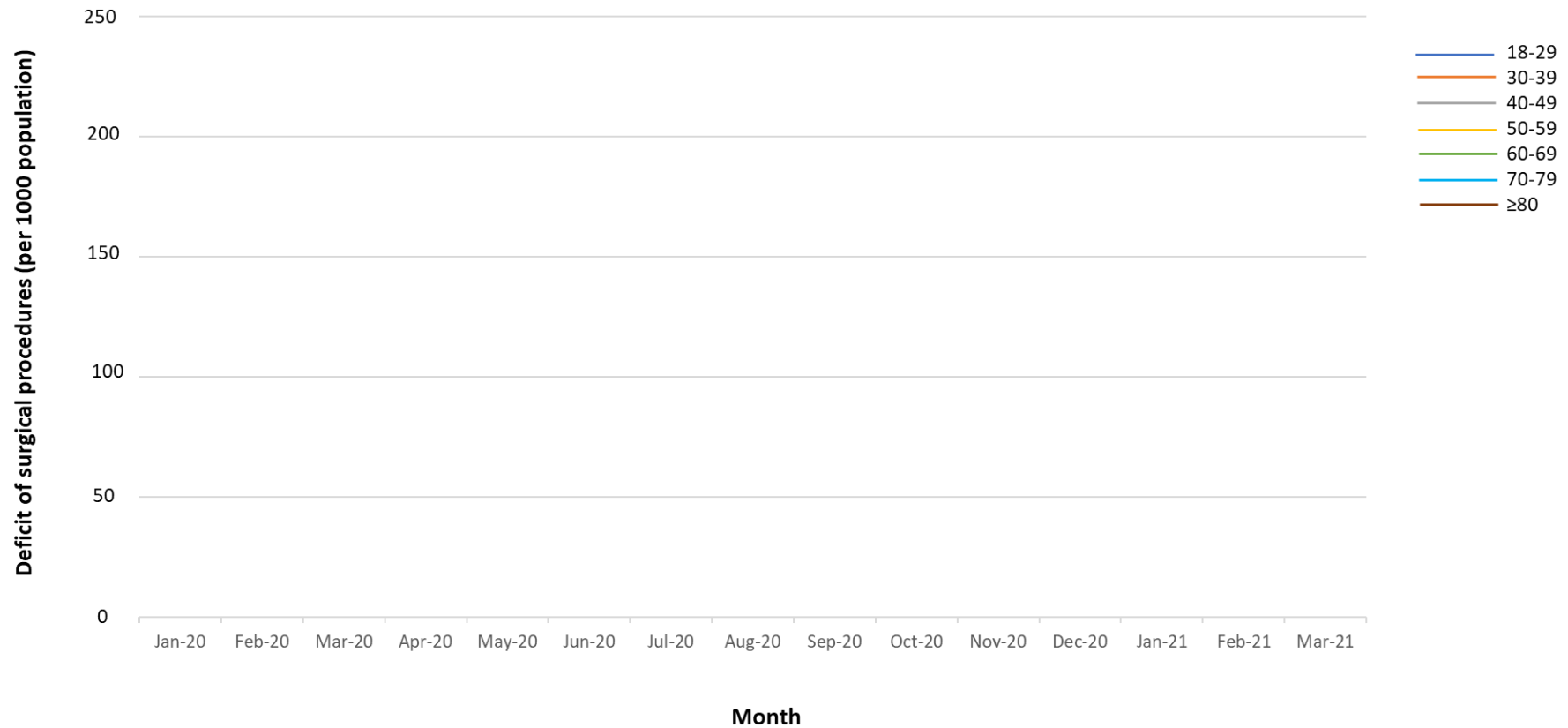


Figure 2. Cumulative stacked bar chart of the surgical procedure deficit within each age category from 1st January 2020 to 31st March 2021 compared with 1st January 2016 to 31st December 2019.

