

# Disparities in surgery rates during the COVID-19 pandemic: retrospective study

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## Introduction

The COVID-19 pandemic has had an unprecedented impact on the delivery of surgery<sup>1</sup>. Recent estimates in Canada point to a 'procedure gap' of nearly 937 000 during the first 31 months of the pandemic, with one province accounting for nearly a third of this gap<sup>2</sup>. Addressing this procedure gap is a public health priority.

Before the pandemic, a third of Canadian patients exceeded wait time targets for common scheduled surgeries<sup>3</sup>. Prior research suggests that structural barriers limited access to surgery for certain subgroups, despite a universal healthcare system. Individuals from marginalized communities were more likely to experience: delayed cancer and emergency surgery<sup>4,5</sup>; greater pain after cancer surgery<sup>6</sup>; and deferred surgical care<sup>7</sup>.

The disproportionate impact of the pandemic on marginalized populations in terms of COVID-19 hospitalization, death, and quality of life is well documented<sup>8</sup>. Whether at-risk communities also experienced diminished surgery rates is unknown; understanding this impact will inform policy for an equitable surgical recovery.

The objective of this study was to determine surgery rates during the COVID-19 pandemic for subgroups with a risk of impaired surgical access; the hypothesis was that the rates of scheduled surgery would be lower for communities with fewer material resources, older patients, those with co-morbid disease, female patients, and immigrant and refugee populations.

## Methods

A population-based repeated cross-sectional study of rates of scheduled surgery for all adults (greater than or equal to 18 years

or older) living in Ontario<sup>9</sup>, between January 2017 and March 2023, was conducted. The 'pre-COVID-19 interval' was between January 2017 and February 2020. The 'COVID-19 interval' began in March 2020 and included the remainder of the study interval.

In this study, health administrative databases were linked using unique encoded identifiers and analysed at ICES (*Appendix S1*)<sup>10</sup>. ICES is an independent, non-profit research institute that houses health administrative data in Ontario and whose legal status under Ontario's health information privacy law allows it to collect and analyse healthcare and demographic data, without consent, for health system evaluation and improvement<sup>10</sup>.

The most common non-obstetrical, non-cancer surgeries were included: inguinal hernia repair, cholecystectomy, hip or knee replacement, cataract removal, hysterectomy, or transurethral resection of the prostate (*Appendix S2*)<sup>11</sup>.

Several at-risk subgroups were identified (*Supplementary Materials*), including individuals residing in areas with lower material resources based on the validated Ontario Marginalization Index<sup>12</sup>, older patients, those with a high co-morbidity burden based on the Johns Hopkins ACG system<sup>13</sup>, female patients, and immigrant or refugee populations.

Monthly rates of procedures per 1000 persons were generated, using the corresponding population on 1 January of each year as the denominator. To measure relative changes in surgery rates during the COVID-19 interval, Poisson generalized estimating equations were used to model pre-COVID-19 trends and these were used to forecast expected COVID-19 procedure rates<sup>14,15</sup>. Yearly procedure rates between levels of each measure were compared by assigning Duncan groupings of rate ratios for each level and using *t* tests to compare each level with the reference<sup>14</sup>.

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## Results

Relative procedure rates were lower in 2020, 2021, and 2022 for all subgroups (Fig. 1) compared with the pre-COVID-19 interval. In 2023, relative procedure rates were the same as or higher than pre-COVID-19 for all subgroups except immigrants (adjusted rate ratio (aRR) 0.90 (95% c.i. 0.80 to 0.99),  $P=0.040$ ) and recent migrants (aRR 0.82 (95% c.i. 0.71 to 0.94),  $P<0.001$ ).

In 2020, lower procedure rates were observed for those with the least material resources (quintile 5) compared with the most material resources (quintile 1) and those with medium and high co-morbidity burden compared with low co-morbidity (Table 1 and Table S1). These differences did not persist in subsequent years. Procedure rates for immigrants (aRR 0.92 (95% c.i. 0.88 to 0.97),  $P<0.001$ ) and recent migrants (aRR 0.92 (95% c.i. 0.86 to 0.98),  $P=0.008$ ) were low in 2020 compared with Canadian-born or long-term residents; these low rates persisted in 2021 (immigrants aRR 0.88 (95% c.i. 0.82 to 0.94),  $P<0.001$ ; recent migrants aRR 0.85 (95% c.i. 0.77 to 0.93),  $P<0.001$ ), 2022 (recent migrants aRR 0.82 (95% c.i. 0.72 to 0.93),  $P=0.001$ ), and 2023 (immigrants aRR 0.86 (95% c.i. 0.77 to 0.97),  $P=0.011$ ; recent migrants aRR 0.80 (95% c.i. 0.69 to 0.92),  $P=0.002$ ).

Analyses limited to outpatient procedures reflected differences observed for all procedures (Fig. S1 and Table S2). By 2022, there was evidence of recovery of outpatient procedure rates for all groups except immigrants (aRR 0.85 (95% c.i. 0.78 to 0.92),  $P<0.001$ ) and recent migrants (aRR 0.72 (95% c.i. 0.63 to 0.83),

$P<0.001$ ) compared with pre-COVID-19. In 2023, rates of surgery were at or higher than pre-COVID-19 rates for all groups except recent migrants (aRR 0.84 (95% c.i. 0.72 to 0.98),  $P=0.03$ ).

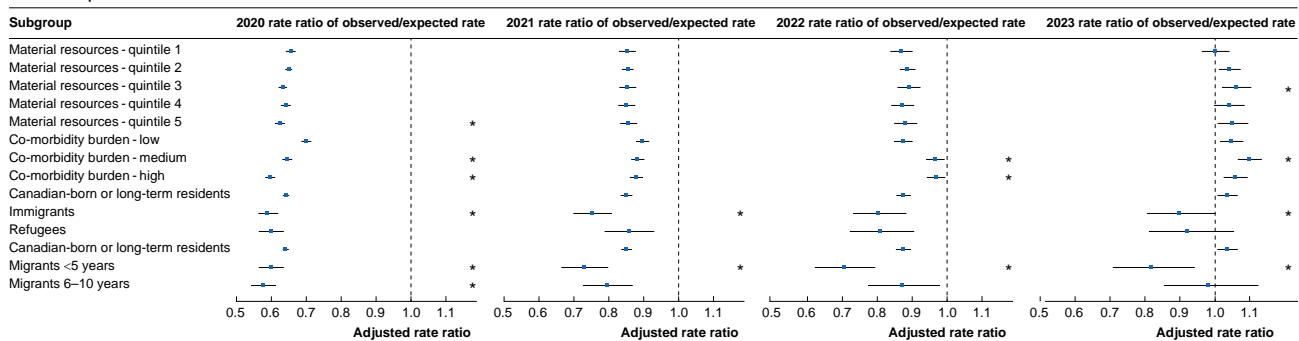
Though lower rates of outpatient surgery were observed in 2020 for those with fewer material resources (quintile 5 versus quintile 1) and those with medium and high co-morbidity compared with low co-morbidity, these differences did not persist later. Outpatient procedure rates were lower for immigrants and recent migrants in 2020 compared with Canadian-born or long-term residents; these effects persisted in 2021, 2022, and 2023.

Results of analyses assessing age and sex differences, and procedures rates and differences for inpatient and outpatient surgery and for cataract and non-cataract surgery are presented in the Supplementary Material.

## Discussion

Immigrants and recent migrants consistently experienced lower surgery rates compared with long-term residents throughout the pandemic, suggesting worsening procedure gaps. Conversely, elderly patients and those with co-morbid disease initially experienced decreased rates of surgery, but demonstrated recovery to pre-pandemic levels by 2023. Though a backlog of procedures still exists, it is not worsening likely due to outpatient procedure recovery.

All Included procedures



**Fig. 1** Adjusted rate ratios of observed procedure rates over expected procedure rates, by each access measure, for each year of the COVID-19 interval compared with pre-COVID-19 rates for all procedures

An asterisk denotes a difference in the observed to expected rate ratio for the level of access compared with the reference level for the specified year (for example material resources – quintile 5 compared with material resources – quintile 1 as the reference).

**Table 1** Adjusted rate ratio (95% c.i.) of observed to expected procedure rates for each level of measure

Subgroup	2020	2021	2022	2023
Material resources* - quintile 1	Reference	Reference	Reference	Reference
Material resources - quintile 2	1.00 (0.98,1.02)	1.01 (0.98,1.04)	1.03 (0.98,1.07)	1.04 (0.99,1.09)
Material resources - quintile 3	0.98 (0.95,1.00)	1.01 (0.97,1.05)	1.03 (0.98,1.08)	1.06 (1.00,1.12)
Material Resources - quintile 4	0.99 (0.96,1.02)	1.00 (0.97,1.04)	1.01 (0.96,1.06)	1.04 (0.98,1.10)
Material resources - quintile 5	0.97 (0.94,0.99)	1.02 (0.98,1.05)	1.03 (0.98,1.08)	1.05 (0.99,1.11)
Co-morbidity burden† - low	Reference	Reference	Reference	Reference
Co-morbidity burden - medium	0.93 (0.91,0.94)	0.99 (0.96,1.02)	1.11 (1.07,1.15)	1.05 (1.00,1.09)
Co-morbidity burden - high	0.86 (0.85,0.88)	0.99 (0.96,1.02)	1.12 (1.08,1.16)	1.01 (0.97,1.06)
Canadian-born or long-term residents	Reference	Reference	Reference	Reference
Immigrants	0.92 (0.88,0.97)	0.88 (0.82,0.94)	0.92 (0.83,1.01)	0.86 (0.77,0.97)
Refugees	0.95 (0.89,1.01)	1.02 (0.93,1.11)	0.93 (0.83,1.05)	0.90 (0.78,1.03)
Canadian-born or long-term residents	Reference	Reference	Reference	Reference
Migrants <5 years	0.92 (0.86,0.98)	0.85 (0.77,0.93)	0.82 (0.72,0.93)	0.80 (0.69,0.92)
Migrants 6-10 years	0.91 (0.85,0.97)	0.94 (0.86,1.03)	1.00 (0.89,1.13)	0.94 (0.82,1.08)

\*Based on the validated Ontario Marginalization Index<sup>12</sup>. †Based on the Johns Hopkins ACG system<sup>13</sup>.

Early in the pandemic, preference was given to healthier patients to preserve hospital resources, with some traditionally inpatient procedures transformed to outpatient surgery for carefully selected patients<sup>16</sup>. These changes, in addition to patient choice and hospital avoidance, may have contributed to diminished rates of surgery for sicker patients early in the pandemic<sup>17</sup>.

Immigrants and recent migrants consistently experienced diminished rates of surgery, especially for outpatient and cataract procedures. Further research disentangling surgical access in the context of the broader immigrant experience, ascertaining factors such as limited social support, unstable employment, language barriers, and structural obstacles to access<sup>18</sup>, is warranted. Other health systems have pioneered partnerships between hospital systems and community organizations, and instituted alternative funding models to support comprehensive care<sup>19</sup>, both of which reduced surgical wait times in migrant communities.

Various strategies have been proposed to address the procedure gap, including weekend scheduled surgery<sup>20</sup>, single-entry models<sup>21</sup>, and expansion of for-profit outpatient facilities. For-profit surgical centres may preferentially perform low-risk surgery in low-risk patients, while diverting staffing from the existing system, thereby worsening existing barriers to access<sup>22</sup>. Equity considerations should inform surgical recovery strategies, prioritizing populations with persisting procedure gaps.

Despite capturing all selected publicly funded scheduled procedures, limitations exist, such as limited data on individual-level marginalization, changing patterns of travel and immigration during the pandemic, changes to care patterns negating rather than delaying surgery, and the intersection between measures of risk to surgical access. Despite these limitations, this study highlights population-level discrepancies in surgery rates, particularly for immigrant communities. Further research is needed to disentangle proximate causes of disparities to inform policy that supports equitable access to surgery.

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## Author contributions

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All authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

## Disclosure

The authors declare no conflict of interest.

## Supplementary material

[Supplementary material](#) is available at *BJS Open* online.

## Data availability

The data set from this study is held securely in coded form at ICES. While legal data sharing agreements between ICES and data providers (for example healthcare organizations and government) prohibit ICES from making the data set publicly available, access may be granted to those who meet pre-specified criteria for confidential access, available at [www.ices.on.ca/DAS](http://www.ices.on.ca/DAS) (e-mail: [das@ices.on.ca](mailto:das@ices.on.ca)). The full data set creation plan and underlying analytic code are available from the authors upon request, understanding that the computer programs may rely upon coding templates or macros that are unique to ICES and are therefore either inaccessible or may require modification.

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