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Prevalence of socioeconomic deprivation and risk factors in patients on the elective surgery waiting list in the North East and North Cumbria region of England: a cross-sectional study

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ABSTRACT

Objectives We examined the association of risk factors with socioeconomic deprivation in patients waiting for high volume low complexity (HVLC) surgical procedures in the North East and North Cumbria region.

Settings We analysed data from the Rapid Actionable Insight Driving Reform database which links primary and secondary care elective waiting list data.

Participants Patients were included if they were waiting for HVLC surgery or an initial outpatient appointment for HVLC surgery.

Outcomes Smoking status, living with obesity, type 2 diabetes mellitus (T2DM), atrial fibrillation, chronic obstructive pulmonary disease (COPD), hypertension, serious mental illness or learning disability. Differences in outcomes by the England Index of Multiple Deprivation score quintiles were examined using ORs (95% CI).

Results Of 78 571 patients, 30.6% were living in the most deprived quintile, 29.4% were living with obesity, 28.9% had hypertension and 13.5% were smokers. Though younger, 64.2% of patients in the most deprived quintile had at least one risk factor compared with 48% of patients in the least deprived quintile (OR 1.9 (95% CI 1.9, 2.0). The odds of being a smoker, living with obesity, T2DM, COPD and a serious mental illness or learning disability decreased as deprivation decreased in a dose–response relationship.

Conclusions People waiting for surgery from areas of greater deprivation are living with significantly more risk factors, and this may impact eligibility for surgery and surgical outcomes. Perioperative service provision must be delivered with deprivation in mind, otherwise health inequalities will be amplified.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ A main strength of this study is the use of real-world data to examine the prevalence of comorbidities and their association with socioeconomic deprivation for those waiting for elective surgery.
⇒ There was also a large sample size of 78 571 patients with linked primary and secondary care data.
⇒ Limitations include the cross-sectional design and the lack of postoperative surgical outcome data.
⇒ The majority of participants were of white ethnicity, therefore other ethnicities may have differing patterns of comorbidities.

INTRODUCTION

Surgery is one of the most common treatments offered by the National Health Service (NHS) in the UK. Around 1 in 10 adults undergo a surgical procedure each year,[1] and up to 60% of the surgical patients need high volume low complexity (HVLC) surgery, such as hernia repairs or joint replacement operations.[2] Perioperative outcomes and the risk of complications vary across the socioeconomic spectrum.[3] A recent study involving a secondary analysis of two large cohort studies showed that compared with the most advantaged group, the most deprived surgery patients in England had a 40% greater age-adjusted risk of dying over 3 years after surgery or experiencing postoperative complications.[3] The reasons for this disparity are multifactorial but likely involve the well-established socioeconomic gradient in health risk behaviours and associated comorbidities.[3] For instance, health risk behaviours including smoking,[4–6] risky alcohol use,[7 8] poor diet[9–11] and physical inactivity leading to poor aerobic fitness[12] are associated with poorer perioperative outcomes and are strongly associated with socioeconomic deprivation.[13–15]

Crucially, the same health risk behaviours and comorbidities that can impact perioperative outcomes can also impact a patients'

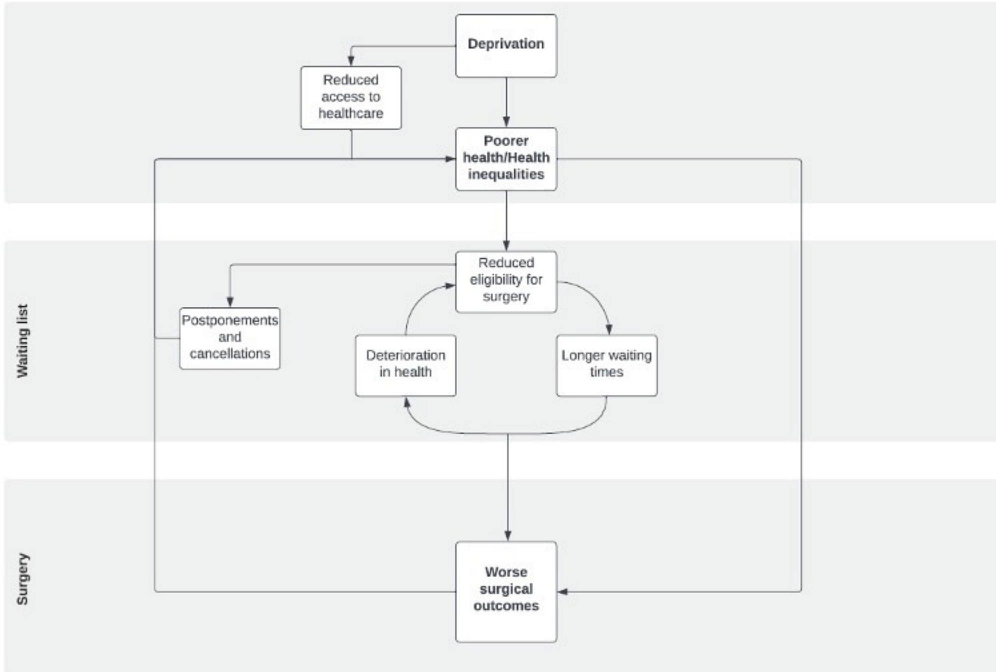

Figure 1 Proposed pathway showing how socioeconomic deprivation can generate and amplify inequalities in health (surgery risk factors and surgery outcomes) and care (access to surgical services) in patients needing surgery.

eligibility for surgery. In the UK, service commissioners may apply strict thresholds and criteria around these risk factors to ration resources (eg, people with a body mass index (BMI)≥30 kg/m^2 must lose at least 10% of their body weight before surgery or sustain a 12-month period of attempted weight loss).[16] Waiting longer for surgery due to not meeting these criteria can cause patients (and service providers) distress and adversely impact their quality of life and health.[17–20] For instance, in the study by McLaughlin *et al*,[21] BMI thresholds for hip surgery increased waiting time and were associated with worsening preoperative symptom scores and rising weight. This deterioration in health could potentially further extend waiting time, lead to the cancellation of the surgery completely or result in poorer surgical outcomes if surgery goes ahead,[17–19 22 23] ultimately amplifying health and care inequalities. A recent study examined the postponement of operations in the UK over a 2-week period and found that 7.3% of operations were postponed. This was due to medical reasons, such as uncontrolled diabetes or hypertension, rather than pathway reasons.[24] This suggests that understanding the health profile of people on waiting lists is important to inform provision of presurgery interventions to address risk factors and prevent surgery postponements. The proposed mechanism of how social deprivation can generate and amplify inequalities in health and care in surgical populations is presented in figure 1.

While previous research has examined the association of comorbidities, surgical outcomes and socioeconomic position in UK patients who had received surgery,[3] to our knowledge, no research has examined the prevalence of risk factors of UK patients waiting for surgery across the socioeconomic spectrum. Understanding the health risk profile of people waiting for surgery across social groups, including those who are still awaiting initial consultation (non-admitted pathway), would help policymakers and service commissioners design eligibility criteria and prioritise perioperative healthcare resources to specifically address health inequalities, such as providing targeted optimisation of comorbid disease. Therefore, the aim of the current study was to determine the prevalence of selected risk factors across the socioeconomic spectrum in patients waiting for HVLC elective surgical procedures in the North East and North Cumbria (NENC) region of England.

METHODS

Data source

The NENC region is one of the most deprived regions of England and is home to 3.1 million people living in the 14 local authorities that cover the region.[25] On average, 31.9% of the NENC population live in the most deprived Index of Multiple Deprivation (IMD) quintile; this is closer to 50% in the most deprived local authorities in the region.[26] The study is a cross-sectional analysis using data from the Rapid Actionable Insight Driving Reform (RAIDR) dataset based on primary care data merged onto the elective waiting list in the NENC. RAIDR is a health intelligent tool that connects datasets and was created by the North of England Commissioning Support (NECS) to act as a single portal for data analysis. Data extraction from participating general practices in NENC occurred systematically via electronic medical records through RAIDR and subject to meeting strict data governance rules.

Data selection

The data here are from all patients who were alive, aged 18 and over and permanently registered with a participating practice up to 21 July 2024 and on a surgical waiting list in one of the seven foundation trusts in the NENC Integrated Care System. To be included in the analysis, patients had to have a valid postcode recorded in their records to calculate an England IMD score, an area-based measure of socio-economic deprivation. IMD is a set of relative measures of deprivation based on seven different domains: income deprivation, employment deprivation, education, skills and training, health deprivation and disability, crime, barriers to housing and services and living environment deprivation. Combining the seven domains creates the IMD. Data are freely available and can be accessed at https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019. Patient data were included if they either were classified as being on an admitted or non-admitted waiting list for an HVLC elective surgical specialty likely to require general anaesthesia (general surgery, orthopaedics including hip and knee surgery, gynaecology, urology, and ear, nose, throat) as defined by Getting It Right First Time.[27] Online supplemental table 1 details the most common procedures included. We focused on HVLC surgery as these procedures comprise around 60% of patients on the waiting list and are the focus of NHS England's approach to reduce waiting lists for elective surgery.[27] Patients who had more than one surgery planned were excluded as their data would be counted more than once, inflating the findings. The cumulative data used in the analysis was extracted on 21 July 2024 and included age, sex and IMD, the latter of which were categorised into quintiles based on England quintiles.[28] Patients on multiple pathways or awaiting multiple surgeries were excluded. Figure 2 documents the patient flow for inclusion in the analysis.

Outcomes

The primary outcome was the odds of risk factors across IMD quintiles (IMDQ). We selected 10 risk factors based on their impact on surgical outcomes, that is, they are associated with poorer outcomes of surgery and accessibility of data (ie, recorded in primary care records). These were smoking,[29] living with obesity (BMI>30 kg/m^2),[30] severe mental illness (SMI),[31] learning disabilities,[32] type 2 diabetes mellitus (T2DM) (latest HbA1c<53 mmol/mol, 53–69 mmol/mol and >69 mmol/mol),[33] chronic obstructive pulmonary disease (COPD),[34] hypertension and unmanaged hypertension defined as most recent blood pressure>150/90 mm Hg[35] and atrial fibrillation (AF).[36]

Statistical analyses

The analysis was carried out by authors, SMB and BG, Business Intelligence Manager with NHS NECS Unit and Business Intelligence lead for the Waiting Well Programme. Frequencies and percentages were used to present data on prevalence of risk factors. χ^2 tests of independence were conducted to test for the presence of differences in the proportion of patients on the waiting list for elective surgery and differences in the proportion of patients in age group categories across IMDQ. We described visual differences and trends in the data rather than conducting post-hoc analysis so as not to reduce statistical power (increased risk of type II error). We calculated the OR (OR (95% CI)) of having risk factor(s) using the most deprived patients as a reference group (IMDQ1) and IMDQ2, 3, 4 and 5 (increasingly less deprived) as comparison groups.

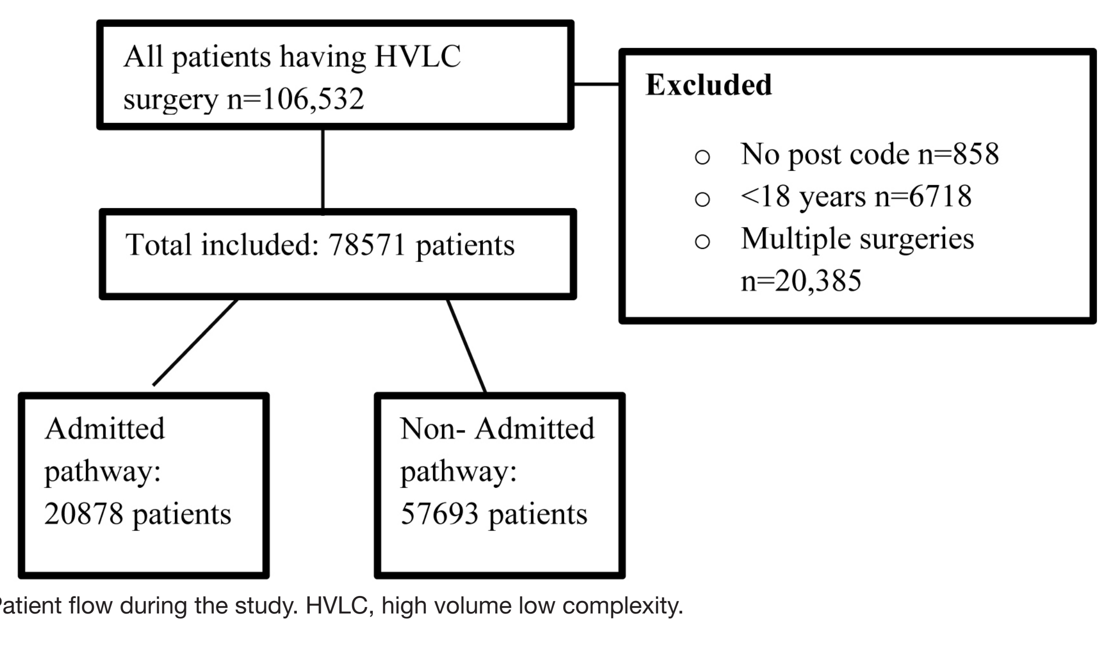

Figure 2 Patient flow during the study. HVLC, high volume low complexity.

Table 1 Characteristics of patients waiting for elective surgery on admitted, non-admitted pathways and combined pathways

	Admitted pathway	Non-admitted pathway	Combined pathways
Number of patients (%)	20878 (26.6)	57693 (73.4)	78571 (100%)
IMDQ1 n (%)	6424 (30.8)	17621 (30.5)	24045 (30.6)
IMDQ2 n (%)	4963 (23.8)	13142 (22.8)	18105 (23.0)
IMDQ3 n (%)	3463 (16.6)	9478 (16.4)	12941 (16.5)
IMDQ4 n (%)	3194 (15.3)	9038 (15.7)	12232 (15.6)
IMDQ5 n (%)	2834 (13.6)	8414 (14.6)	11248 (14.3)
Female n (%)	9292 (44.5)	29542 (51.2)	38834 (49.4)
Male n (%)	8555 (41)	18896 (32.8)	27451 (34.9)
Unknown/not recorded n (%)	3031 (14.5)	9255 (16.0)	12286 (15.6)

χ^2 tests of independent showed significant differences in the proportion of patients in IMDQs in the admitted, non-admitted and combined pathways.
IMDQ, Index of Multiple Deprivation Quintile.

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

RESULTS

Sample characteristics

There were 78571 patients included in analyses. We excluded 792 patients from analyses as a valid postcode was not available. Of the total sample included in analyses, there were 20878 (26.6%) patients on the admitted pathway and 57693 (73.4%) patients on the non-admitted pathway. On the admitted, non-admitted and combined pathways, there were significant differences in the proportion of patients in IMDQ (χ^2 for all pathways p<0.01; table 1). The greatest proportion of patients was in IMDQ1 (most deprived) (n=6424; 30.8% for admitted and n=17621; 30.5% for non-admitted) while the smallest proportion was in IMDQ5 (least deprived) (n=2834; 13.6% for admitted and n=8414; 14.6% for non-admitted) (table 1). There were statistically significant differences in the proportion of patients in age group categories across IMDQ. In the younger age groups, there was a greater proportion of more deprived patients. In the older age groups, there was a greater proportion of less deprived patients (online supplemental tables 2 and 3).

The proportion of women on the admitted and non-admitted pathways was 44.5% and 51.2%, respectively. Sex was either unknown or not reported for 14.5% and 16.0% of patients on the admitted and non-admitted pathways, respectively.

Prevalence of risk factors and association with IMD

There were 7848 (37.6%) patients on the admitted pathway who had no risk factors. For the non-admitted pathway, this was 21487 (37.2%) patients. The most common risk factors across both admitted and unadmitted pathways were living with obesity (33.3% and 24.9%, respectively) and hypertension (33.3% and 23.6%, respectively). Smoking and T2DM were the next most common risk factors in patients in both pathways. There were 2800 (13.4%) patients on the admitted pathway and 7567 (13.12%) on the non-admitted pathway who were current smokers. There were 2610 (12.5%) patients on the admitted pathway and 5496 (9.5%) patients on the non-admitted pathway who had T2DM. All other comorbidities had lower prevalence (ie, <10%) (online supplemental tables 4–6).

As the patterns in the data for the association of risk factors with IMD were similar between the admitted and non-admitted pathways, we have summarised these results for the combined pathways (online supplemental table 6). The odds of having no risk factors increased as IMD score increased (less deprivation). Compared with patients in IMDQ1 (most deprived), patients in IMDQ5 (least deprived) had almost double the odds of having no risk factors (OR 1.94 (1.86–2.03) for combined pathways). With regards to specific risk factors, patients with less deprivation had significantly lower odds of having COPD, T2DM, T2DM (HbA1c 53–68), T2DM (HbA1c>69), a learning disability, a serious mental illness, BMI (≥30), BMI (≥35) or being a current smoker. These risk factors had a dose–response relationship with IMD score, such that the odds of having these risk factors decreased with decreasing disadvantage (higher IMD score). For example, the odds of having T2DM decreased as IMD score increased (IMDQ1 vs IMDQ2 0.96 (0.91–1.02); versus IMDQ3 0.82 (0.77–0.88); versus IMDQ4 0.79 (0.73–0.84); versus IMDQ5 0.62 (0.57–0.67)). The relationship with IMD was strongest for being a current smoker (IMDQ1 vs IMDQ5 0.24 (0.22–0.26)), having a learning disability (IMDQ1 vs IMDQ5 0.31 (0.22–0.43)), SMI (IMDQ1 vs IMDQ5 0.34 (0.26–0.43)) and COPD (IMDQ1 vs IMDQ5 0.35 (0.31–0.40)). Of patients who had diabetes,14.3% in IMDQ1 had uncontrolled diabetes (HbA1c>69) versus 9.9% in IMDQ5. This suggests a slightly higher percentage for those patients in the most deprived quintile.

The odds of having AF and hypertension were greater in more advantaged patients, although no strong dose–response relationship was observed (online supplemental table 6). In the combined pathways, patients in IMDQ5 had 1.51 (1.23–1.86) the odds of having AF compared with the most deprived patients (IMDQ1). Patients in IMDQ5 had 1.08 (1.03–1.14) odds of having hypertension compared with patients in IMDQ1 (most deprived). Unmanaged hypertension was the only risk factor that was not associated with IMD.

DISCUSSION

The most prevalent risk factors in patients waiting for HVLC surgery in the NENC were living with obesity, hypertension, being a current smoker and T2DM. Patients living in the most advantaged areas were around twice as likely to have no risk factors compared with patients living in the most deprived areas, even though more deprived patients were younger. Many risk factors had a dose–response relationship with deprivation. The socioeconomic gradient was strongest for being a current smoker and having a learning disability, an SMI and COPD. Conversely, the odds of having AF and hypertension were greater in more advantaged patients, although no strong dose–response relationship was observed. Unmanaged hypertension was the only risk factor that was not associated with deprivation.

Our finding that the most prevalent risk factors in patients in the current study were living with obesity (29.4%), hypertension (28.9%), smoking (13.5%) and T2DM (10.8%) is expected given their high prevalence in the general population. As there is very little research on the prevalence of risk factors in patients on surgery waiting lists, we have compared our findings with studies in patients who have undergone surgery. Our findings for rates of T2DM align with other studies in England reporting that patients with T2DM account for 8%[37] to 15%[38] of all (non-obstetric)[37] surgeries. Likewise, the proportion of patients with hypertension in the current study is similar to a UK study finding that up to 25% of patients having major non-cardiac surgery have hypertension.[39 40] With regards to smoking, previous literature has reported a wide range of smoking rates. One UK study reported that 11% of patients who had undergone knee or hip replacement surgery were identified as current smokers.[41] In contrast, two US studies in large samples of surgery patients found that around a quarter[6 42] were current smokers. Large variation in rates of smoking may reflect different profiles of patients across surgical specialties, with higher smoking rates expected in populations that include cardiac patients. Variation may also be due to differences in prevalence of smoking across countries and methods of assessing smoking status. To our knowledge, the rates of living with obesity in UK surgery populations, including those on waiting lists, have not been previously reported.

Our observation that deprivation was associated with greater odds of risk factors in patients on surgery waiting lists reflects the well-established socioeconomic gradient in health risk behaviours and associated comorbidities in the general population. Our findings also align with those of Wan *et al* who found that the prevalence of COPD and diabetes in UK patients who had undergone surgery increased with increasing disadvantage. In the current study, the socioeconomic gradient was strongest (ie, magnitude of the OR) for smoking, learning disabilities, serious mental illness and COPD. Previous UK studies suggest that the socioeconomic gradient in smoking and COPD is greater than any other risk factor in the general population.[43–45] Unexpectedly, in the current study, the rates of AF and hypertension were higher in more advantaged patients, while unmanaged hypertension showed no relationship with IMD. Our findings are in contrast with those observed in a large UK study that found individuals from areas with higher deprivation in socioeconomic and living status had higher AF incidence.[46] Similarly, a UK study found that participants in low-income versus high-income households had a higher probability of being hypertensive; the probability of undiagnosed hypertension was not different between income groups.[47] The discrepancy between our findings and those reported in previous studies may be explained by the fact that in our study sample, patients from areas of higher deprived patients were younger and also that these patients may not have had the diagnosis made as yet. The prevalence of AF is very low among young individuals (<1% in people aged<40 years)[48] with similar trends observed for prevalence of hypertension.[49] A previous UK study also found that black ethnicity was associated with increased risk of hypertension[50]; while ethnicity data were not available for the current study, the population in NENC is predominantly white British.[51]

The most prevalent risk factors in our current sample, that is, living with obesity, high blood glucose and smoking, are commonly used as eligibility criteria for elective surgery. As these risk factors are more common in more deprived populations, it follows that the implementation of these strict surgery criteria will predominantly affect socially deprived populations.[3 21 52] A study by McLaughlin *et al*[21 52] found that the introduction of strict BMI thresholds for hip and knee surgery in England was associated with an increase in the proportion of privately funded surgeries and the proportion of more affluent patients receiving surgery, raising the concern that such policies can widen health inequalities. Likewise, an analysis of nationally representative US data revealed that inflexible surgery criteria with respect to BMI, HbA1c and smoking status disproportionately discouraged performing hip and knee arthroplasty in non-Hispanic black patients and those with greater socioeconomic deprivation.[3] Being unable to access these services may prolong time to surgery or the procedure being cancelled or denied completely, which, in turn, may result in further deterioration of the patients' health and amplification of health inequalities. While having learning disabilities and SMIs were not common in the study sample, they showed a strong relationship with IMD. Anaesthetists, operating theatre and learning disability teams play a pivotal role in ensuring individualised admission plans are made for patients with a learning disability or SMI to reduce these healthcare inequalities and improve perioperative care.[53]

Surgery represents an opportunistic 'teachable moment' where patients may be more motivated to adopt risk-reducing health behaviours.[54] Policymakers and service commissioners can leverage this teachable moment, the time spent waiting for surgery and to plan sustainable, targeted provision of services and address comorbidities and health risk behaviours. Prehabilitation interventions could be integrated into usual perioperative care in areas of greater deprivation to improve eligibility for surgery, surgical outcomes, longer-term risk behaviour profiles and potential health inequalities. Focusing prehabilitation on deprivation would be important as there is normally greater uptake of preventative measures by people with lesser needs (ie, less deprived).[55] Our recent review found that prehabilitation interventions reduced length of stay (especially for patients undergoing lung surgery), presurgery and early postsurgery functional capacity and smoking cessation, and longer-term smoking cessation across surgical specialties.[56] Indeed, a more proactive model of care providing even earlier intervention in patients on non-admitted pathways could potentially provide greater benefit still, for example, downgrade to a lower severity surgery and eliminate the need for surgery completely.

A main strength of the current work is its novelty; while the prevalence of comorbidities and their association with socioeconomic deprivation in the general population is well-documented, there is a lack of evidence for patients waiting for elective surgery. Rates of living with obesity in surgery populations are not well established, and the current study makes a novel contribution to the literature. Additional strengths are that many patients were included in the analysis, and we used routinely collected data that links hospital and primary care data. However, the latter is also a limitation as the accuracy of routinely collected data cannot be guaranteed, for example, smoking status is reported as a binary outcome and may not have been recently updated, and we have no record of when comorbidities were recorded. However, there is no reason to believe that there would be systematic differences in records by deprivation and, therefore, it is unlikely to influence the main aims and outcomes of this study. Ethnicity, sex and other salient health risk behaviours such as alcohol use were poorly reported; therefore, we were unable to look at patterns in the data by these variables. In NENC, most patients identify as white British (90.6%), compared with London, for example, where white British ethnicity is only 36.8% of the population.[51] Additionally, the NENC region is more deprived than other regions in England. Therefore, our results may not be generalisable to other areas of the UK with more ethnically diverse and affluent populations. Also, the prevalence of comorbidities in the NENC is slightly higher than the other regions in the UK, which may also limit generalisability. For instance, rates of living with obesity in the North East are 34.0% compared with 23.4% in London.[57] A further limitation is the cross-sectional design which allowed us to examine the prevalence of comorbidities but does not enable us to determine their impact on access or timing to surgery or surgical outcomes. Future longitudinal research should investigate this. Additionally, we excluded patients who were having multiple surgeries (to not count the risk factor more than once), and it could be suggested that people having multiple operations are likely to have greater risk factors and therefore we may have underestimated the prevalence. Finally, we were only able to analyse data of patients registered at a GP practice and with a valid postcode. This removes a marginalised group who are likely at greatest risk of poor outcomes and difficulty accessing services.

People living in areas of greater socioeconomic deprivation appear at a younger adult age on surgery waiting lists and are living with significantly more comorbidities. This may have implications for access to surgery, surgery outcomes and resources. Policymakers and perioperative service commissioners must consider deprivation in service design and delivery, otherwise, health inequalities could be amplified. Presurgery intervention such as prehabilitation (if planned well) represents one such service that may be able to minimise inequalities if appropriately targeted to need; these should prioritise management of excess weight, smoking and hypertension.

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Contributors JP, MF and EK designed the study. SMB and BG conducted the statistical analysis. CM, BG, JP and MF interpreted the findings. CM and MF drafted the paper. JP, EK, EFSK, SMB and CS critically reviewed the paper. CM is the guarantor for the study 2025.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval Data extraction from participating general practices in NENC occurred systematically via electronic medical records through RAIDR and subject to meeting strict data governance rules. Secondary Care Commissioning datasets are governed by Data Sharing Agreements between NHS Digital and NHS North East and Cumbria Integrated Care Board (ICB), primary care datasets are governed by local Data Sharing Agreements between individual GP Practices, the ICB and NECS. No patient identifiable data was available to the study team; only anonymised, aggregated data were accessed that were collected as part of routine care. Due to these reasons, no ethical approval was required.

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