The Impact of the COVID-19 Pandemic on Sociodemographic Disparities in Rates of Elective Hernia Surgeries

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Abstract

Background: The global pandemic has shed light on the role of health care disparities; however, little data exists to determine how COVID-19 affected access to elective surgical care. We aimed to determine the impact of health care disparities and surgical care for patients undergoing hernia surgery across a national quality collaborative database.

Materials and Methods: All patients undergoing elective hernia surgery between March 2018 and April 2021 were identified within the Abdominal Core Health Quality Collaborative. Patients were divided based on date of surgery into pre-, post-, and COVID-19 spike groups. Descriptive statistics were calculated for comorbidities, demographics, surgical location, Distressed Community Index (DCI), and hernia characteristics stratified by period of surgery. Rates and chi-squared test were used for categorical variables. Median, IQR, and Wilcoxon test were used continuous variables.

Results: 35 149 patients met inclusion criteria. Pre-COVID-19, COVID-19 spike, and post-COVID-19 groups showed no significant difference in mean age or the proportion of patients in each DCI variable. Proportionately fewer females and more White non-Hispanic patients were operated on during the COVID-19 spike. Surgeons affiliated with academic hospitals saw proportionality fewer elective cases during the COVID-19 spike.

Discussion: This study suggests white males with private hospital affiliation were more likely to have elective hernia surgery during the COVID-19 spike, however these trends were not associated with health care DCI changes during the same period. Further study is necessary to determine the reasons for these differences and will be important to optimize surgical care for patients during a worldwide pandemic.

Keywords
general surgery, socioeconomic

Key Findings

- Proportionally more males and White (non-Hispanic) patients had elective surgery during the COVID-19 spike.
- Academic centers had reductions in overall case volume, while academic-affiliated and community hospitals were less affected during the measured phases of the pandemic.
- Our results did not clearly link several common indicators of socioeconomic distress to delays in access to care.

Introduction

Healthcare inequality and differential access to medical care has been an ongoing issue in the United States. Social determinants of health are wide ranging and are thought to play an important role in determining health outcomes.[1] The recent global pandemic has highlighted many aspects of health care disparities, however, there remains a sparsity of data on how COVID-19 affected access to surgical care, particularly for elective operations.

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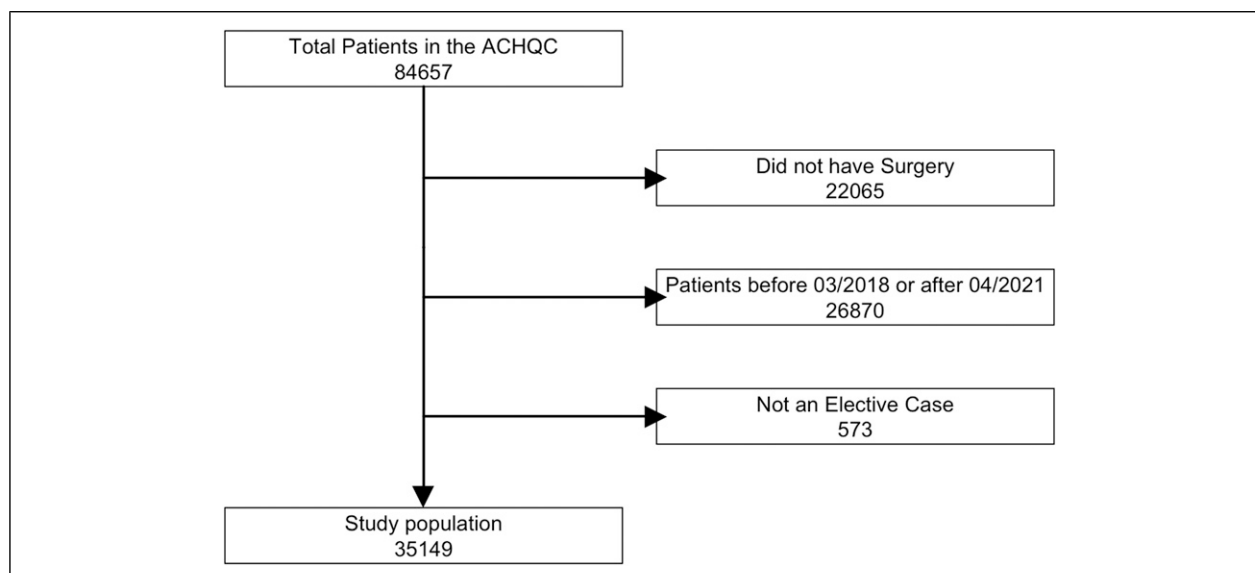Email: Richard.pierce@vumc.org

Figure 1. Study population describing included and excluded patients.

Emerging evidence of health care disparities in access to and wait times for elective surgery during the recovery phase of the pandemic has recently been published, suggesting the disproportionate effects various social determinants of health had on access to surgical care which resulted in untreated disease burdens.[2] Further knowledge is necessary to fully evaluate the effect of the pandemic on elective surgery in vulnerable groups. With hernia surgery being the most common procedure performed by general surgeons, and the fact that these repairs are often performed in an elective setting, although if neglected can require emergent repairs, hernia care provides the ideal model to evaluate the potential effect of a global pandemic on access to elective surgery as well as the time to recover to baseline.[3] Using a national hernia quality collaborative, we aimed to identify if socioeconomic disparities were associated with reduced access to elective hernia surgery during the COVID-19 pandemic.

Materials and Methods

After obtaining institutional review board approval from Vanderbilt University Medical Center, a retrospective analysis of prospectively collected data from the Abdominal Core Health Quality Collaborative (ACHQC) was performed. The ACHQC is a prospectively maintained national quality database designed to improve the value of hernia care using continuous quality improvement principles. At the time of this study, the ACHQC had data available from nearly 85,000 patients entered by over 400 surgeons who practice in a variety of clinical settings including academic, community, and academic affiliated hospitals.

The ACHQC database was queried for all patients undergoing elective hernia surgery between March 2018 and April 2021. Patients in the ACHQC who did not have surgery and were not classified as an elective case were excluded (Figure 1). Patients were divided into 3 groups based on the date of their surgery. The pandemic spike was defined based on governmental shutdown mandates. Patients were divided into pre-COVID-19 spike (March 1st, 2018-March 14th, 2020), COVID-19 spike (March 15th, 2020-May 31st, 2020), post-COVID-19 spike (June 1st, 2020–April 30th, 2021) groups.

Our primary objective was to identify associations between patient demographics, socioeconomic determinants, hernia characteristics, and comorbidities compared by the period of the pandemic. Evaluated patient demographics included age, gender, and race. Age was capped at 90 years and treated as a continuous variable reported as median, IQR range, and mean with standard deviation. Gender and race were treated as categorical variables. Race was broken down into 6 different groups: American Indian or Alaskan Native, Asian or Pacific Islander, Black (not of Hispanic origin), Hispanic, Middle Eastern, and White (not of Hispanic origin). Race was additionally categorized as White (not of Hispanic origin) versus all others.

Socioeconomic status was stratified by primary insurance, surgeon practice location, and distressed community index (DCI). Primary insurance was treated as a categorical variable and grouped as Medicaid, Medicare, private, self-pay, Tricare (military), unknown, VA, workers compensation, and other. Surgeon affiliation was defined as a categorical variable and included academic, private, and private practice with academic affiliations.

The DCI is designed to provide a measure of economic well-being across communities throughout the United States. The DCI edition used during the time of this study is built using the U.S. Census Bureau's American Community 5-Year Estimates and the Census Bureau's Business Patterns datasets covering 2014-2018. The DCI Survey combines 7 economic component metrics to score the communities on a scale that can convey each community's standing relative to its peers. The 7 components of the index are no high school diploma, housing vacancy rate, adults not working, poverty rate, median income ratio, change in employment, and change in establishments.[4] The community's score on the index is then normalized to sort the communities into 5 even quintiles of economic well-being: prosperous, comfortable, mid-tier, at risk, and distressed.

Hernia characteristics included hernia width reported as median, range, and mean and a hernia-specific quality of life tool, HerQLes.[5] HerQLes is a 12-question validated hernia quality of life (QOL) instrument that rates QOL in patients undergoing hernia surgery on a 100-point scale, with 0 indicating the worst possible response and 100 the best possible response. The selection of comorbidities was based on clinical consensus and included: smoking, history of abdominal wall surgical site infection (SSI), chronic obstructive pulmonary disease, diabetes, hypertension, history of open abdomen, recurrent incisional hernia, history of inflammatory bowel disease, and dialysis.

Descriptive statistics, including means, standard deviations, counts, and proportions, were calculated for patient characteristics stratified by period of the pandemic. Rates and chi-squared test were used for categorical variables. Median, IQR, and Wilcoxon test were used continuous variables.

Results

During the study period, 84 657 patients were registered in the ACHQC and 35 149 met inclusion criteria (22 065 did not have surgery, 26 870 were patients before 03/2018 or after 04/20 221, and 573 were not an elective case). Patients having surgery during the defined periods included pre-COVID-19 (N=23 077), COVID-19 spike (N=899), and post-COVID-19 spike (N=11 173) as shown on Figure 1.

Based on demographics, there was no difference in patient mean age. However, proportionally more males and White (non-Hispanic) patients had elective surgery during the COVID-19 spike. Additionally, as seen in Table 1, proportionately more American Indian or Alaskan Native and black, not of Hispanic origin, patients were operated on during the COVID-19 spike. Asian or Pacific Islander, Hispanic, and Middle Eastern patients were operated on proportionately less during the COVID-19 spike (Table 1).

Patients with Medicaid, Medicare, self-pay, and unknown insurance had proportionately more cases during the COVID-19 spike (Table 1). Patients with private, Tricare, VA, workers compensation, and other insurance had proportionately less cases during the COVID-19 spike (Table 1). As demonstrated in Table 1, surgeons affiliated with academic centers had proportionately fewer elective cases during the COVID-19 spike while surgeons affiliated with private centers and private practice with academic affiliation had proportionately more cases during the COVID-19 spike. No significant difference was found between the proportion of patients in each DCI variable based on their period of surgery (X^2 = 9.51, P = .301). (Figure 2).

As seen in Table 1, median and mean hernia width increased proportionately during the COVID-19 spike. The phase of the pandemic showed no significant difference in baseline scaled HerQLes (P=.541). Additionally as shown in Table 1, the phase of the pandemic showed no significant differences in the variables including smoker within 1 year, chronic obstructive pulmonary disease, diabetes, hypertension, recurrent incisional hernia, history of inflammatory bowel disease, and dialysis. The proportion of patients with a history of abdominal wall SSI went down as the pandemic went on (Table 1). The proportion of patients with a history of open abdomen also dropped during the COVID-19 spike and did not recover to pre-COVID-19 rates as seen in Table 1.

Discussion

This study is the first to analyze the change in volume and characteristics of elective hernia surgery cases during the various initial phases of the COVID-19 pandemic. Our results show that the number of elective surgeries dropped drastically after governmental shut-down mandates but rebounded to rates close to those pre-COVID-19 spike within 3 months. It is also noteworthy that this drop was more focused in the academic medical centers and less so in the community setting. This likely can be explained by the strain on large academic hospitals during the initial phases of the pandemic. Our study also found that several socioeconomic factors may have played a role in access to care during the spike in the pandemic including race and gender. However, other factors typically linked to health care disparities including insurance type, distressed community index, and hernia characteristics were not identified as being affected in our analysis.

During the spike in the pandemic, the proportion of White (non-Hispanic) males who received elective care was significantly higher. While the exact cause of these findings are unclear, it is possible that other populations were disproportionately affected. Other groups have noted that delays in accessing elective care due to socioeconomic factors can lead to increases in the demand for

Table 1. Demographics and Hernia Characteristics based on period of surgery.

	N	Pre-COVID-19-spike (N = 23 077)	COVID-19-Spike (N = 899)	Post-COVID-19-spike (N = 11 173)	Test statistic
Year of operation	35 149				$X2\ 6 = 28\ 077.76$, $P < .001^{b}$
2018		9055/23 077 (39.24)	0/899 (.00)	0/11 173 (.00)	
2019		11 533/23 077 (49.98)	0/899 (.00)	0/11 173 (.00)	
2020		2489/23 077 (10.79)	899/899 (100.00)	7068/11 173 (63.26)	
2021		0/23 077 (.00)	0/899 (.00)	4105/11 173 (36.74)	
Age capped at 90	35 149				$F_{2,35\ 146} = .42$, $P = .660^{a}$
Median (interquartile range)		59.00 (47.00—68.00)	59.00 (46.00—69.00)	59.00 (47.00—68.00)	
Range		18.00—90.00	18.00—90.00	18.00—90.00	
Mean±SD		57.44±14.77	56.86±15.60	57.19±14.96	
Gender: Male	35 149	16 631/23 077 (72.07)	679/899 (75.53)	8200/11 173 (73.39)	$X2\ 2 = 10.67$, $P = .005^{b}$
Race: White, not of Hispanic origin	35 146	19 436/23 075 (84.23)	782/899 (86.99)	9315/11 172 (83.38)	$X2\ 2 = 10.08$, $P = .006^{b}$
Race	35 146				$X2\ 10 = 54.84$, $P < .001^{b}$
American Indian or Alaskan Native		63/23 075 (.27)	6/899 (.67)	36/11 172 (.32)	
Asian or Pacific Islander		240/23 075 (1.04)	7/899 (.78)	126/11 172 (1.13)	
Black, not of Hispanic origin		1777/23 075 (7.70)	84/899 (9.34)	1006/11 172 (9.00)	
Hispanic		1286/23 075 (5.57)	16/899 (1.78)	562/11 172 (5.03)	
Middle Eastern		273/23 075 (1.18)	4/899 (.44)	127/11 172 (1.14)	
White, not of Hispanic origin		19 436/23 075 (84.23)	782/899 (86.99)	9315/11 172 (83.38)	
Primary insurance	35 149				$X2\ 16 = 164.26$, $P < .001^{b}$
Medicaid		1414/23 077 (6.13)	72/899 (8.01)	903/11 173 (8.08)	
Medicare		6845/23 077 (29.66)	294/899 (32.70)	3452/11 173 (30.90)	
Other		1113/23 077 (4.82)	37/899 (4.12)	329/11 173 (2.94)	
Private		11 762/23 077 (50.97)	415/899 (46.16)	5699/11 173 (51.01)	
Self-pay		561/23 077 (2.43)	27/899 (3.00)	231/11 173 (2.07)	
Tricare (military)		211/23 077 (.91)	8/899 (.89)	76/11 173 (.68)	
Unknown		479/23 077 (2.08)	22/899 (2.45)	250/11 173 (2.24)	
VA		55/23 077 (.24)	1/899 (.11)	37/11 173 (.33)	
Workers compensation		637/23 077 (2.76)	23/899 (2.56)	196/11 173 (1.75)	
BMI capped 15-60	35 095				$F_{2,35\ 092} = 16.84$, $P < .001^{a}$
Median (interquartile range)		28.20 (25.00—32.68)	28.10 (24.80—32.40)	27.80 (24.70—32.10)	
Range		15.00—60.00	15.00—60.00	15.00—60.00	
Mean±SD		29.31±6.36	29.29±6.38	28.94±6.23	
Smoker within 1 year: Yes	35 149	3106/23 077 (13.46)	117/899 (13.01)	1443/11 173 (12.92)	$X2\ 2 = 1.99$, $P = .370^{b}$
History of abdominal wall SSI: Yes	35 149	1186/23 077 (5.14)	41/899 (4.56)	437/11 173 (3.91)	$X2\ 2 = 25.24$, $P < .001^{b}$
Chronic obstructive pulmonary disease: Yes	35 149	1003/23 077 (4.35)	34/899 (3.78)	418/11 173 (3.74)	$X2\ 2 = 7.24$, $P = .027^{b}$
Diabetes Mellitus: Yes	35 149	2714/23 077 (11.76)	88/899 (9.79)	1257/11 173 (11.25)	$X2\ 2 = 4.71$, $P = .095^{b}$

(Continued)

Table 1. Continued

	N	Pre-COVID-19-spike (N = 23 077)	COVID-19-Spike (N = 899)	Post-COVID-19-spike (N = 11 173)	Test statistic
Hypertension: Yes	35 149	9503/23 077 (41.18)	355/899 (39.49)	4421/11 173 (39.57)	$X2\ 2 = 8.59$, P = .014[b]
History of open abdomen: Yes	35 149	818/23 077 (3.54)	24/899 (2.67)	299/11 173 (2.68)	$X2\ 2 = 19.06$, P < .001[b]
Recurrent incisional hernia: Yes	17 911	2867/11 978 (23.94)	107/411 (26.03)	1291/5522 (23.38)	$X2\ 2 = 1.79$, P = .409[b]
History of inflammatory bowel disease: Yes	35 149	308/23 077 (1.33)	9/899 (1.00)	151/11 173 (1.35)	$X2\ 2 = .78$, P = .676[b]
Dialysis: Yes	35 149	124/23 077 (.54)	4/899 (.44)	51/11 173 (.46)	$X2\ 2 = 1.05$, P = .592[b]
Hernia width	17 819				$F_{2,17\ 816} = 13.08$, P < .001[a]
Median (interquartile range)		3.00 (2.00—8.00)	3.50 (2.00—8.00)	3.00 (1.84—8.00)	
Range		.50—60.00	.50—34.00	.10—50.00	
Mean±SD		5.66 ± 5.78	6.05 ± 6.13	5.46 ± 5.72	
Surgeon affiliation	35 149				$X2\ 4 = 30.48$, P < .001[b]
Academic		11 957/23 077 (51.81)	430/899 (47.83)	6086/11 173 (54.47)	
Private		6896/23 077 (29.88)	298/899 (33.15)	3185/11 173 (28.51)	
Private practice with academic affiliation		4224/23 077 (18.30)	171/899 (19.02)	1902/11 173 (17.02)	
Scaled HerQles, baseline	7027				$F_{2,7024}=.61$, P=.541[a]
Median (interquartile range)		46.67 (25.00—71.67)	48.33 (25.00—71.67)	48.33 (25.00—73.33)	
Range		.00—100.00	.00—100.00	.00—100.00	
Mean±SD		48.40 ± 28.64	47.75 ± 27.81	49.25 ± 29.25	
Quintile (5 = Distressed)	31 047				$X2\ 8 = 9.51$, P = .301[b]
At risk		2906/20 300 (14.32)	128/826 (15.50)	1446/9921 (14.58)	
Comfortable		4427/20 300 (21.81)	174/826 (21.07)	2186/9921 (22.03)	
Distressed		2784/20 300 (13.71)	118/826 (14.29)	1291/9921 (13.01)	
Mid-tier		3473/20 300 (17.11)	136/826 (16.46)	1613/9921 (16.26)	
Prosperous		6710/20 300 (33.05)	270/826 (32.69)	3385/9921 (34.12)	

N is the number of non-missing value.
[a]Kruskal-Wallis.
[b]Pearson.
[c]Wilcoxon.

emergent surgery.[6-8] Specifically, Docimo et al., found that race is a contributing factor in patients undergoing emergent hernia repair in New York State.[9] These emergent repairs have been associated with increased length of stay, higher costs, and increased risk of in-hospital mortality.[10] Given these concerns, future work should assess whether there were any changes in the demand for non-elective surgery as a result of the pandemic and if that is linked to health care disparities.

Our study also identified a difference in hospital settings and their response to the pandemic. Academic centers had dramatic reductions in overall case volume, while academic-affiliated and community hospitals were less affected during the measured phases of the pandemic. While we cannot elucidate the exact mechanism for this difference, it seems logical that large academic centers in major cities were most heavily hit and potentially overwhelmed by the early phases of the pandemic and thus went into lockdown for elective, non-essential cases. Further work is necessary to determine if the current wave of the pandemic with Delta and Omicron variants, and their prevalence in smaller communities might alter our findings.

Our results did not clearly link several common indicators of socioeconomic distress to delays in access to
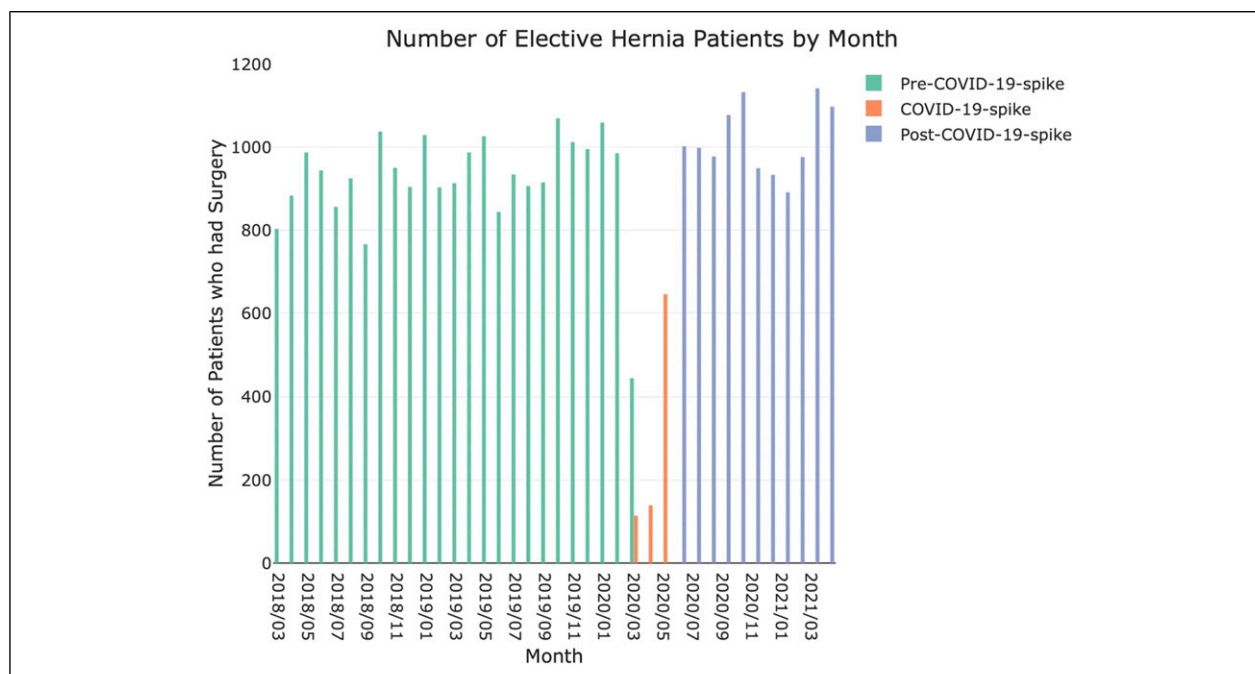
Figure 2. Number of elective hernia patients during 3 periods by month.

care. For instance, the DCI categories were not linked to reduced rates of elective procedures. While more data is necessary to understand these findings, it is notable that the ACHQC database contains a higher proportion of patients in the more affluent DCI categories, and thus our study might not be sufficiently sensitive to identify some of these trends in the lower, more underprivileged groups. Other investigators have linked patients of lower socio-economic status, as demonstrated by payer source or insurance coverage, to be more likely to undergo emergent care associated with more complications.[11-13] The fact that more patients with Medicaid and self-pay insurance still had surgery during the pandemic spike is both contradictory to this previous finding and intriguing. It is possible that Medicaid patients had more "symptomatic" hernias requiring timely repair, although not technically emergent. However, the ACHQC database does not specifically measure the severity of symptoms for elective surgery. Likewise, it is feasible that self-pay patients might have been able to negotiate individual access for surgical care, despite lock down measures. Again, it is important to take these trends in context and understand that the root cause of these differences is complex and beyond the capabilities of this analysis. The fact that hernia width was significantly higher in the pandemic spike might explain some of the severity of the hernias and the need for larger more complex hernias to become essential. This interpretation should be balanced against the similarities in baseline abdominal wall functional scores and other complexity indicators.

This study has several limitations that deserve mention. First, the ACHQC database does not collect all hernia repairs performed throughout the United States and might not be a representative sample, for disadvantaged socioeconomic groups. In particular, most patients in the ACHQC are white and in the more affluent DCI categories. Perhaps most importantly, the ACHQC is not able to capture the specific reason for cancellation or postponement of a given surgical procedure, and it must be assumed in this setting that all cancellations were the result of the pandemic.

In conclusion, our study identified a significant drop in elective hernia cases performed during the initial COVID-19 spike. This reduction in elective hernia care was most pronounced in academic centers and in non-White individuals. Given that the COVID-19 pandemic is continuing and likely will not resolve in the short term, it is critical to understand which populations face increased barriers when accessing elective surgical care. Thus additional studies conducted in similar data repositories may be needed to evaluate larger (and potentially more diverse) patient populations and determine if the findings of this study are replicated. Regardless, several of the groups identified in this analysis should have more focused attempts to reduce these disparities and prevent vulnerable groups from needing emergent operations or forgoing necessary interventions. Future work should be done to improve strategies to increase access to healthcare for vulnerable communities, as future social and economic events will continue to strain these populations.

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References

1. Gupta A, Cadwell JB, Merchant AM. Social determinants of health and outcomes of ventral hernia repair in a safety-net hospital setting. *Hernia*. 2021;25(2):287-293. doi:10.1007/s10029-020-02203-9.

2. Lin JA, Braun HJ, Schwab ME, Pierce L, Sosa JA, Wick EC. Pandemic recovery: Persistent disparities in access to elective surgical procedures. *Ann Surg*. 2021. doi:10.1097/sla.0000000000004848. Publish Ahead of Print.

3. *Hernia Surgical Mesh Implants*. 2018. U.S. Food and Drug Administration.

4. ABKFDNKODJ Lettieri. *Economic Innovation Group: 'Evolution of American Communities in the New Century'*. Targeted News Service. Economic Innovation Group; 2020. https://eig.org/wp-content/uploads/2020/10/EIG-2020-DCI-Report.pdf.

5. Krpata DM, Schmotzer BJ, Flocke S, et al. Design and initial implementation of HerQLes: A hernia-related quality-of-life survey to assess abdominal wall function. *J Am Coll Surg*. 2012;215(5):635-642. doi:10.1016/j.jamcollsurg.2012.06.412.

6. Greenberg AL, Schwartz H, Collins CR, et al. Emergency general surgery utilization and disparities during COVID-19: An interrupted time-series analysis. *Trauma Surg Acute Care Open*. 2021;6(1):e000679. doi:10.1136/tsaco-2021-000679.

7. Wong LE, Hawkins JE, Langness S, et al. Where are all the patients? Addressing Covid-19 fear to encourage sick patients to seek emergency care. *Nejm Catalyst*. 2020. doi:10.1056/CAT.20.0193.

8. Lazzerini M, Barbi E, Apicella A, Marchetti F, Cardinale F, Trobia G. Delayed access or provision of care in Italy resulting from fear of COVID-19. *Lancet Child Adolesc Health*. 2020;4(5):e10-e11. doi:10.1016/s2352-4642(20)30108-5.

9. Docimo S Jr., Spaniolas K, Yang J, Talamini MA, Pryor AD. Health care disparity exists among those undergoing emergent hernia repairs in New York State. *Hernia*. 2021;25(3):775-780. doi:10.1007/s10029-020-02244-0.

10. Mehta A, Hutfless S, Blair AB, et al. Emergency department utilization and predictors of mortality for inpatient inguinal hernia repairs. *J Surg Res*. 2017;212:270-277. doi:10.1016/j.jss.2016.12.012.

11. Schwartz DA, Hui X, Schneider EB, et al. Worse outcomes among uninsured general surgery patients: Does the need for an emergency operation explain these disparities? *Surgery*. 2014;156(2):345-351. doi:10.1016/j.surg.2014.04.039.

12. Novitsky YW, Orenstein SB. Effect of patient and hospital characteristics on outcomes of elective ventral hernia repair in the United States. *Hernia*. Oct 2013;17(5):639-645. doi:10.1007/s10029-013-1088-5

13. Cherla DV, Poulose B, Prabhu AS. Epidemiology and disparities in care: the impact of socioeconomic status, gender, and race on the presentation, management, and outcomes of patients undergoing ventral hernia repair. *Surg Clin*. 2018;98(3):431-440. doi:10.1016/j.suc.2018.02.003.