

Children with acute, uncomplicated appendicitis from lower opportunity neighborhoods are more likely to have prolonged hospitalizations and increased healthcare utilization

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The authors have no conflicts of interest to disclose.

Background

- Prior studies show neighborhood level social determinants of health (SDOH) are associated with increased pediatric healthcare utilization for nonsurgical illnesses.
- Less is known regarding this association for children admitted with common surgical conditions such as acute uncomplicated appendicitis (AUA).

Objective

- We aim to test the hypothesis that lower neighborhood level SDOH is associated with increased healthcare utilization in pediatric AUA, and to determine if this association was modified during the COVID-19 pandemic.

Methods

- Design:** Retrospective cohort database study
- Participants:** Inclusions: Healthy children < 19 years, admitted through the ED with AUA (ICD-10-CM codes: K35, K35.3, K35.30, K35.31, K35.8, K35.80, K35.89, K35.891, K37, K35.890). Exclusions: children with complex chronic conditions determined by CCC classification system version 2, previous diagnosis of appendicitis, readmissions during index visit timeframe, missing data, ICD-10-CM code for complicated appendicitis (K35.2, K35.20, K35.21, K35.32, K35.33, K36) during index visit.
- Setting:** 28 hospitals in the Pediatric Health Information System (PHIS) Database; discharge dates: 01/01/17- 02/28/22.
- Statistical Analysis:**
 - Descriptive statistics reported characteristics of study population in comparison with PHIS database.
 - Childhood opportunity index (COI), a zip-code level composite of neighborhood opportunity, served as a validated approach of estimating neighborhood level SDOH.
 - Logistic regression with generalized estimating equations assessed for association of COI with prolonged length of stay (PLOS), defined as ≥ 2 SD above the mean LOS, and/or a related 30-day return visit (Table 1)

Table 1. Related 30-day return visit ICD-10-CM codes

ICD-10-CM Code	Related ICD-10-CM Codes
Appendicitis related complications	Intraabdominal abscess: K65.1, K68.1, K68.11, K68.19, L02.211 Intestinal obstruction/small bowel obstruction: K56, K56.0*, K56.5*, K56.6*, K56.7*, K91.3*, K91.6*, K91.7*, K91.8*, T81*, K43*, K66.0, K66.1, N99.4, R18, R18.8 Postoperative complications: Ileus, incisional hernia, wound/surgical infection: K91.2*, K91.6*, K91.7*, K91.8*, T81*, K43*, K66.0, K66.1, N99.4, R18, R18.8 Clostridium difficile: A04.7* Peritonitis: K65* Systemic inflammatory response syndrome (SIRS)/sepsis/shock: A40*, A41*, R65.2*, T81.12*, T81.10*, T81.19*, T81.44*
Appendicitis	Complicated appendicitis: K35.2, K35.20, K35.21, K35.32, K35.33, K36 Acute uncomplicated appendicitis: K35, K35.3, K35.30, K35.31, K35.8, K35.80, K35.89, K35.891, K37, K35.890
Abdominal pain	R10*
Vomiting	K91.0 R11 R11.1 R11.10 R11.11 R11.12 R11.13 R11.2
Fever	R50.8 R50.81 R50.9 R68.83
Anorexia	R63.0
Dehydration	E86.0

*Annotates additional related ICD-10-CM diagnosis codes with higher level of specificity

Results

- Characteristics of study population are shown in Table 2.
- Incidence of healthcare utilization outcomes: 2,678 (7.1%) had PLOS, defined as ≥ 3 days (mean LOS: 1.4 days, SD 0.8); 1,340 (3.6%) had related 30-day return visit and 241 (0.6%) had both outcomes.

Table 2. Characteristics of Study Population

Variable	Study Population (n=37,670)	PHIS Database (n= 855,061)
Age, years		
Median (IQR)	11 (8-14)	4 (1-12)
Length of stay, days		
Median (IQR)	1 (1-1)	2 (1-3)
Sex, n (%)		
Other		407 (0.05)
Male	22,820 (60.6)	458,897 (53.7)
Female	14,850 (39.4)	395,757 (46.2)
Ethnicity/race, n (%)		
Asian	1,047 (2.8)	27,377 (3.2)
Hispanic	14,229 (37.8)	195,527 (22.9)
Multiracial	227 (0.6)	11,840 (1.4)
Non-Hispanic black	2,399 (6.4)	168,865 (19.8)
Non-Hispanic white	17,421 (46.3)	394,921 (46.2)
Other/Unknown	2,347 (6.2)	56,531 (6.6)
Primary payment source, n (%)		
Other	857 (2.3)	23,638 (2.8)
Self pay	1,551 (4.1)	28,173 (3.3)
Commercial	17,242 (45.8)	335,573 (39.3)
Public ^o	18,020 (47.8)	467,677 (54.7)
Admit quarter, n (%)		
Jan-March	10,137 (26.9)	243,173 (28.4)
April-June	9,312 (24.7)	188,551 (22.1)
July-Sept	9,632 (25.6)	198,250 (23.2)
Oct-Dec	8,589 (22.8)	225,087 (26.3)
Rural-Urban Commuting Code*, n (%)		
Rural	3,472 (9.4)	99,423 (11.6)
Urban	33,627 (90.6)	744,867 (87.1)
Median Household Income, n (%)		
\leq \$30,000	5,362 (14.2)	146,276 (17.1)
> \$30,000- < \$75,000	28,855 (76.6)	654,281 (76.5)
\geq \$75,000	3,453 (9.2)	54,504 (6.4)
Overall COI Level ^e, n (%)		
Not defined	80 (0.2)	1,622 (0.2)
Very low	8,041 (21.4)	207,825 (24.3)
Low	7,322 (19.4)	168,616 (19.7)
Moderate	6,566 (17.4)	154,611 (18.1)
High	6,495 (17.2)	149,818 (17.5)
Very high	9,166 (24.3)	172,569 (20.2)
Treatment, n (%)		
Appendectomy	36,176 (96.0)	
No appendectomy	1,494 (3.9)	

*Missing data: Rural-Urban Commuting Code (Study population n=571; PHIS database 10,771)

^e Based on patient's zipcode

^o Medicaid, CHIP, charity, other government, Medicare, and Tricare

^o PHIS database population "Other" Sex (n=407; 0.05) hidden in chart as Study population "Other" Sex (n=2) was excluded from study

Table 3. Adjusted^a Association of Healthcare Utilization Outcomes with COI in Patients <19 years admitted with AUA

Healthcare Utilization Outcome ^b	COI Level	Total study timeframe			Pre-COVID-19			Intra- COVID-19		
		n	aOR	CI	n	aOR	CI	n	aOR	CI
PLOS	Very low	716	1.7	1.2-2.4	564	1.6	1.2-2.2	152	2	1.1-3.6
	Low	607	1.6	1.3-1.9	474	1.5	1.2-1.8	133	2	1.4-2.7
	Moderate	445	1.3	1.1-1.4	358	1.2	1.1-1.4	87	1.4	1.1-1.7
	High	433	1.3	1.1-1.6	339	1.2	1.0-1.5	94	1.6	1.1-2.3
	Very high	747	1 (ref.)		388	1 (ref.)		86	1 (ref.)	
Related 30-day return visit	Very low	312	1.3	1.0-1.5	214	1.4	1.2-1.8	98	1	0.7-1.4
	Low	267	1.2	1.0-1.4	189	1.4	1.1-1.7	78	0.9	0.7-1.2
	Moderate	232	1.1	0.9-1.3	146	1.2	1.0-1.4	86	1.1	0.8-1.4
	High	239	1.2	1.0-1.4	151	1.2	1.0-1.6	88	1.1	0.8-1.5
	Very high	290	1 (ref.)		176	1 (ref.)		114	1 (ref.)	
PLOS + Related 30-day return visit	Very low	61	1.6	1.1-2.4	51	1.6	1.0-2.5	10	2.1	0.9-4.7
	Low	43	1.3	0.8-2.0	35	1.2	0.7-1.9	8	1.9	0.7-5.2
	Moderate	51	1.7	1.2-2.4	42	1.6	1.1-2.3	9	2.3	0.7-7.4
	High	46	1.6	1.1-2.3	37	1.5	0.9-2.3	9	2.5	0.8-7.7
	Very high	40	1 (ref.)		35	1 (ref.)		5	1 (ref.)	

^a Adjusted for age, sex, overweight/obesity, and pre/intra- COVID-19 pandemic timeframe

^b Outcomes are in comparison to 'neither PLOS or 30-day return visit' population n= 33,411

Conclusions

- In children < 19 years with AUA, low COI was associated with increased healthcare utilization. Further research is needed to identify the contributing factors and develop strategies to reduce disparities.

Acknowledgements

- The research described was supported by NIH/National Center for Advancing Translational Science (NCATS) Einstein- Montefiore CTSA Grant Number UL1TR002556.
- Thank you to Aileen McGinn, PhD and Melissa Fazzari, PhD, MS, for their expertise and guidance throughout our study.