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Contemporary practice and perceptions surrounding the management of asymptomatic umbilical hernias in children: A survey of the American Pediatric Surgical Association

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ABSTRACT

Purpose: To explore variation in perceptions regarding the natural history of asymptomatic umbilical hernias, and to characterize the influence of clinical and nonclinical factors on decision-making surrounding timing of repair.
Methods: This was a survey of the American Pediatric Surgical Association. Branching logic and Likert scale questions were used to explore perceptions surrounding natural history (risk of complications and likelihood of spontaneous closure), preferred age for repair, and influence of anatomic, caregiver, sociodemographic, and biological factors on operative timing.
Results: 44% of members completed the survey (371/846). The most common age respondents would consider elective repair was 3 years (37%), although the majority preferred to wait until 4 or 5 years (54%). Most respondents estimated a <1% risk of complications for unrepaired defects, and much greater variability was found in the perceived likelihood of spontaneous closure over time. Decision-making surrounding operative timing was most influenced by anatomic factors (larger defects, proboscoid changes, and interval growth) and parental anxiety surrounding need for emergency surgery, cosmesis, and stigma of parental neglect.
Conclusion: Practice and perceptions surrounding management of asymptomatic umbilical hernias vary widely. More robust epidemiological data are needed to define the likelihood of spontaneous closure in the context of age and physical exam findings. Collaborative efforts between surgeons and referring providers are also needed to optimize management of caregiver anxiety and expectations surrounding need for surgical referral and repair.
Level of evidence: Level V (expert opinion).

Umbilical hernias are common in childhood and affect 800,000 children or nearly 25% of all newborns in the United States each year [1]. Despite their relatively high prevalence, significant practice variation has been reported in the timing of umbilical hernia repair in asymptomatic children [2,3]. In a multicenter study of 38 children's hospitals, 30% of all elective repairs were performed in children 3 years of age or younger, and hospital-level rates of repair for this age group ranged from 6.9% to 54.3% [2]. This high degree of practice variation may be in part because of a lack of consensus guidelines among professional societies and published reviews surrounding the ideal timing for elective repair. While 2 years of age has been cited as the earliest age that surgery should be considered [4,5], more contemporary guidelines including those proposed by the American Academy of Pediatrics Section on Surgery have recommended delaying repair for most children until at least 4 to 5 years of age [6–8].

To date, little data exist to explain the nature and drivers of practice variation among individual surgeons, and in particular, why some surgeons prefer to repair asymptomatic hernias before 4 years of age. The purpose of this survey-based study was to explore differences in perceptions surrounding the natural history of asymptomatic umbilical hernias, and to characterize the influence of both clinical and nonclinical factors on surgeon decision-making surrounding timing of elective repair. Insight from this survey may be used to guide future educational and outreach efforts, as well as research initiatives to address knowledge gaps around the optimal timing for elective umbilical hernia repair.

1. Methods

1.1. Survey design

The survey was designed using guidelines established by the American Pediatric Surgical Association (APSA) Outcomes and Evidence-Based Practice Survey Committee [9]. The survey was

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comprised of 3 sections, with the first collecting demographic information about respondents, including age, gender, years in practice, practice setting, geographic region, affiliation with training programs, and number of practice partners. The second section assessed how surgeons would manage a hypothetical patient: a boy with an asymptomatic 0.5 cm umbilical hernia who just turned 3 years of age. Surgeons were given 4 possible options: 1) recommend repair now; 2) encourage parents to make the decision between operative management and further observation after a discussion of the risks and benefits of both options; 3) recommend further observation with the plan for future repair if the hernia persists past a certain age; or 4) recommend further observation with the plan for future repair only if the hernia becomes symptomatic. Branching logic was used to further explore decision-making in the context of a surgeon's perceived risk of future emergency surgery and likelihood of spontaneous closure. Surgeons were further queried on the earliest age they would routinely recommend repair for asymptomatic hernias. Likert scale questions were used to assess the relative influence of physical exam findings, caregiver perceptions, sociodemographic characteristics, and biological considerations (race, ethnicity, sex) on the surgeon's decision to recommend repair for asymptomatic hernias earlier than they normally would. The final section of the survey included open-ended questions to assess perceived drivers of practice variation and strategies for establishing consensus guidelines surrounding timing of elective repair. Responses were anonymous.

1.2. Survey distribution and data analysis

The survey was distributed using a SurveyMonkey weblink to all APSA regular members in April 2019. Responses were analyzed both in aggregate and stratified by demographic characteristics including age, sex, years in practice, practice setting (USA or Canada, academic or community), type of hospital (freestanding children's, within-hospital/ward, nonchildren's hospital), affiliation with trainees (pediatric surgery fellowship, general surgery residency, medical school), number of practice partners, and earliest age that repair would be routinely offered.

Descriptive statistics were used for demographic characteristics, and Chi-square statistics were used to compare binary and categorical responses across comparison groups. All statistical analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC), and P-values <0.05 were considered statistically significant. The Institutional Review Board of Boston Children's Hospital exempted this study (P00030984).

2. Results

2.1. Characteristics of survey respondents

The survey was completed by 371 ASPA members, reflecting a response rate of 43.9% (371/846). The majority of respondents were male (75.4%), between 41 and 60 years of age (69.7%), practiced at a freestanding children's hospital (56.8%), and were affiliated with a United States-based academic institution (73.8%) (Table 1).

Table 1
Demographic and clinical practice characteristics of survey respondents.

Characteristics	$n = 371$ (%)
Sex	
Male	279 (75.4)
Female	92 (24.6)
Age (years)	
<40	50 (13.5)
41–50	140 (37.8)
51–60	118 (31.9)
>61	62 (16.8)
Years in practice	
1–5	61 (16.5)
6–10	81 (21.9)
11–20	124 (33.5)
>21	104 (28.1)
Practice type	
USA/Academic	273 (73.8)
USA/Community	83 (22.4)
Canada/Academic	14 (3.8)
Hospital type	
Freestanding children's	210 (56.8)
Children's hospital/ward within a hospital	149 (40.3)
Non-children's hospital	11 (3.0)
Affiliation	
Pediatric surgery fellowship	169 (45.7)
General surgery residency	293 (79.2)
Medical school	282 (76.2)
Practice partners	
1–2	59 (16.0)
3–5	144 (38.9)
6–10	111 (30.0)
>11	56 (15.1)

2.2. Variation in management

The most commonly reported approach for managing the hypothetical asymptomatic patient in the clinical vignette who recently turned 3 years of age was delayed repair if the hernia persisted past a certain age (58.7%), followed by encouraging parents to decide between operative management and further observation (19.5%), and recommending repair without further observation (18.1%) (Fig. 1). Surgeons practicing in Canada were more likely to engage parents in shared decision-making compared to their colleagues in the United States (50.0% vs 18.3%, $P < 0.01$). Among surgeons in the United States, community-based surgeons were nearly twice as likely to engage parents in the decision-making process compared to academic-based surgeons (29.3% vs 15.0%, $P < 0.01$).

Based on the hypothetical patient, 97.3% of all respondents estimated a less than 5% risk of future emergency surgery if the hernia remained unrepaired, with 65.4% estimating a risk less than 1% (Fig. 2A). Surgeons who recommended repair at 3 years of age or younger perceived a slightly higher risk for future emergency surgery compared to those who routinely operated at 4 years of age or older, although the majority of respondents in both groups perceived a risk less than 1% (Fig. 2A). Differences were also found between surgeons who preferred to repair earlier versus later in the perceived likelihood of spontaneous closure if the hernia in the hypothetical patient remained unrepaired, with 39.3% of surgeons favoring later repair estimating a greater than 50% chance of spontaneous closure compared to only 9.2% by those favoring early repair ($P < 0.01$) (Fig. 2B).

Significant variation among respondents was also observed for the earliest age they would routinely consider elective repair in asymptomatic children. Overall, 3 years of age was the single most common response (37.2%), although more than half of respondents reported delaying repair until 4 (34.5%) or 5 (19.1%) years of age (Fig. 3). Respondents older than 50 years of age were 3-times more likely to routinely repair asymptomatic hernias in children 2 years of age or younger compared to younger surgeons (13.4% vs 4.4%, $P < 0.01$).

2.3. Factors influencing decision-making to consider earlier repair

The relative influence of clinical and nonclinical factors on a surgeon's decision to recommend repair earlier than they typically would is presented in Fig. 4. More than half of surgeons reported being influenced either somewhat or strongly by the presence of a defect larger than 1 cm, growth of the hernia over time, and proboscoid skin changes. Overall, the strongest influence was associated with the presence of a 2 cm defect enlarging over time (77.3% of respondents reporting some or strong influence) and proboscoid skin changes associated with any size defect that was enlarging over time (75.9%). Surgeons affiliated with pediatric surgery fellowship programs were less

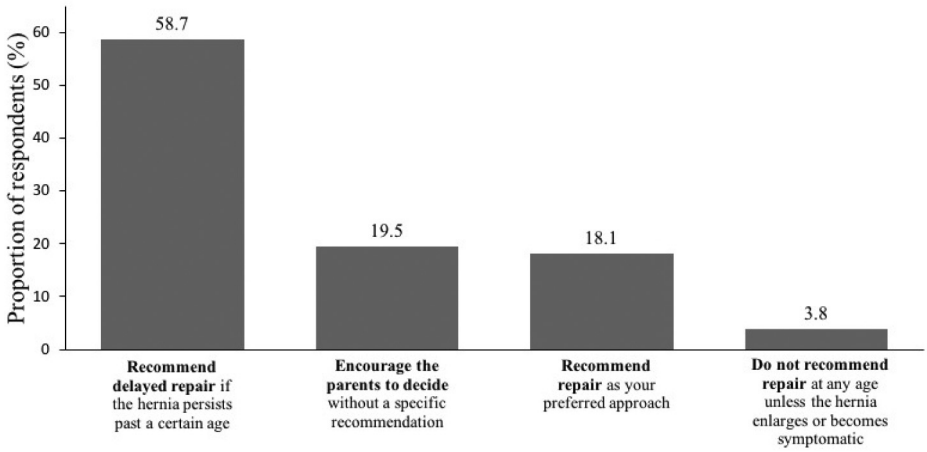

Fig. 1. Relative distribution of preferred management approaches reported by pediatric surgeons for a boy with an asymptomatic 0.5 cm umbilical hernia who just turned 3 years of age.

likely than their counterparts to be influenced by these physical exam findings. Fellowship-affiliated surgeons reported no influence of 1 cm unchanged defects (33.7% vs 44.8%, P = 0.03), 1 cm defects growing in size (42.6% vs 28.9%, P < 0.01), 2 cm defects growing in size (27.8% vs 18.4%, P = 0.03), or proboscoid skin changes increasing over time (30.2% vs 18.9%, P = 0.01) on their decision-making surrounding timing of repair.

Caregiver perceptions and attitudes were also found to influence a surgeon's decision to operate early. Parental anxiety over risk of future incarceration had the strongest influence (77.6% reporting some or strong influence), followed by concern over perceived parental neglect by peers (57.3%), and cosmetic appearance (52.4%). Female surgeons were less likely than their male colleagues to be influenced by parental concern over cosmetic appearance (41.8% vs 55.9%, P = 0.02). Surgeons who routinely recommended repair of asymptomatic hernias after 4 years of age were less likely to be influenced by cosmetic concerns compared to surgeons who routinely operated at 3 years and younger (46% vs 58%, P = 0.03).

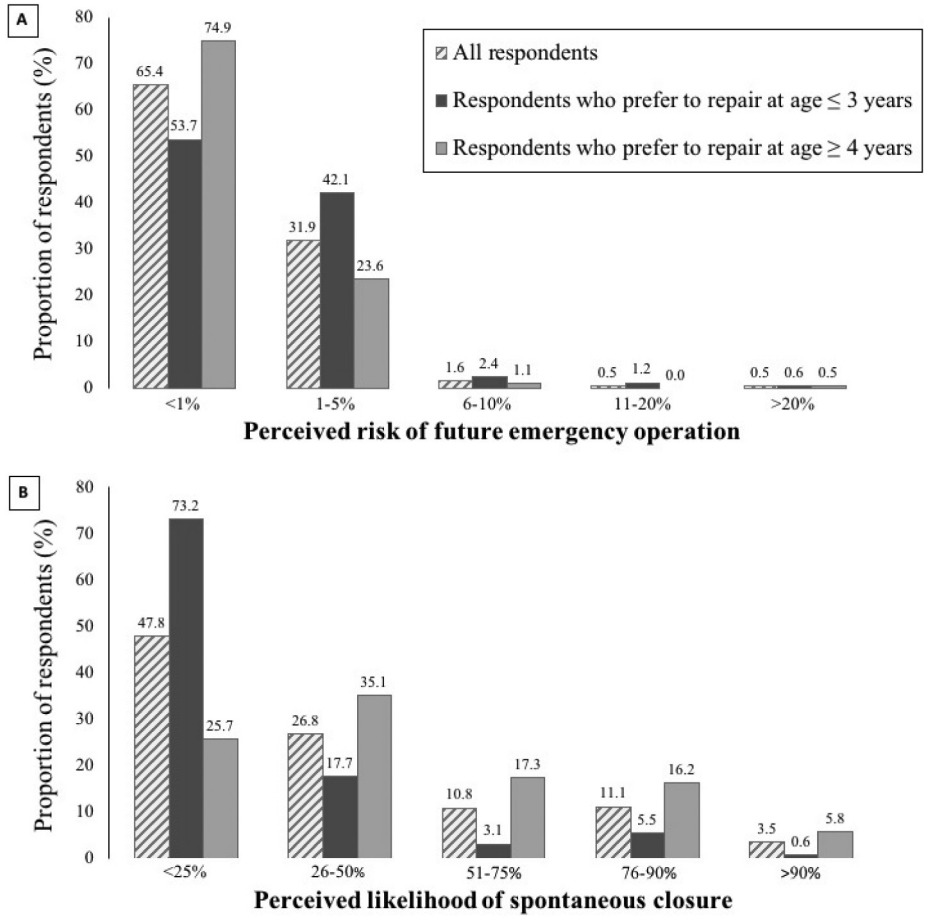

Fig. 2. Relative distribution of responses by pediatric surgeons associated with the perceived risk of a future emergency operation **[A]** and likelihood of spontaneous closure **[B]** for a boy with an asymptomatic 0.5 cm umbilical hernia who just turned 3 years of age if the hernia remains unrepaired. Responses are categorized by overall responses and by the preferred age surgeons would routinely offer elective repair (0–3 years vs. ≥4 years).

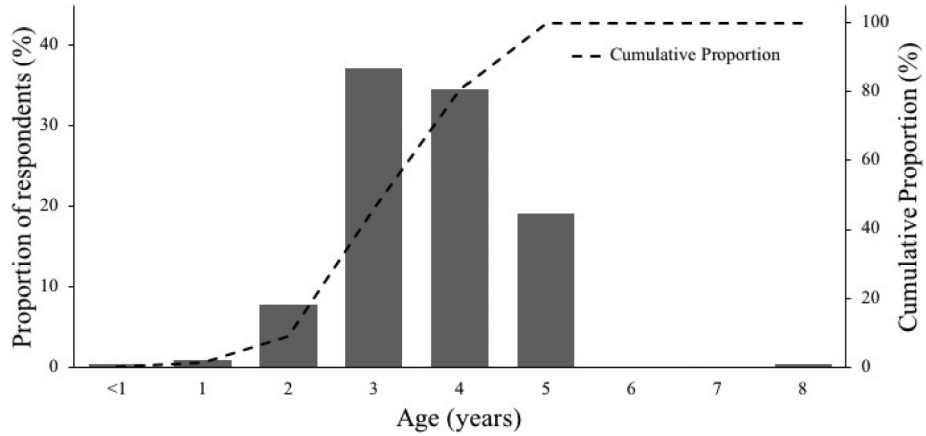

Fig. 3. Relative distribution of responses by pediatric surgeons with respect to the earliest age they would routinely consider elective repair for a child with an asymptomatic 0.5 cm umbilical hernia.

Compared to caregiver concerns and physical exam findings, sociodemographic considerations had less influence on a surgeon's decision to consider earlier repair. Sociodemographic factors with greatest relative influence included missed clinic visits owing to unreliable transportation (33.8% reporting some or strong influence) and lack of reliable access to a primary care provider (27.6%). Requirement for an interpreter had relatively little overall influence (6.2%), although surgeons practicing at nonchildren's hospitals were more likely to be influenced by this requirement compared to surgeons practicing at freestanding or children's hospitals/wards within a hospital (27.3% vs. 5.7% $P = 0.01$). Only 15.9% of respondents reported that they would be influenced to perform an earlier repair if the referring provider had

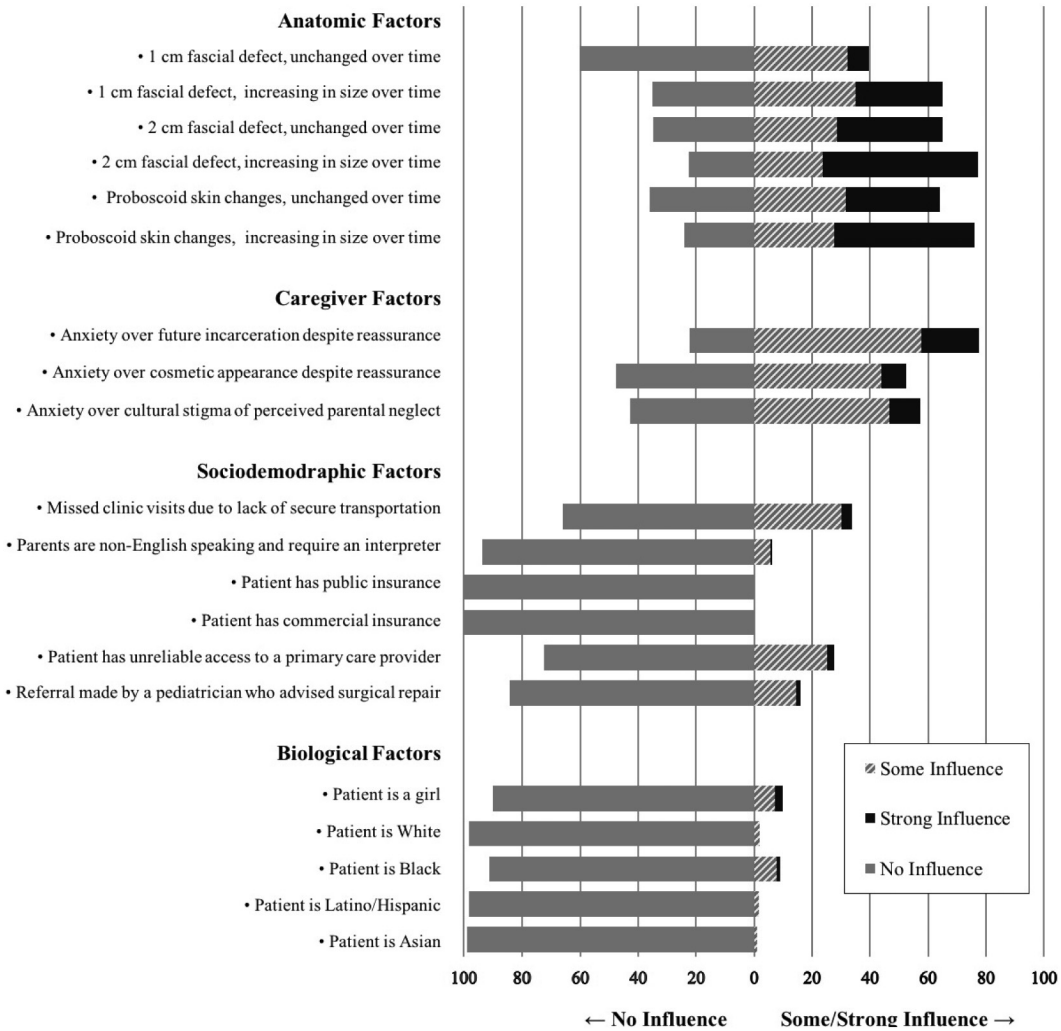

Fig. 4. Influence of physical exam findings, caregiver perceptions, sociodemographic characteristics, and biological factors on a surgeon's decision to repair an asymptomatic umbilical hernia earlier than they would typically recommend elective repair.

advised the caregivers that the hernia should be repaired. However, surgeons who were older than 50 years of age were more likely to be influenced by this consideration compared to younger surgeons (20.0% vs 12.1%, P = 0.04). Compared to their Canadian colleagues, surgeons practicing in the United States were more likely to be influenced by unreliable transportation (35.1% vs 0%, p < 0.01) and access to a primary care provider (28.7% vs 0%, P = 0.02).

Biological factors had the least overall influence on a surgeon's decision to consider earlier repair. However, Black race was up to 8-times more likely to influence a surgeon's decision for earlier repair compared to other race/ethnicity categories (Black: 8.9%, White: 1.9%, Latino/Hispanic: 1.6%, Asian: 1.1%; P < 0.001). Patient sex was also a factor in decision-making, with 10% of all surgeons reporting they would be influenced to consider earlier repair if the patient was a girl.

2.4. Qualitative assessment of surgeon perspectives surrounding practice variation

The most common themes expressed by survey respondents for perceived drivers of practice variation in timing of elective repair included: management strategies adopted during fellowship training (25.0% of all surgeons), local competition for market share and financial incentives (19.0%), differences in managing parental anxiety (18.4%), unclear natural history of asymptomatic umbilical hernias (17.2%), and expectations set by referring providers that hernias should be repaired (14.0%).

The most common themes expressed by survey respondents for potential solutions to reduce practice variation among pediatric surgeons included: better outcomes data to guide evidence-based decision-making (51.8%), consensus guidelines or position statements by medical and surgical societies (14.3%), and targeted education of referring providers (8.6%) (Table 2).

3. Discussion

The results of this survey suggest that significant variation exists among pediatric surgeons in their perceptions surrounding the natural history and ideal management of asymptomatic umbilical hernias in children. This includes marked variation in the perceived likelihood of spontaneous closure, recommendations surrounding the ideal timing of elective repair, and the influence of different clinical and nonclinical factors on decision-making for earlier repair. Furthermore, despite the lack of published data characterizing the natural history of umbilical hernias in the age range of the child featured in the survey vignette, fewer than 1 in 5 surgeons reported they would engage caregivers in a shared decision-making process surrounding management during the initial presentation.

Table 2
Most common themes expressed by survey respondents for potential solutions to reduce practice variation in the operative management of asymptomatic umbilical hernias in children.

Common Themes for Solutions to Reduce Practice Variation	Relative Proportion (%)
1) Better data to establish the true rates of incarceration and spontaneous closure overall and over time with increasing age	52%
2) Establishment of consensus guidelines by medical and surgical societies (i.e., APSA, AAP, ACS)	14%
3) Education of referring primary care providers to set appropriate expectations with parents regarding surgical consultation/management	9%
4) Educational efforts targeting pediatric surgeons (in-training and practicing) through training curriculums and national conferences	7%
5) Better data to establish the true risk and long-term consequences of early exposure to general anesthesia	7%
6) Reimbursement mechanisms and financial incentives that align with evidence-based guidelines	4%
7) More effective counseling strategies to reduce caregiver anxiety and promote family-centered decision-making	2%

The results of this survey provide further insight into findings from recent studies demonstrating wide practice variation and disparities in care associated with the management of asymptomatic umbilical hernias in children. In a retrospective study of 6,551 children undergoing umbilical hernia repair from 3 different states, a 2-fold variation in rates of elective repair was observed [3]. In a study of 23,144 children undergoing umbilical hernia repair at 38 freestanding children's hospitals throughout the United States, a 9-fold variation in rates of elective repair was found in children 3 years of age or younger [2]. Sociodemographic factors have also been associated with earlier age at repair in asymptomatic children, with public insurance, lower income, and female sex identified as independent risk factors [10]. Collectively, these findings suggest that clinical as well as nonclinical factors may influence a surgeon's decision-making surrounding the ideal time for elective repair. To our knowledge, this is the first study to provide surgeon-level insight into practice variation with an emphasis on the perceived natural history of umbilical hernias and various factors that may influence surgeon-level decision-making.

With respect to the perceived natural history of umbilical hernias in children, the results of this survey suggest that surgeons differ markedly in their perceptions of both risk of future complications and likelihood of spontaneous closure for defects that remain unrepaired. However, differences in perceived risk of future complications were relatively modest compared to differences in perceived likelihood of spontaneous closure. This variability is particularly noteworthy when comparing surgeons who typically delay repairs until after 4 years of age with surgeons who typically offer earlier repairs. For the hypothetical patient in the survey vignette, less than 3% of surgeons in both groups perceived a risk of future complications higher than 5%. However, nearly three-quarters of surgeons who routinely repair hernias after 4 years of age perceived more than a 25% likelihood of spontaneous closure compared to only 27% of surgeons who typically operate at 3 years of age and younger. These findings would suggest that a primary driver of early repair may be the perception that further observation beyond 3 years of age will offer little or no benefit to the patient, rather than differences in perceived risk of future complications.

With respect to the influence of clinical and nonclinical factors, physical exam findings had the greatest overall and relative influence on the decision to consider an early repair. Larger fascial defects, growth over time, and proboscoid skin changes were all found to have significant influence, as may be expected given the existing body of literature characterizing the association between these factors with complications and spontaneous closure [11–18]. In contrast, biological factors including differences in race, ethnicity, and sex had the least amount of overall influence. However, variability was observed in terms of the perceived need for earlier repair in Black children and girls. These findings may reflect concerns surrounding increased risk for complications or a decreased likelihood of spontaneous closure in these cohorts, however, more contemporary data have not supported such practice [19–21].

Caregiver-related factors were also associated with significant influence over the timing of elective repair. Parental anxiety over the risk of future incarceration had the greatest relative influence on surgeon decision-making out of all the factors examined in the survey (78% of all respondents). This was an unexpected finding given that the majority of surgeons estimated a less than 1% risk of future emergency complications if the hypothetical patient in the survey vignette remained unrepaired. More than half of surgeons also reported being influenced to consider earlier repair based on parental anxiety over cosmetic appearance, as well as anxiety over perceived parental neglect by family or friends. These findings suggest that caregiver anxiety is a powerful factor that may strongly influence surgeons to change their typical practice.

Sociodemographic factors were associated with the least overall influence on surgeon decision-making. Respondents were unanimous in reporting that insurance status had no influence on their consideration of earlier repairs, despite recent data that associated public insurance with an increased risk for undergoing early repair [10]. Variability was observed, however, in the relative influence of perceived financial challenges, unreliable access to a primary care provider, and expectations set by referring providers. These findings suggest that some surgeons may be influenced by a complex interplay between financial or insurance barriers to elective surgical care, as well as reliable primary care follow-up to ensure safe expectant management of asymptomatic hernias.

3.1. Limitations

The findings of this study should be considered within the context of its limitations. Despite a relatively high response rate for an APSA survey, respondents may differ from nonrespondents in their demographic characteristics and management practices for asymptomatic umbilical hernias. Although respondents were fairly heterogenous across demographic categories, only a small minority were either Canadian surgeons or practiced at community or nonchildren's hospitals**,** suggesting that results may be biased towards academic children's hospitals in the United States. Finally, responses were based on a single hypothetical patient, and the use of multiple choice and Likert scale responses to measure management and perceptions may oversimplify the nuanced approaches to umbilical hernia management in children.

4. Conclusions

The results of this APSA survey provide new insight into surgeon-level differences in practice and perceptions surrounding the management of asymptomatic umbilical hernias in children. Based on the findings of this study, multiple strategies may be necessary to reduce practice variation and disparities in care associated with this common condition. First and foremost, robust population-level epidemiological data are needed to define the natural history of umbilical hernias, particularly after 3 years of age and in the context of different constellations of physical exam findings over time. This may be particularly important for establishing the likelihood of spontaneous resolution as variation in perceived closure over time was much greater between surgeons who preferred to repair early rather than later compared to variation in the perceived risk of incarceration. Targeted educational efforts to address misconceptions surrounding higher complication rates and lower rates of spontaneous resolution in Black children and girls are also needed. Collaborative efforts between surgeons and primary care providers are needed to optimize management of caregiver anxiety and expectations, particularly surrounding cosmetic appearance and risk of complications. Finally, until more definitive epidemiological data are available, empowerment of caregivers through better informed consent and shared decision-making should be a high priority. These strategies are in alignment with the perceived needs expressed by survey respondents and could serve as a roadmap not only to establish consensus guidelines, but perhaps more importantly, reduce the number of children who may be undergoing potentially unnecessary surgery.

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