JTD JOURNAL OF THORACIC DISEASE
A PEER-REVIEWED, OPEN ACCESS JOURNAL FOR HIGH-QUALITY RESEARCH IN THORACIC DISEASES
IMPACT FACTOR 2.895

Peer Review File

Article information: https://dx.doi.org/10.21037/jtd-21-1671

Reviewer A

The paper describes an exciting problem of the pectus excavatum repair in a group of adults. According to many papers, the actual prevalence of pectus excavatum in adult populations is controversial. The methodology is appropriate, aimed at examining epidemiological data in a fairly large population. The results are pretty interesting. However, the manuscript requires major revision.
First of all, the manuscript requires some English editing. Note the missing articles.

Several mistakes to correct, for example:
Line 83 "the adult"
Reply: Thank you for this correction, the manuscript has been amended.
Changes in text: Line 83: There is limited data on the adult repair of Pectus Excavatum (PE).

Line 96 "a higher "
Reply: Thank you for this correction, the manuscript has been amended.
Changes in text: Line 106: "Increasing age was associated with a higher likelihood of any complication..."

Line 135 "the time"
Reply: Thank you for this correction, the manuscript has been amended.
Changes in text: Line 122: "to age at the time of surgery have not previously"

Line 145 " a single-institution experiences "
Reply: Thank you for this correction, the manuscript has been amended.
Change in text: Line 127: "relies on single institution experiences."

Line 151 "the preponderance"
Thank you for this correction, the manuscript has been amended to read:
Change in text: Line 132-133: "the preponderance of institutional level data suggests..."

line 172 "to capture better"
Reply: We disagree with this verbiage and have left the manuscript unaltered.

Line 174 " the above described "
Reply: Thank you for this correction, the manuscript has been amended.

Change in text: Line 164: "the above described criteria"

Line 179 " the severity of chest"
Reply: Thank you for this correction, the manuscript has been amended.
Change in text: Line 177: "the severity of chest wall deformity"

Line 211 "a higher"
Reply: Thank you for this correction: This section has been revised entirely.

Line 212 "a low rate of major"
Reply: Thank you for this correction: This section has been revised entirely.

Line 231 I suggest replacing "young adults" with "adolescents"?
Reply: Thank you for this correction: This section has been revised entirely.

Line 243 "overwhelming of the Caucasian race"
Reply: Thank you for this correction: This section has been revised entirely.

Line 246 "the frequency"
Reply: Thank you for this correction, the manuscript has been amended.

Line 250 "the more frequent"
Reply: We disagree with this verbiage and have left the manuscript unaltered.

Line 268 double "that"
Reply: Thank you but we are unable to find this in the manuscript.

Line 269 - "lower" instead of "inferior"
Reply: Thank you for this correction: This section has been revised entirely.

Line 275 "were" instead of "was"
Reply: Thank you for this correction, the manuscript has been amended.

Line 275 skip "for"
Reply: Thank you for this edit. The text has been changed as described below:
*Changes to text: Line 300: We have replaced "for" with "in", to read: "*shows that modified Nuss repairs in patients 30 and above were..."

Line 276 "the time"
Reply: Thank you for this correction, the manuscript has been amended.

Line 305 "differences"

Reply: Thank you for this correction, the manuscript has been amended.

In addition, the paper requires corrections when it comes to the content of individual parts:

Line 139-141: "The purpose of this..." - I suggest writing this sentence at the end of the Introduction, as a summary of the Introduction part.
Reply: Thank you for this suggestion. This sentence has been combined with the final sentence of the introduction as suggested.

Line 142-155: The introduction should briefly outline the problem and underline "gab in knowledge" in an interesting way to the reader. Please shorten it and simplify the Introduction. Some of the information contained in the Introduction may be transferred to the discussion.
Reply: Thank you for this suggestion. The following changes have been made
Changes to text: Lines 132-133 "but there is some data to suggest women comprise approximately 30% of patients over the age of 30 undergoing repair(6)." Has been removed.
Changes to text: Lines 123-126 "Because of a coding change associated with the adoption of ICD 10, it is now possible to disaggregate the modified Nuss procedure from other approaches to PE repair. Thus, studying patterns of care related to the modified Nuss procedure for adults undergoing surgery is now possible." Has been removed.

Results part I would not say I like the way the results are presented. The Results should contain a synthetic presentation of the results that have been successfully investigated together with the percentage proportions and the results of statistical significance. Narration using phrases such as "however" or "while" should be included in the discussion.
Reply: Thank you for this feedback, editorialized phrases have been removed from the results section. The section has been entirely re-written as directed with percentage proportions and all results of significance.

Line 101 (Conclusions in Abstract) The most important results from the paper should be found in the Conclusions. The first sentence is too general for me since you got the exact results. " Further study.." - this sentence makes no sense at this point. It can be included in the discussion, but in my opinion it should not be in conclusions, where the summary of the essential points of the paper should be.
Reply: Thank you for this suggestion, the text has been revised:
Changes in Text, Line 111-114: "Conclusion: Women comprise nearly half of patients undergoing modified Nuss repair after 30 years of age. There are significant differences in complication rates and charges when comparing patients by age.

Patients undergoing repair at high-volume facilities benefitted from shorter lengths of stay.

Discussion Despite interesting observations, the discussion lacks interesting conclusions and references from the literature. Despite the limitations in the literature mentioned by the authors, it is possible to attempt a much more exciting polemic to show that the authors know the topic they are writing about. Here I get the impression that the source material has not been adequately studied.
Reply: Thank you for this review. We have amended the discussion substantially. Changes in the text are too extensive to highlight here, we kindly refer reviewers to the the full manuscript to assess updates.

Lines 232-234 - this is an interesting observation, but I am utterly unconvinced by your conclusion from a scientific point of view. I do not quite believe that "patients frequently wait to undergo repairs until their 5th decade of life". I suggest you rethink and develop it somehow. You analyzed patients from 2016-2018. Maybe it is worth considering the operational possibilities in this group in the context of their demographics? The Ravitch Method was created in 1948 and Nuss in 1998 - perhaps these are people who had not had the option of minimally invasive treatment before? Moreover, today many of the funnel-cage operations in developed countries are now cosmetic considerations. It would be worth checking what indications were there 20 or 30 years ago when the current 50-year-olds were children? Maybe if the patients did not present cardiopulmonary compromise or evident exercise intolerance, they were not qualified for the procedure? Some papers also report the Haller index tendency to decrease with advancing age in adults. Maybe the current 50-year-olds patients were not qualified for surgery when they were adolescents but developed somatic symptoms in adulthood that forced them to undergo surgery?
Reply: Thank you for this correction. We have amended to the text to further discuss the possibility of patients having changes in physiologic reserve for older age and lacking access to a minimally invasive approach in younger age.
Changes in Text, Lines 247-257 "We believe this also raises important questions about pathways to adult repair of PE. From this data, it is unclear if these patients are aware of their conditions and delay treatment or rather remain undiagnosed until time of repair as adults. In cases in which patients have delayed treatment, it is also unclear what factors influence these decisions. It's possible that, in this adult cohort, some patients deferred treatment due to the lack of minimally invasive repair available at the time of diagnosis. It is further hypothesized that increasing symptom severity in older age could underpin this trend. Although the Haller index, a validated and widely utilized radiologic measurement of sternal depression, is widely understood to decrease with age as the shape of the chest wall shifts to a more circular transverse shape(14), it is possible that severity of symptoms simultaneously increase given age-related deterioration in physiologic reserve."

Lines 241-242 it's also an interesting observation, but I would not say I like the lack of a broader discussion of the results. In women, firstly, PE occurs less frequently; secondly, more often than PE, they pay attention to the asymmetry of the breast, which can also lead to PE under-recognition. In the case of females' chest wall deformities, keep in mind that most of the existing literature focuses on breast asymmetry and cosmetic reconstruction. Breast development and modesty in young women may mask the chest wall defect. According to some authors, despite the increased severity of PE deformity, females had a significantly better cardiopulmonary function and exercise tolerance than males. Furthermore, according to some findings, women had more severe deformities (higher Haller index value) and undergo the repair when they are older, with more significant symptoms and severity.
Reply: Thank you for this suggestion. The most recent epidemiologic radiology literature has identified gender equivalence of PE, we thus reject the premise that PE occurs less frequently in women. The literature surrounding cardiopulmonary testing and gender is controversial, and we believe lays outside of the scope of this study. We believe it is best to allow more focused studies on the specific topic to address the issue.

Lines 242-245: This conclusion is incomprehensible to me. Pectus excavatum appears to be most prevalent in whites. No specific data are available regarding racial distribution; however, treating pectus excavatum in African Americans is unusual. The sentence "This suggests non-Caucasian patients also remain underdiagnosed and treated for PE" contains an erroneous conclusion in my opinion; this observation just confirms the observation from other papers that found no significant difference between Caucasians and other races. Why are there no literature references here, even though there is research available on the subject?
Reply: Thank you for this suggestion. We have removed all references to race in the discussion.

Line 248-250 "It is unclear why the work by Kauffman et al. failed to identify the relationship between increased age and inferior outcomes that we and other researchers have shown." - I believe that this sentence should either be changed or removed from the article. They just got different results. Additionally, there is no citation in Bibliography. Kaufman's paper contains an immense disproportion between the adolescent group and the group of adults (92.1% vs. 7.9%), which could bias the results. Either way, this sentence is out of place. If you want to talk about someone's results, you should follow the described methodology and draw decent conclusions.
Reply: Thank you for this critique. We have amended the language as follows:

Changes in text: 280-285: "Our data and the above literature conflicts with the single previously published large database study evaluating outcomes for adult patients undergoing repair. This study showed no difference in complication rates when comparing pediatric and adult patients treated with modified Nuss procedure(9). It is unclear what underlying differences in data or analysis may have led to these conflicting results. Because of this disparity, further analysis utilzing NSQIP data, the NIS, and other large datasets is warranted to corroborate findings."

Tables All tables in the manuscript should be referenced in the text of the article. References to Tables 2 and 3 are missing.
Reply: Thank you for this critique. We have combined tables and assured they are appropriately referenced.

Reviewer B

It is always interesting to compare what volume does to outcome but this paper does not meet this purpose. You compare departments which do one maybe two cases in three years with departments which do 5 cases in average a year. Both should be categorized as low volume.
Reply: We appreciate this feedback. While the volume/outcome relationship is featured in this paper, it is not the primary emphasis of this study. Our selection of volume cutoffs is limited by the rarity of the procedure and the overall low volume of this procedure that is performed each year. Further, by performing this analysis, which does not exist elsewhere in the literature, we are able to see the overall acceptable risk profile of Nuss procedures being performed at low volume facilities.

Your analyze of the insurance status shows in my mind a social inequality. The rich can afford to have an insurance which might pay and that the white segment too might have the economy for this opposite the blacks and Hispanics.
Reply: We thank you for this feedback. We believe that an in-depth discussion of race and socioeconomic implication of insurance status is beyond the scope of this paper, but agree this is an important area for future research.

Your suggestion concerning that females are underdiagnosed you cann't conclude from your paper. I think the right conclusion is that the same number of females and males ask for correction in the group older than 30 years.
Reply: We thank you for this feedback. We have removed this language from the paper.
Changes in Text: Line 260-265: "We have found that the proportion of women undergoing repair also differs by age groups. In this dataset, there is near gender parity amongst those treated with modified Nuss after the age of 29. It remains unclear what factors drive this trend. Of note, a recent large radiologic cohort study found a slight female predominance of PE utilizing two standardized metrics for chest

wall measurement(14). Further research is needed to better understand gender-balance and timing of repair for PE."

You need to include some departments which do at least 1case a month and more than one case a year in the old group to conclude about volume and outcome.
Reply: We thank you for this feedback. We are unfortunately limited by the dataset and are unable to include higher volume facilities. We believe this analysis remains worthwhile for two reasons. (1) We have shown that differences do exists between our volume designations both in the demographics of the patients they treat and outcomes; and (2) because for many patients and providers, geography and financial constraints will limit surgeon and facility selection to hospitals with the experience profiles we have evaluated. Better characterizing the facilities and their outcomes we believe to thus be of value for this relatively rare procedure.

Reviewer C
Thank you for this very interesting retrospective analysis regarding PE demographics and outcomes following the Nuss procedure. Interestingly, you found a higher total complication rate in high volume centers and that patient wait undergo PE repair until 5th decade of life. You deduce no advantage for PE repair in high volume centers and you question the utility of regionalization of care.

Please allow some comments meant to improve the quality of the paper.
- your conclusions are base on a retrospective analysis and on a database including ONLY 20% of all inpatient hospital encounters. So, this analysis is not really representative, and the conclusions are not evidence based. So, I'm not sure that the word "trends" in the title is appropriate.
Reply: Thank you for this feedback. The NIS offers a representative sample, and we believe the sample size is adequate given the overall scale of the US healthcare system.

- thus, you question the utility of regionalization meant to improve the quality of provided care and to properly utilize available resources. Should you not consider achieving the learning curve of each single surgeon (responsible for a better surgical outcome) is more likely in a high than in a low volume center. Therefore, when defining "high volume center" it is important to state by how many surgeons the total number of interventions has to be divided to know the real number of interventions per surgeon. As reported in the literature, high specialized centers have better outcomes than smaller centers (i.e. Martini Hospital in Hamburg/Germany regarding the outcomes of prostate care). So, I cannot agree with your conclusions.
Reply: Thank you for this feedback. We argue that there is literature to support improved outcomes for patients as related to the volume/outcome relationship when examining at level of surgeon-volume (as the reviewer specifies) but also at a facility-

volume level. This likely owes to a multitude of factors as related to perioperative care. (See: Varghese et al. "Variation in Esophagectomy Outcomes in Hospitals Meeting Leapfrog Volume Outcome Standards." Annals of Thoracic Surgery, Volume 91, Issue 4, April 2011, Pages 1003-1010, Ruth Huo. Et al. "Systematic review and a meta-analysis of hospital and surgeon volume/outcome relationships in colorectal cancer surgery." J Gastrointest Oncol. 2017 Jun; 8(3): 534–546.)

While future research would benefit exploration of the surgeon –volume outcomes relationship in the context of Nuss, the NIS does not allow for study of this. We will explore further study on this issue with a dataset that is not prohibitive to such an analysis.

- introduction: you mention two "purposes of the study". Please condense, which one is

Reply: Thank you for this feedback, we have condensed these as suggested.
Changes in text: Lines 137-140: "The purpose of this study is to utilize a representative national sample to describe the current landscape of adult repair of PE via modified Nuss procedure, with attention to the demographics of patients undergoing adult repair and outcomes as related to patient age and facility procedure volume.

- methods: please specify "modified Nuss procedure"; lack of severity of PE;
Reply: Thank you for this specified our definition of "modified nuss."
Changes in text: Lines 150-151: "While the term "modified Nuss" has been used broadly in the literature to describe multiple innovations, we employ the term to describe the minimally invasive approach originally developed by Donald Nuss in 1987 utilizing two lateral thoracic incisions via which a sub-sternal steal bar is placed which was later modified to allow for the use of thoracoscope to avoid mediastinal injury(10-12).
Reply: We are unsure of the intention of this comment, "lack of severity of PE." We have addressed the lack of data surrounding Haller index or other measures of disease severity in the NIS database.
Changes in text: Line 319-320: "Third, the NIS lacks a variable to describe Haller Index or other measures of PE severity thus limiting our comparison."

- discussion: Line 269: erase "this". Pertinent questions remained unanswered, i.e. why you have more bar dislocation and more medical complications in the older population?
Reply: Thank you for this correction.
Changes in text: Lines: 288-289. "While this trend was driven by minor complications, it nonetheless conflicts with previous literature."

Reply: Thank you for this suggestion regarding sternal bar rotations, we have amended the text.

Change in text: Lines 269-272: "This prior evidence demonstrates that operative times are significantly longer in patients over 30(6), that there is a trend toward more frequent sternal bar rotation or displacement (which is attributed to stiffer chest walls found in older patients)(4, 6).."

Reviewer D

Few studies have analyzed adult cases of pectus excavatum surgery. This study is very significant because it examines the age distribution, gender, race, length of hospital stay, and hospitalization costs and so on of cases who underwent the Nuss procedure in the United States.

With regard to the male to female ratio of pectus excavatum, a paper has been seen where the ratio of females is almost equal to that of males in adults while males are more common in children. This study also showed that the proportion of females increases with age. This is very significant. The study also showed that the median age for surgery in adults over 30 was 48 years. This suggests that symptoms associated with aging may be a factor in the decision to operate.

A more detailed study of surgical outcomes and complications using a larger number of patients is still needed, but this survey has its limitations.

Reply: We appreciate this reviewer's comments and agree that these novel findings are important to share in the academic literature. Despite the limitations posed by the sample size and the dataset, we believe these findings will be a useful basis to spark further valuable research around the topic of gender and age with regard to diagnosis and treatment of PE.

Reviewer E

The authors compare trends in Modified Nuss procedure using the National Inpatient Sample (NIS). Differences between adults and pediatrics are interesting although major conclusions are limited given the limitations of the registry which the authors acknowledge. The findings are interesting and of general importance to the surgical community. Minor questions.

Reply: We appreciate these comments.

1. Thrombotic complications are higher in adults which are not surprising since DVTs are uncommon in children and patients are rarely given prophylaxis. Is data on DVT prophylaxis available?

Reply: We appreciate this insight. The trend appears to be mostly driven by anemia, however, and this unfortunately no data on DVT prophylaxis available in the dataset.

2. Line 254, 264 spelling error

Reply: Thank you, corrected as follows.
Change in text: Lines 275-276 "Ultimately, there is some evidence that procedures performed on patients after the age of 30."

3. Table 2 compared to table 4 and 5. Thrombotic complications are listed as a major complication in Table 2 and are under Minor complication in table 4 or 5. I am not sure if this is an intentional subheading in table 4 and 5. Would clarify.
Reply: Thank you for this suggestion. The tables have been revised to clarify. There are only thrombotic complications of "major" designations.

Reviewer F

The purpose of the study "National Trends in Pectus Excavatum Repair: Patient age, facility volume, and outcomes" is to elucidate characteristics of the population undergoing elective adult repair of PE; outcomes as they relate to patient age at time of repair; and any trends in outcomes as they may relate to hospital type and annual procedural volume.

Overall, the questions posed in the article are relevant and of scientific interest. Unfortunately, the data to illuminate the questions are too weak and the methodological arguments on which the conclusions are based are not valid.

1. Line 130-132:
"For patients with sternal depression causing cardiopulmonary compromise, exercise intolerance, or severe cosmetic defect, surgical repair via modified Nuss procedure is the preferred treatment."
Despite numerous descriptions of patients reporting subjective improvement of exercise tolerance after PE correction, clear and consistent objective data to corroborate this phenomenon physiologically have been elusive (Obermeyer et al., 2018; Cebeci et al., 2020). This statement should therefore be softened as recent literature does not support such an indisputable statement.
Reply: Thank you for this recommendation, we have amended the text.
Changes in text: Lines 117-118: "For patients diagnosed with sternal depression causing cardiopulmonary compromise, exercise intolerance, or severe cosmetic defect, surgical repair via modified Nuss procedure frequently offered as treatment."

2. Line 143-144: "there remains limited literature on adult repair." Define "limited literature". A simple Pubmed search for "Pectus excavatum adult" shows several articles on the subject. Please rephrase the sentence.
Reply: Thank you for this valuable contribution. We have amended the text.
Changes in text: Lines 124-127 "While the modified Nuss procedure has been broadly studied and is accepted as the standard of care for pediatric patients undergoing PE

repair, there remains limited high level evidence on adult repair. Existing literature is exclusively retrospective in nature and predominantly relies on single-institution experiences(2-6).”

3. In the introduction the purpose is defined twice: “The purpose of this study is thus to utilize a representative national sample to better describe the current landscape of adult repair of PE via modified Nuss procedure, with attention to the characteristics of the population undergoing elective adult repair and outcomes as they relate to both age and facility procedure volume” and “The purpose of this study is to elucidate: characteristics of the population undergoing elective adult repair of PE; outcomes as they relate to patient age at time of repair; and any trends in outcomes as they may relate to hospital type and annual procedural volume”. Define the purpose of the study only once.
Reply: Thank you for this feedback, we have condensed these as suggested.
Changes in text: Lines 137-140: “The purpose of this study is thus to utilize a representative national sample to better describe the current landscape of adult repair of PE via modified Nuss procedure, with attention to the characteristics of the population undergoing elective adult repair and outcomes as they relate to both age and facility procedure volume.”

4. I assume that the data collected from a National Inpatient Sample (NIS) database was a US-National database and if so please clarify. In the method sections, it must be explained what the database covers, i.e. how large a proportion of hospitals that perform pectus surgery are registered in the database and who runs the database.
Reply: Thank you for this valuable suggestion. Please find amendments to the text below. Unfortunately, as this is only a random sample, it is impossible to know how many facilities are performing this procedure based on this or any other database to our knowledge.
Changes in text: Lines 143-148: “The NIS is a large, all-payer inpatient database that is publicly available and allows for the estimation of national trends in the United States (US). Each year of data contains more than 7 million unweighted hospitalizations. Data is collected and maintained by the Healthcare Cost and Utilization Project (HCUP) which is managed by the Agency for Healthcare Research Quality (AHRQ), a division of the US federal Department of Health and Human Services (HHS).”

5. An argument for this study was to “utilize a representative national sample” over a two-year period, however, if data was collected from a National database in the US it seems strange that only 360 patients were included. And if so, it would not be reasonable to state “representative national sample”.

Reply: The NIS offers a representative sample. Given the overall low volume of the procedure that is performed each year, we believe this volume is consistent with the sample size.
Changes in text: Lines 143-148: "The NIS is a large, all-payer inpatient database that is publicly available and allows for the estimation of national trends in the United States (US). Each year of data contains more than 7 million unweighted hospitalizations. Data is collected and maintained by the Healthcare Cost and Utilization Project (HCUP) which is managed by the Agency for Healthcare Research Quality (AHRQ), a division of the US federal Department of Health and Human Services (HHS)."

6. A major weakness of the study is the lack of correlation between complications and severity of pectus excavatum in regard to Haller index. This point must be addressed.
Reply: Thank you for this suggestion. This has been added to the limitations section.
Changes in text: Line 319-320: "Third, the NIS lacks a variable to describe Haller Index or other measures of PE severity thus limiting our comparison."

7. A weakness of the study is the inability to use the Clavien-Dindo classifications when analyzing NIS data and complications. This point should be addressed.
Reply: Thank you for this suggestion. This has been added to the methods and to the discussion in the limitations section.
Line 181-182: "Clavien-Dindo classifications are unable to be used when analyzing NIS data given the lack of detail regarding treatment for some complications. There was no missing data in our sample."
Line 320-322: "Fourth, we are limited in the granularity of our analysis of complications due to lack of information about how complications were treated, thus inhibiting the use of the Clavien-Dindo classifications."

8. What is the rationality for the age divisions? It is not satisfying only to refer to a previous study by Jaroszeswki et al.
Reply: Thank you for this query. There appears to be no definitive rational for the subjective age categorizations that have been used previously in the literature when segregating patients that have undergone Nuss repairs. We have thus sought to use the same categorizations as a respected author and highly-cited work in order to facilitate comparisons across available data.

9. Categorizing the facility as a low or high-volume facility in accordance to the mean number of operations per facility over the three years of analysis is NOT valid. A cut-off of above 7 Nuss repairs is by far not enough.
Reply: Thank you for this feedback. We believe that this volume cutoff is a reflection of the overall low volume of this procedure being performed annually in the US. Because many patients and providers considering this procedure must choose

between surgeons with limited or very limited experience with the procedure, we believe this analysis remains a valuable contribution to the limited existing national-level literature on this procedure.

10. In table 1 I'm puzzled that pneumothorax is not listed as a complication?
Reply: Thank you for this important query. We believe that diagnosis of minor pneumothorax after this thoracic procedure is to be expected. There is unfortunately no way to designate clinically significant pneumothorax or pneumothorax that develops after chest tube removal from insufficient pneumothorax in the NIS data. We have thus excluded this from our analysis.

11. House income by zip should be clarified.
Reply: Thank you for this recommendation. The text has been amended as follows.
Changes to text: Lines 168-169: "Data were collected on patient demographics, including: age, sex, race, admission status, insurance status, and median income quartile by patient zip code (US geographic postal code designations)."

12. Access to insurance and differences between insurances should be clarified.
Reply: Thank you for this query. Clarification has been added to the text.
Changes to text: Lines 169-174: "Data on insurance status was also gathered (Medicare is a federally-funded, public insurance program available to all persons ages 65 or older; Medicaid is a state-based federally subsidized public insurance program with varying qualifications linked to individual or household income-level in each state; private insurance is designated as employer-based insurance programs or those purchased on health insurance marketplaces as a created by the Affordable Care Act (ACA))."

Reviewer G
line 264 page 10 "appropriate" sp
Reply: Thank you for this revision. The spelling has been corrected.

I would comment that there should be a paragraph discussing adult pectus repair in general and the nuss procedure in adults. Are there technical considerations when performing the nuss procedure in adults vs children? I think this is critical to understanding the outcomes differences and complication rates. Chest walls are significantly less compliant in the adult population and some would argue the theory behind why the nuss procedure works doesn't carry over to the adult population.
Reply: Thank you for this suggestion. The following has been added to the discussion.
Changes to text: Lines 276-279: "It has been argued that the decreased adult chest wall compliance as compared to pediatric and adolescent patients may impact the success of Nuss repair and drive increased rates of some types of complications amongst adults(17).

Reviewer H

The aim of this present retrospective study was to describe national trends in adults undergoing Nuss procedure using data from a national database. A total of 360 patients were included in analysis and results indicate higher complication rates and hospital charges in older patients.

The paper is well written, although It does not add noteworthy to our knowledge of the Nuss procedure not achieve its aims due to some of the lacks mentioned below.

Comments:

ll. 169-171: why exclude patients <12 year of age?
Reply: Thank you for this query. The focus of this study is the adult repair of pectus. We have sought to include adolescents insofar as their value as comparator group. While there is a dearth of literature on adult repair, we find ample evidence regarding pediatric repair in the literature and have thus excluded them from the analysis as they are not the primary population of interest.

ll. 169-175: It is not specified in detail the specific technique as the nuss procedure has several modifications, and different techniques have shown different complication profiles.
Reply: Thank you for this query. Our interpretation and definition of the term for this paper is now explained in the methods section.
Changes in the text: Lines 150-151: "While the term "modified Nuss" has been used broadly in the literature to describe multiple innovations, we employ the term to describe the minimally invasive approach originally developed by Donald Nuss in 1987 utilizing two lateral thoracic incisions via which a sub-sternal steal bar is placed which was later modified to allow for the use of thoracoscope to avoid mediastinal injury(10-12).

ll. 179-182: On which basis was the complications classified in either minor or major? This is a very central point; various authors reporting diverging complication rates from Nuss surgery (and modifications thereof) use non-validated classifications of complications leading to incomparable results.
Reply: Thank you for this query. There is unfortunately no prior literature utilizing the NIS to mirror, and the dataset employs different coding than is employed by the NSQIP database. We therefore have relied on surgeon designation of which complications are relevant to the given procedure, and designated any complication which could prolong a hospitalization as "major" and others as "minor".

Changes in the text: Lines: 178-180 "Complications were sub-classified according to major vs. minor, and type based on the authors' discretion prior to analysis. Complications which would prolong hospitalization were designated as major."

ll. 187-189: why use the mean number of operations to categorize high and low volume centers? >7 repairs per facility per one or two years to be classified as high volume is debatable.
Reply: Thank you for this feedback. We believe that this volume cutoff is a reflection of the overall low volume of this procedure being performed annually in the US. Because many patients and providers considering this procedure must choose between surgeons with limited or very limited experience with the procedure, we believe this analysis remains a valuable contribution to the limited existing national-level literature on this procedure.

ll. 284-287: as mentioned by the authors, the data from the NIS registry only conveys 20 % of in hospital encounters. It is unknown whether the NIS database gives a representative sample when aiming to answer the aim of this paper (national trends in adult patients). This is a major drawback and severely limits the value of the findings. Is it possible to compensate for this; which centers are missing? How many nuss corrections are performed annually?
Reply: Thank you for this query. The data in the NIS is unfortunately not linked to facility identifiers, we therefore do not know which centers are missing. Similarly, there is no definitive data on how many Nuss procedures are performed each year that exist at a national level.

Reviewer I

Abstract
- "Modief Nuss repair 2016-2018" -> "between" is missing
Reply: Thank you for this correction. "Between" has been added.
Changes in the text: Lines: 88-90 "Because of a coding change associated with ICD10, a retrospective cohort analysis using the National Inpatient Sample (NIS) for patients 12 or older undergoing modified Nuss repair between 2016-2018 was possible."

Introduction
- The problem or issue faced, leading to the research question or aim of this study, other than the fact that this has not been previously analyzed, does not become entire clear from the introduction.
Reply: Thank you for this feedback. We would argue that the lack knowledge surrounding the demographics and outcomes of adult patients undergoing adult repair is identified as the premise of the paper.

- In addition, the purpose of the study is presumptuous.
Reply: Thank you for this comment. The language has been amended to be less presumptuous.
Changes in text: Lines 137-140: "The purpose of this study is thus to utilize a representative national sample to better describe the current landscape of adult repair of PE via modified Nuss procedure, with attention to the characteristics of the population undergoing elective adult repair and outcomes as they relate to both age and facility procedure volume."

Methods
- Please state the country et cetera where this study has been conducted?
Reply: Thank you for this comment. Please see amendment to the NIS description to show this is a study of the United States.
Changes in text: Lines 143-148: "The NIS is a large, all-payer inpatient database that is publicly available and allows for the estimation of national trends in the United States (US). Each year of data contains more than 7 million unweighted hospitalizations. Data is collected and maintained by the Healthcare Cost and Utilization Project (HCUP) which is managed by the Agency for Healthcare Research Quality (AHRQ), a division of the US federal Department of Health and Human Services (HHS)."

- Please add a state regarding patient consent, whether it was waived or not?
Reply: Thank you for this recommendation. Text has been altered as below.
Changes in text: Lines 156-157 "Patient consent was deferred due the retrospective nature of the analysis and the lack of identifiable information."

- Please add the STROBE guidelines to report your article.
Reply: Thank you for this suggestion. We have utilized STROBE guidelines for cohort study.
Changes to text: Line 154-155: "Missing data were reviewed on a case-by case basis regarding inclusion or exclusion of the given patient."
Changes to text: Line 237-238: There were six missing data elements identified: Four patients lacked household income data, two patients were missing data regarding total charges. These patients were included in the final analysis, appropriate adjustments were made in income and charge analyses to reflect these missing data."

- It is strange to subclassify complications based on the author's discretion. If the data is too limited to apply the Clavien-Dindo classification which is rather simplistic, how can an author than classify the complications? In addition, which author did perform

this? Was it a single surgeon? Or just a researcher? If it was classified by more assessors, how were disagreements resolved?

Reply: Thank you for this query. There is unfortunately no prior literature utilizing the NIS to mirror, and the dataset employs different coding than is employed by the NSQIP database. We therefore have relied on surgeon designation of which complications are relevant to the given procedure, and designated any complication which could prolong a hospitalization as "major" and others as "minor".

Changes in the text: Lines: 178-180 "Complications were sub-classified according to major vs. minor, and type based on the authors' discretion prior to analysis. Complications which would prolong hospitalization were designated as major."

- The fact that no missing data was present in a retrospective series over 3 years seems rather strange?

Reply: Thank you for this revision. We have now included information on this important issue.

Changes to text: Line 237-238: There were six missing data elements identified: Four patients lacked household income data, two patients were missing data regarding total charges. These patients were included in the final analysis, appropriate adjustments were made in income and charge analyses to reflect these missing data."

- Please elaborate on the age groups by Jaroszewski. Now the readers are required to separately open and read the article of Jaroszewski, troubling the easiness of reading your article.

Reply: Thank you for this query. There appears to be no definitive rationale for the subjective age categorizations that have been used previously in the literature when segregating patients that have undergone Nuss repairs. We have thus sought to use the same categorizations as a respected author and highly-cited work in order to facilitate comparisons across available data.

- How was normality tested?

Reply: Thank you for this revision. We have now included information on this in our methods section.

Changes to text: Line 195: "Kolmogorov-Smirnov test was employed to asses for normality."

- Why wasn't the Fisher's exact test used instead of the chi-square test for 2x2 cross comparisons.

Reply: Thank you for this suggestion. We have reflected changes in our manuscript and tables. Fisher's exact tests were utilized for 2x2 cross comparisons when the expected frequency of a complication rate of interest was less than 5%. For example, major complication rates.

Changes to text: Lines 193-194 "Fisher's exact tests were used when expected frequencies were less than 5% for the analysis regarding complication rates."

Results

- Is your operated cohort representative since pectus excavatum is known to be more common among males? In the present study there is almost a 50:50 distribution. Please comment.

Reply: We believe this is one of the important contributions of this study, identifying the prevalence of PE amongst females. Indeed the most recent epidemiologic radiology study suggests female predominance (see: Biavati M, Kozlitina J, Alder AC, Foglia R, McColl RW, Peshock RM, et al. Prevalence of pectus excavatum in an adult population-based cohort estimated from radiographic indices of chest wall shape. PLoS One. 2020;15(5):e0232575.).

- A linear relationship was observed for complications with increasing age? However this was not supported by any statistics? From your analysis it can only be said that it differs among age groups. Relationships should be identified by e.g. correlation coefficients.

Reply: Thank you for this feedback. Language around "linear" has been removed. Please find below amendments to the results section.

Changes in Text: Lines 266-268: "Regarding complications, we have identified differences in rates of complications amongst age groups"

- If the total number of included patients were 360, how many patients were at least operated by "high-volume centers"? In addition, from how many centers were the enrolled patients included?

- A lot of data is shown, however, no emphasis is placed on for example a primary outcome. This is also constituted by a missing well formulated research aim or objective with rationale.

Reply: thank you for this critique. The primary aim of this research is to define the demographics of those undergoing adult PE repair. We believe the value in this question is identified in the previously discussed identification of the prevalence of PE treatment of adult women, which has not previously been identified.

Discussion

- Older patients tend to suffer from more postoperative pain than those of younger age undergoing the Nuss procedure. Please comment on this in your discussion. A useful citation is shown below. de Loos, Erik R., et al. "Nuss procedure for pectus excavatum: a comparison of complications between young and adult patients." The Annals of Thoracic Surgery 112.3 (2021): 905-911.

Reply: Thank you for this critique. We believe that discussion of postoperative pain is beyond the scope of the clinical data the NIS can usefully illustrate. We have included this important citation.

- Please elaborate on the presence of registration/selection bias as not all centers contributed to the registry? Were all patients automatically entered? Otherwise this may also introduce additional bias.
Reply: Thank you for this critique. We believe this issue of facility selection bias is already adequately covered with the below text: Lines 310 - 315. "There are several notable limitations to this study. First, the NIS data we have worked from includes approximately 20% of all inpatient hospital encounters in the United States each year. It is thus possible major centers performing high volumes of Nuss repair have been inadvertently excluded from this analysis. This could bias our results against the benefit achieved at very high volume institutions, and this possibility would undermine our analysis with regards to trends in regionalization."

- "Our data suggests the modified Nuss 273 procedure is being performed safely at both high and low volume facilities" Please comment on this statement in the light of the following reference: de Loos, E. R., Daemen, J. H., Pennings, A. J., Heuts, S., Maessen, J. G., Hulsewé, K. W., & Vissers, Y. L. (2020). Minimally invasive repair of pectus excavatum by the Nuss procedure: The learning curve. The Journal of Thoracic and Cardiovascular Surgery.
Reply: Thank you for this valuable suggestion. We have included the reference and altered the text as follows.
Changes in text: Lines 295-299 "Overall, we argue that this data shows that the modified Nuss procedure is being performed safely at both high and low volume facilities. This aligns with previous literature surrounding the learning curve for the Nuss procedure showing that after 10 proctored procedures Nuss can safely be performed by surgeons previously untrained in the technique(18)."

- The conclusion is too presumptuous. The study has severe limitation by which hard conclusions cannot be made. For example it is stated that major complications increase with age, it can only be stated that it differs among age groups, as previously mentioned. In addition, complications were subjectively graded by the authors which is extremely prone to errors.
Reply: Thank you for this feedback. We have addressed the issue of subjectivity of complication categorizations and the rationale for this approach in the above queries and responses. Similarly, we have revised the discussion as indicated above to state that complication rates differ.

- In addition: I don't see how it is questioned that regionalization favors the outcomes? This is not statistically determined nor constituted by the results.

Reply: This comment is difficult to interpret. We believe regionalization is favorable in cases where procedures (such as Whipple procedure or esophagectomy) achieve poor outcomes at low volume facilities. Therefore, if there is demonstration of comparable outcomes between facilities performing low and high volumes of a procedure, there is little utility in policies or financial incentives to promote regionalization in the authors' opinion. We have left the text unaltered.

- There was no attribute funding for this research does not belong in the conclusion.
Reply: Thank you for this feedback. This has been removed from this section of the manuscript