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SYSTEMATIC REVIEW

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The prevalence of spontaneous resolution among pediatric trigger thumb: a systematic review and meta-analysis

QingSong Tang[1†], XinLing Miao[2†], Kang Zhao[1], Jie Hu[1] and Xiang Ren[1*]

Abstract

Background Trigger thumb is a prevalent hand condition observed in children, and its management remains a topic of considerable debate, ranging from mere observation to surgical intervention. In recent times, there has been a growing interest in exploring nonoperative treatments as alternatives to surgical procedures for managing pediatric trigger thumb. Gaining insight into the prevalence of spontaneous resolution in pediatric trigger thumb is of paramount importance. However, the literature presents a wide variation in estimates regarding the prevalence of this spontaneous resolution, highlighting the need for further investigation and consensus. The aim of this review was to estimate the overall prevalence of spontaneous resolution among pediatric trigger thumb.

Methods This study meticulously followed the PRISMA guidelines and registered in the PROSPERO. The PubMed, Embase, and Cochrane Library databases were searched for all relevant studies up to May 2024.Inclusion criteria were studies reported only observation spontaneous resolution pediatric trigger thumb, aged up to 14 years, reported at least 10 thumbs and followed up time at least 3 months. Confounded intervention treatment measure studies were excluded. To synthesize the prevalence rates from individual studies, we employed a random-effects meta-analysis. In order to uncover the sources of heterogeneity and to compare prevalence estimates across different groups, we performed sensitivity and subgroup analyses. To meticulously evaluate the quality of the included studies, the Joanna Briggs Institute's quality assessment checklist was employed. Furthermore, to assess the heterogeneity among the studies, both Cochran's Q test and the I^2 statistic were utilized.

Results A total of eleven studies were included for the final analysis, with 599 pediatric trigger thumbs. Our final meta-analysis showed that more than one-third of these pediatric trigger thumb cases resolved spontaneously, with a resolution rate of 43.5% (95% CI 29.6–58.6). Subgroup analyses showed that in terms of age at the first visit, the prevalence of spontaneous resolution in the less than 24 months group and in the 24 months or older group was 38.7%(95% CI 18.1–64.4)and 45.8%(95% CI 27.4–65.4), respectively. There was no significant difference between the two groups($P=0.690$). When analyzing follow up time, the prevalence of spontaneous resolution in the 24 months or longer group and in the less than 24 months group was 58.9%(95% CI 41.6–74.2)and 26.8%(95% CI 14.7–43.8),

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respectively.There was significant statistical differences between the two groups($P=0.009$). Based on the initial severity of interphalangeal (IP) joint flexion contracture, the prevalence of spontaneous resolution in the 30 degrees or less group and in the other measurements group was 54.1%(95% CI 31.5–75.1)and 37.1%(95% CI 21.9–55.4), respectively.There was no significant difference between the two groups($P=0.259$).

Conclusion Our study demonstrates that a significant proportion of pediatric trigger thumbs resolve spontaneously. This finding highlights the benefits of early observation in managing this condition. By prioritizing non-operative observation, both parents and surgeons are better equipped to make informed decisions regarding the treatment of pediatric trigger thumb, potentially reducing the need for surgical intervention.

Keywords Spontaneous resolution, Pediatric, Trigger thumb, Systematic review, Meta-analysis

Introduction

Research findings indicate that the prevalence of pediatric trigger thumb (PTT) ranges from 0 to 3.3 per 1,000 live births [1, 2].The etiology of pediatric trigger thumb remains ambiguous, with some scholars suggesting a combination of congenital and acquired factors [2, 3]. It is plausible that the actual prevalence acquired may be higher than congenital, as numerous cases manifest after the age of 12 months. Typically, the average age at diagnosis falls between 6 and 24 months [4].The primary concern revolves around a developmental discordance between the flexor pollicis longus tendon and its encompassing sheath. Historically, the surgical release of the A1 pulley has been the conventional approach for treating pediatric trigger thumb. However, emerging research indicates that a non-surgical observational strategy may result in spontaneous resolution of the condition. Study has reported over half of the affected children can anticipate a natural recovery without surgical intervention, typically within an average follow up time of approximately four years [5]. In addition, surgical intervention involving A1 pulley release has demonstrated successful outcomes for children over the age of five, irrespective of their age at the time of the procedure [6]. However, national data reveal that the surgical management of pediatric trigger thumb is often conducted more frequently and at younger ages than what the current literature advocates. This tendency toward over-treatment not only poses potential harm to patients but also imposes unwarranted financial burdens on healthcare systems [7].

Therefore, comprehending the authentic rate of spontaneous resolution in pediatric trigger thumbs is of paramount importance. This understanding is essential for considering early observation as a viable approach, which could alleviate suffering and mitigate associated negative outcomes. Broadly speaking, the reported prevalence rates of spontaneous resolution exhibit considerable variability across different studies, ranging from no occurrences to nearly four out of every five cases resolving on their own [8–10].

No systematic review or meta-analysis has thoroughly estimated the consolidated incidence of spontaneous resolution in pediatric trigger thumb. Evidence derived from such a meta-analysis would offer robust insights into the epidemiology of spontaneous resolution in pediatric trigger thumb. This information could be invaluable for both parents and surgeons, aiding them in making informed decisions regarding the choice between non-operative and operative treatments for pediatric trigger thumb.Therefore, the objective of this review is to undertake a comprehensive analysis of existing literature on the prevalence of spontaneous resolution in pediatric trigger thumb, employing both qualitative and quantitative methodologies.

Methods

Research design and method

This study meticulously followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines throughout its protocols. The systematic process of searching, assessing eligibility, evaluating quality, extracting data, and analyzing data was rigorously executed based on a predesigned protocol. Moreover, the study protocol was duly registered on the International Prospective Register of Systematic Reviews (PROSPERO) prior to the commencement of data extraction (Registration CRD42024550745).

Data source and selection process

The literature search was conducted on May, 2024, utilizing three major databases: PubMed, Embase, and The Cochrane Library. The search strategy employed a combination of MeSH terms and keywords, specifically targeting the following phrases: “spontaneous resolution” or “observe” or “conservative” and “child” or “infant” or “newborn” or “pediatric”and “trigger finger” or “trigger thumb”.To ensure comprehensive coverage, additional relevant studies were meticulously identified by thoroughly reviewing the reference lists of the selected eligible studies.

Eligibility criteria and study selection

In this comprehensive review, we included studies that adhered to the following criteria: (i) The study

participants were children diagnosed with pediatric trigger thumb, aged up to 14 years, reported at least 10 thumbs and followed up time at least 3 months; (ii) The study either reported the prevalence of spontaneous resolution or provided sufficient data to calculate this prevalence; and (iii) The study was published in the English language. We excluded followed up time less than 3 months, confounded intervention treatment measure studies, reviews, commentaries, case reports, and studies conducted on animal subjects. Additionally, letters to the editor, conference papers, books, editorials, and notes were also excluded from our analysis.

Methods for data extraction and quality assessment

Two independent authors meticulously extracted pertinent data from the selected studies. The information collected from each study encompassed the following details: the name of the first author(s), the sample size, the year of publication, the age at the initial visit, the follow up time, the initial severity of interphalangeal (IP) joint flexion contracture, as well as the number of spontaneous resolution among pediatric trigger thumb and their corresponding prevalence estimates.

All search results were aggregated and subsequently subjected to an independent eligibility screening by two of the authors. In instances of disagreement, a third author intervened during a meeting with the screening authors to mediate and resolve conflicts. This was achieved by attentively listening to the arguments presented and fostering discussions until a consensus was reached. The screening process entailed a meticulous review of the abstracts for each result. Following the initial screening and elimination of duplicates, the studies deemed potentially relevant were subjected to a thorough full-text review to ascertain their suitability for inclusion.

To assess the quality of the studies incorporated into the final analysis, we employed the Joanna Briggs Institute Quality Assessment Tool. This tool evaluates individual studies based on frequency scales, with responses categorized as 'yes,' 'no,' 'not clear,' and 'not applicable.' The total quality score for each study was meticulously calculated by summing the number of positive responses.

Data synthesis and analysis

In this research, all statistical analyses were meticulously performed utilizing the Comprehensive Meta-Analysis Software, version 3.0. The prevalence rates derived from the individual studies were amalgamated through the application of a random-effects meta-analysis model [11]. To evaluate the degree of heterogeneity between the studies, the I^2 statistic was employed [11].The interpretation of the I^2 values is as follows: a value of 75% indicates high heterogeneity, 50% signifies medium heterogeneity, and 25% denotes low heterogeneity [12]. To assess potential sources of heterogeneity across the studies, we considered three key factors: the age at the initial visit, the duration of follow-up, and the initial severity of interphalangeal (IP) joint flexion contracture. To evaluate the risk of publication bias, we employed Egger's regression tests and funnel plots. For all statistical analyses, a P-value of 0.05 was established as the statistical significance.

Outcomes

Identifcation of relevant studies

Our comprehensive and meticulous search process initially identified a total of 123 studies. However, upon closer examination, we found that 52 of these were duplicates and consequently excluded them from our analysis. Subsequently, during the evaluation phase focusing on titles and abstracts, we removed an additional 47 records—24 based on their titles and 23 based on their abstracts—as they failed to meet our stringent inclusion criteria. As a result, we retained the full texts of 24 publications for more in-depth scrutiny. Ultimately, out of these, 11 publications were deemed suitable and qualified for inclusion in our current systematic review and meta-analysis(Fig. 1).

Characteristics of included studies

The fundamental attributes of the studies encompassed in this systematic review and meta-analysis are delineated in Table 1. In total, 11 articles [5, 8, 9, 13–20] were incorporated into the final analysis, encompassing 599 cases of pediatric trigger thumb that exhibited spontaneous resolution. The studies reviewed were published over a substantial period, spanning from 1974 to 2021. The sample sizes of these included studies varied significantly, ranging from as few as 12 pediatric cases to as many as 107. Furthermore, the age of the children at their initial visit for these studies spanned from 18 months to 57 months. The mean follow-up duration for the studies included in our analysis varied significantly, ranging from 3 months to an extended period of 59 months. Among these studies, four meticulously documented the average initial flexion deformity of the interphalangeal joint. This deformity was precisely measured using a goniometer, ensuring accuracy and consistency in the recorded data.

Quality of included studies

Table 2 presents a detailed analysis of the quality and potential biases inherent in the studies included in this review. Notably, four studies, representing 36% of the total, utilized an adequate sample size to accurately determine the prevalence of spontaneous resolution. Furthermore, approximately six studies, accounting for 54.5%, received positive evaluations concerning their response rates. Remarkably, all of the studies, encompassing 100%, employed appropriate statistical analyses to investigate

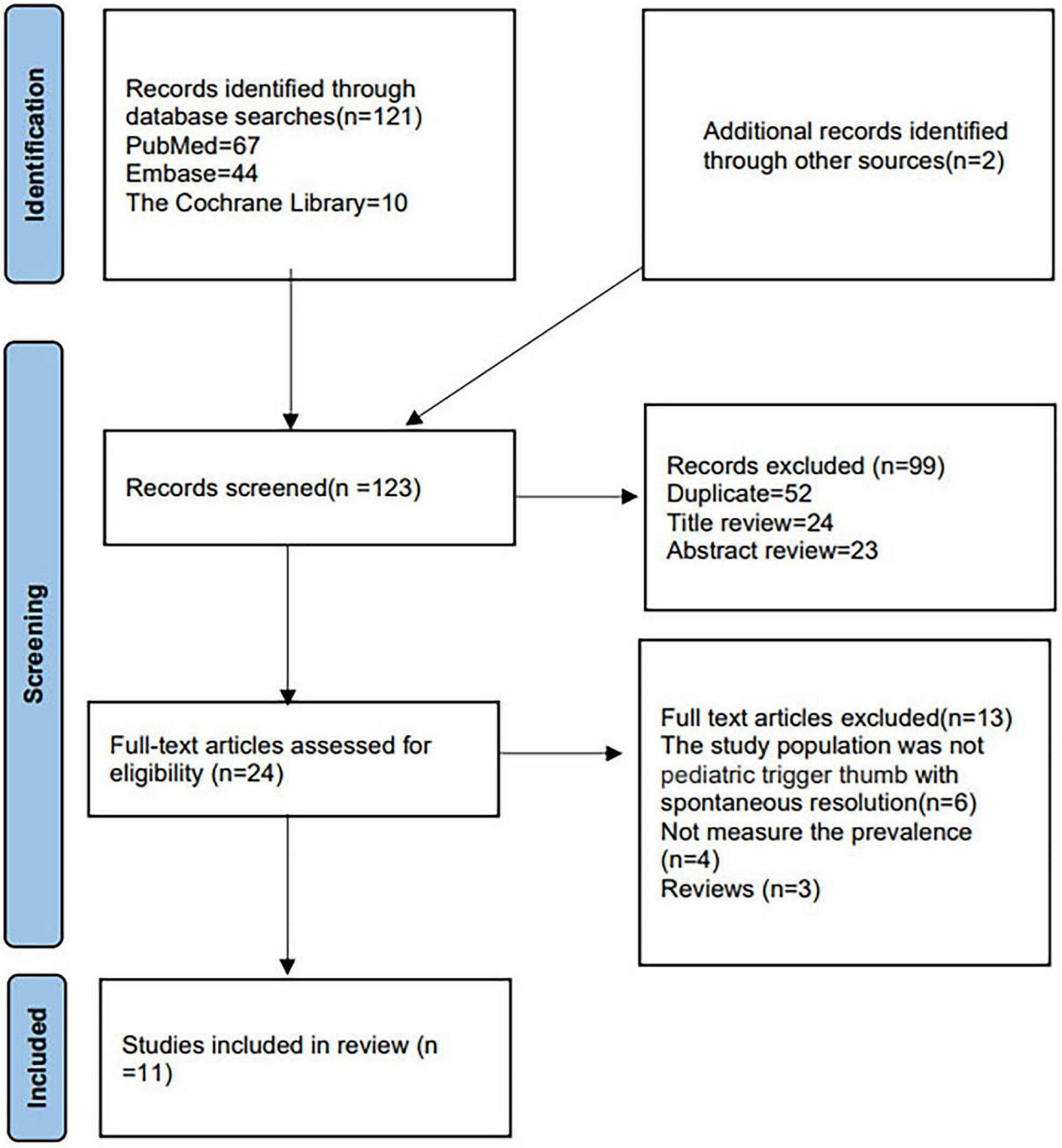

Fig. 1 PRISMA flowchart of review search

the prevalence of spontaneous resolution. Drawing upon the Joanna Briggs Institute's quality evaluation checklist, the articles selected for the final analysis exhibited a mean quality score of 7.36, with individual scores spanning from five to nine. Notably, five studies, constituting 45% of the total, were classified as high-quality, each achieving a score of 7.36 or above. The remaining articles, which scored between five and 7.36, were deemed to be of fair quality.

The prevalence of spontaneous resolution among pediatric trigger thumb (metaanalysis)

The pooled prevalence estimate of spontaneous resolution among pediatric trigger thumb was determined to be 43.5% (95% CI: 29.6–58.6), follow up time ranged from 3 to 59 months. However, significant heterogeneity was observed across the studies included in this analysis (I^2 = 90.462%; P=0.000) (Fig. 2). Subgroup analyses showed that in terms of age at the first visit, the prevalence of

Table 1 The characteristics of included studies

Study name	Sample size	Prevalence, cases (*n*)	age at the first visit(months)	Follow up time(months)	Initial severity of IP joint flexion contracture
Dinham JM 1974	107	12%,13	24(0-132)	6	-
Mihara K 1989	12	83%,10	57(6-180)	42	-
Mulpruek P 1998	42	24%,10	31.2(12–72)	3	-
Dunsmuir RA 2000	53	49%,26	25	7(1–23)	-
Moon W 2001	35	34%,12	24.2(6–54)	5(1 ± 24)	-
Lee ZL 2006	31	23%,7	23.2	20	reduced by gentle manipulation
Baek GH 2008	71	63%,45	23(1–55)	48 (24–114)	26.2° (15°-45°)
Baek GH 2011	87	76%,66	25.3 ± 11.8	49(41.1–56.9)	26.3 ± 9.9°
Koh S 2012	38	60%,23	30(3–94)	59 (SD 46)	locked (Watanabe stage 3)
Yano K 2021	30	43%,13	28.3 ± 20.7 (3-108)	30.3 ± 23.5	26.0° ± 16.1° (range 10–70°)
Hutchinson DT 2021	93	31%,29	18(10.8–26.4)	52.8 (38.4-6)	25° (20°-35°)

The average initial flexion deformity of the interphalangeal joint, was measured with use of a goniometer, with the wrist held in neutral extension, the thumb in 20 of palmar abduction, and the metacarpophalangeal joint in neutral extension

Table 2 Qualities of included studies

Study name	Response									
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Total
Dinham JM 1974	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Mihara K 1989	N	Y	N	Y	Y	N	Y	Y	U	5
Mulpruek P 1998	Y	Y	N	Y	Y	Y	Y	Y	U	7
Dunsmuir RA 2000	Y	Y	N	Y	Y	Y	Y	Y	Y	8
Moon W 2001	N	Y	N	Y	Y	Y	Y	Y	U	6
Lee ZL 2006	N	Y	N	Y	Y	Y	Y	Y	U	6
Baek GH 2008	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Baek GH 2011	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Koh S 2012	N	Y	N	Y	Y	Y	Y	Y	U	6
Yano K 2021	N	Y	N	Y	Y	Y	Y	Y	Y	7
Hutchinson DT 2021	Y	Y	Y	Y	Y	Y	Y	Y	Y	9

Keys: Q1–Q9 represents questions used to assess the quality of included studies, which are listed below

Q1. Was the sample frame appropriate to address the target populations?

Q2. Were the study participants sampled appropriately?

Q3. Was the sample size adequate?

Q4. Were the study subjects and setting described in detail?

Q5. Was the data analysis conducted with suffcient coverage of the identifed sample?

Q6. Was a valid method used in the identification of conditions?

Q7. Was the condition measured in a standard, reliable way for all participants?

Q8. Was there an appropriate statistical analysis?

Q9. Was the response rate adequate, and if not, was the low response rate managed appropriately?

Y yes; N no; U unclear; NA not applicable(7.36)

spontaneous resolution in the less than 24 months group and in the 24 months or older group was 38.7%(95% CI 18.1–64.4)and 45.8%(95% CI 27.4–65.4), respectively. There was no significant difference between the two groups(P=0.690)(Table 3). When analyzing follow up time, the prevalence of spontaneous resolution in the 24 months or longer group and in the less than 24 months group was 58.9%(95% CI 41.6–74.2)and 26.8%(95% CI 14.7–43.8), respectively.There was significant statistical differences between the two groups(P=0.009)(Table 3). Based on the initial severity of interphalangeal (IP) joint flexion contracture, the prevalence of spontaneous resolution in the 30 degrees or less group and in the other measurements group was 54.1%(95% CI 31.5–75.1)and 37.1%(95% CI 21.9–55.4), respectively.There was no significant difference between the two groups(P=0.259) (Table 3).

Sensitivity analysis

To identify potential sources of heterogeneity across the studies and to examine the differences between groups estimating spontaneous resolution among pediatric

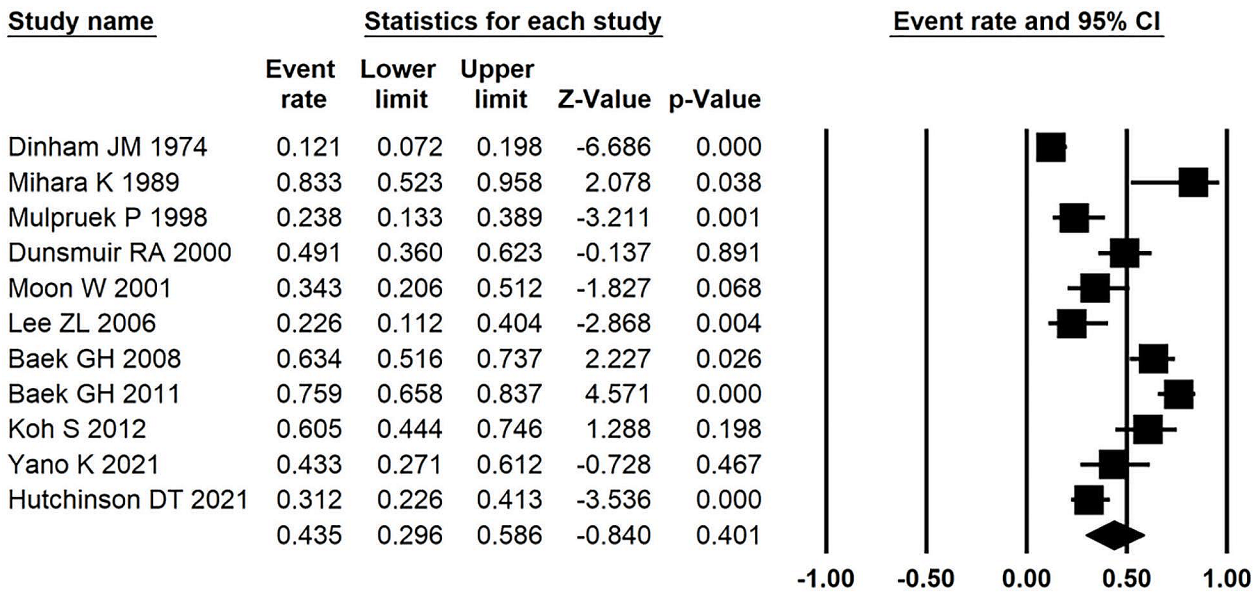

Fig. 2 The prevalence of spontaneous resolution among pediatric trigger thumb: a random-effect meta-analysis ($I^2 = 90.462\%$; $P = 0.000$;based on random effect model)

Table 3 Sensitivity analysis of included studies

Subgroups	Studies, *n*	Cases(*n*)	Prevalence (%)	95% CI	Heterogeneity across the studies		Heterogeneity between groups (*P*-value)
					I^2	Pvalue	
Age at the first visit(months)							
<24	3	195	38.7%	18.1–64.4	90.645	0.000	0.690
≥ 24	8	404	45.8%	27.4–65.4	91.568	0.000	
Follow up time(months)							
<24	5	268	26.8%	14.7–43.8	83.727	0.000	0.009
≥ 24	6	331	58.9%	41.6–74.2	87.863	0.000	
Initial severity of IP joint flexion contracture							
≤ 30°	4	281	54.1%	31.5–75.1	91.972	0.000	0.259
Others	7	318	37.1%	21.9–55.4	87.500	0.000	

Sensitivity analysis of all studies based on the age at the first visit, follow up time and initial severity of IP joint flexion contracture

trigger thumb, we conducted a stratified analysis by categorizing participants based on three key variables: age at the first visit (less than 24 months versus 24 months or older), follow-up duration (less than 24 months versus 24 months or longer), and the initial severity of interphalangeal (IP) joint flexion contracture (30 degrees or less versus other measurements).

This analysis revealed that the observed variation in the prevalence of spontaneous resolution among pediatric trigger thumb, when examined across the aforementioned three variables (groups), did not show statistical significance for age at the first visit (less than 24 months versus 24 months or older) and initial severity of IP joint flexion contracture (30 degrees or less versus other measurements) ($P > 0.05$)(Table 3). However, the follow up time (less than 24 months versus 24 months or longer) demonstrated a statistically significant difference ($P = 0.009$)(Table 3). To further investigate the potential

sources of heterogeneity among the studies included in our analysis, we conducted a leave-one-out sensitivity analysis. This rigorous approach demonstrated that the primary findings are robust and not unduly influenced by any single study. Upon excluding each study one at a time, the pooled estimated prevalence of spontaneous resolution among pediatric trigger thumb ranged from 39.6% (95% CI: 27.2–53.6) to 47.8% (95% CI: 34.8–61.2), thus affirming the stability of our results.

Publication bias

In our comprehensive systematic review and meta-analysis, we uncovered no indications of potential publication bias concerning the prevalence of spontaneous resolution in pediatric trigger thumb. This conclusion is substantiated by the symmetrical appearance of the funnel plot and corroborated by the results of regression tests associated with the funnel plot analysis(Egger's test) (B=−789, SE=3.87, P=0.843)(Fig. 3).

Discussion

Key findings

To the best of our knowledge, this study represents the first comprehensive systematic review and meta-analysis aimed at estimating the prevalence of spontaneous resolution in pediatric trigger thumb. Our review encompassed 11 studies that investigated this phenomenon. Both our qualitative and quantitative analyses revealed that the existing scientific evidence on the prevalence of spontaneous resolution in pediatric trigger thumb exhibits substantial variability depending on the follow up time, the age at the initial consultation, and the initial severity of interphalangeal (IP) joint flexion contracture.

Our comprehensive meta-analysis revealed the pooled prevalence estimate of spontaneous resolution among pediatric trigger thumb was determined to be 43.5%. Notably, the follow up time played a crucial role, the prevalence of spontaneous resolution in the 24 months or longer group and in the less than 24 months group was 58.9%(95% CI 41.6–74.2)and 26.8%(95% CI 14.7–43.8), respectively.There was significant statistical differences between the two groups(P=0.009). This notable difference in resolution rates can greatly assist both parents and surgeons in making informed decisions regarding the preference for nonoperative treatments over surgical interventions for managing pediatric trigger thumb.

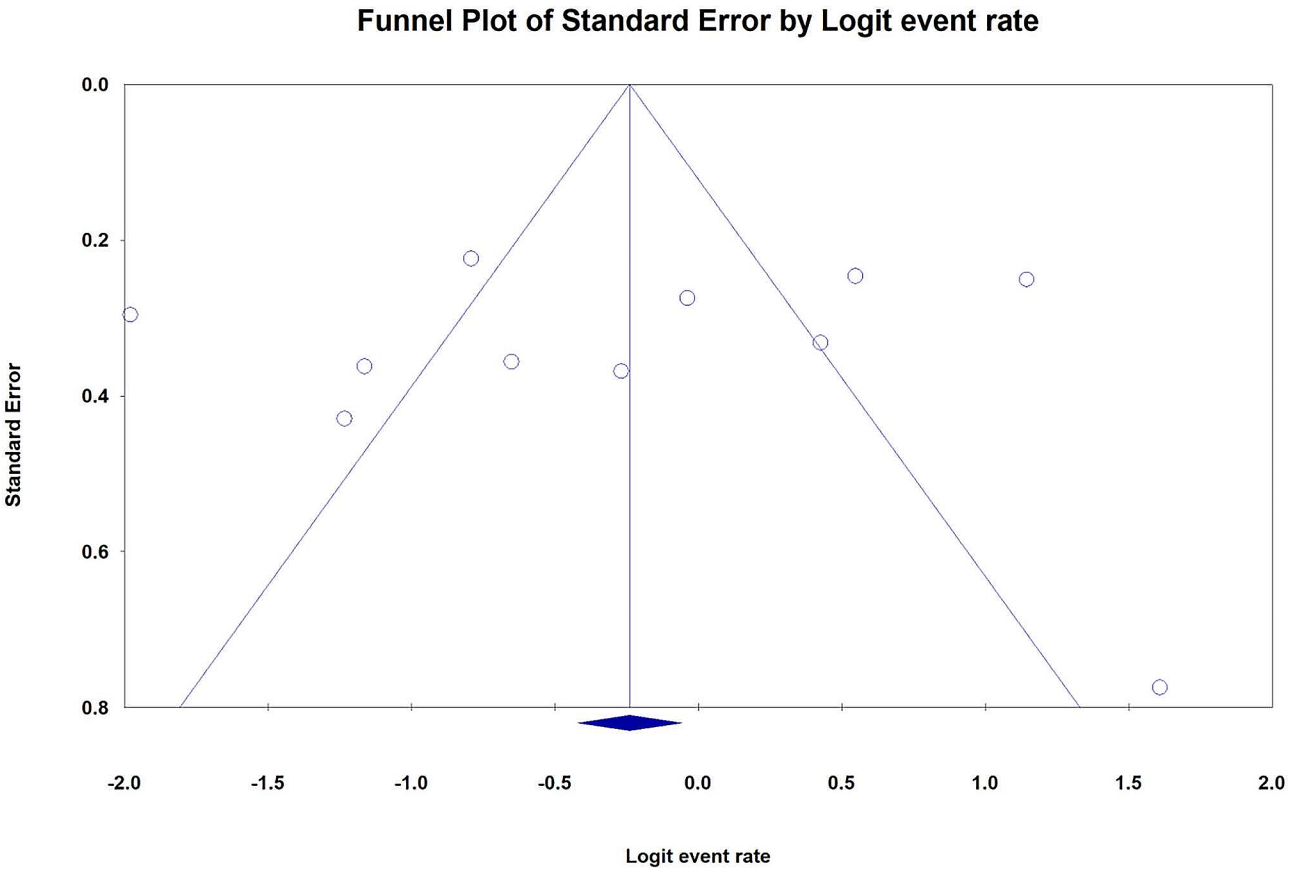

Fig. 3 Funnel plot of the risk of publication bias for the prevalence of spontaneous resolution among pediatric trigger thumb

Comparisons with the existing evidence

The current study's prevalence estimates for spontaneous resolution of pediatric trigger thumb stand at 43.5%. Notably, when the follow up time in the 24 months or longer group, this rate increases to 58.9%. These figures are significantly higher than those reported by some authors, who found no cases of spontaneous recovery during their follow-up periods [10, 21]. The findings of this study suggest that the duration of nonoperative care can be extensive and should be a topic of discussion, allowing parents to actively participate in the decision-making process regarding the choice between nonoperative and operative treatments. One plausible explanation for this phenomenon may be attributed to the fact that some surgeons do not adhere to the recommended 24 months waiting period. Instead, they may choose to pursue alternative therapeutic approaches if spontaneous resolution is not achieved within a shorter timeframe, as indicated by previous research.

This substantial variation can be attributed to several factors including (i) There are notable variations in the characteristics of the children involved in these studies. These differences encompass the initial severity of the interphalangeal joint flexion contracture associated with trigger thumb [20], the duration of follow up time [18], as well as the age at which the condition first presented and whether it affected the right or left side [20, 22]; (ii) Significant discrepancies exist in the definitions of spontaneous resolution of trigger thumb across various studies [5, 20]; (iii) The clinical characteristics of participants exhibit considerable variation, encompassing factors such as metacarpophalangeal joint laxity issues [4] and the diverse ethnic and cultural backgrounds of the participants [20].

This study has unveiled significant heterogeneity among studies investigating the spontaneous resolution of pediatric trigger thumb. This observed variability can be attributed to differences in participant characteristics as well as the methodologies employed in the included studies. Concerning methodological disparities, the studies varied in several respects: sample size, the instruments utilized to measure outcomes, the sampling procedures, as well as the source of population.

Strength and limitations

The present study has several strengths. Firstly, this systematic review and meta-analysis aims to determine the prevalence of spontaneous resolution in pediatric trigger thumb cases. By consolidating existing research, it provides a foundational understanding of this medical phenomenon. Secondly, the study estimates the prevalence rates of spontaneous resolution by considering specific subgroups based on critical factors such as the age at the first visit, follow up time, and the initial severity of interphalangeal (IP) joint flexion contracture. This approach allows for a more detailed and accurate assessment of the condition across different patient demographics. Thirdly, the study incorporates subgroup and sensitivity analyses to identify and mitigate potential biases, ensuring the reliability and validity of the findings. These methodological strengths collectively enhance the study's contribution to the field of pediatric orthopedics, offering valuable insights for clinicians and researchers alike.

Several limitations inherent in this systematic review and meta-analysis warrant careful consideration. Firstly, the majority of the included studies had relatively small sample sizes. This limitation raises concerns that the reported prevalence of spontaneous resolution among pediatric trigger thumb cases in our current analysis may not accurately reflect the true prevalence in the broader population. Secondly, our review exclusively included studies published in the English language. Consequently, there is a possibility that relevant studies conducted in other languages were overlooked, potentially introducing a language bias into our findings.

The implication of the findings

The current study bears profound implications for both research and clinical practice. To begin with, future investigations are imperative to explore the underlying reasons for the elevated prevalence rates of spontaneous resolution observed in pediatric trigger thumb cases when the follow up time in the 24 months or longer group, as compared to those with in the less than 24 months group. Additionally, it is essential that subsequent studies encompass larger sample sizes and incorporate segmentation based on gender and the affected side, thereby ensuring a more comprehensive understanding of this condition. Finally, to mitigate the need for surgical interventions and alleviate the associated suffering, early screening and public education on the spontaneous resolution of pediatric trigger thumb should be prioritized through coordinated and integrated public health strategies.

Conclusion

This study has demonstrated that a significant proportion of pediatric trigger thumbs resolve spontaneously. The prevalence of spontaneous resolution in pediatric trigger thumb cases is significantly higher when the follow up time in the 24 months or longer group, compared to cases with in the less than 24 months group, suggesting substantial benefits associated with an early observation approach for this condition. By opting for a nonoperative strategy initially, both parents and surgeons may be better equipped to make informed decisions about the

treatment plan, potentially avoiding unnecessary surgical interventions.

The average initial flexion deformity of the interphalangeal joint, was measured with use of a goniometer, with the wrist held in neutral extension, the thumb in 20 of palmar abduction, and the metacarpophalangeal joint in neutral extension.

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Author contributions
QingSong Tang and XinLing Miao equally to this work as co-first authors. Tang QS conceptualized the study, performed the search conducted analyses, conducted the quality assessment, write-up and approval of the final manuscript. Miao XL was involved in data extraction, read and approved the final manuscript. Ren X, Zhao K, andHu J was participated in discussion and consensus and approved the final manuscript. All authors read and approved the final manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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