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Pediatric burns research: A history or an evolution?

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ABSTRACT

Background/purpose: Pediatric burns research has increasingly been recognized as a sub-specialty of its own. The aim of this study was to assess and analyze the publication patterns of the pediatric burns literature over the last six decades.
Methods: A search strategy for the Web of Science database was designed for pediatric burns publications, with output analyzed between two periods: 1945–1999 (period 1) and 2000–2013 (period 2).
Results: There were 1133 and 1194 publications for periods 1 (1945–1999) and 2 (2000–2013), respectively. The mean citation counts of the top 50 publications were 77 (range 45–278) and 49 (range 33–145) for periods 1 and 2, respectively. There were 26 and 20 authors with two or more publications in the top 50 list in periods 1 and 2, respectively. Of these there are two authors that have published 47 papers in both combined time-periods. There were 29 and 9 journals that have published 50% of the publications for time-period 1 and 2 respectively. In period 2, there were two burns journals that have published 37.2% of the total articles.
Conclusions: Pediatric burns research has evolved from an associated, dispersed entity into a consolidated sub-specialty that has been successfully integrated into mainstream burns journals.

1. Introduction

The management of burns has evolved from its beginnings shortly after the discovery of fire to modern day medicine. The first publication on burns in a contemporary medical journal was in 1814 in a manuscript which tackled the issue of contractions after burns [1]. Pediatric burns research has recently come to the fore as a specialty separate to adult burns research. The medical literature has progressively expanded in more recent years. The internet, on-line submissions and on-line publishing has facilitated this expansion.

Bibliometrics is a method that can be utilized to evaluate patterns and trends in the literature over time. It has been used to create "top cited articles" in several specialties [2–4]. It has also been used in more novels ways to assess research output and funding [5,6], to identify research gaps within a

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Abbreviations: WoS, Web of Science; MeSH, Medical Subject Heading; JAMA, Journal of the American Medical Association.

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specialty [7,8], with some grant authorities using this technique to decide on where funding should be distributed.

The aim of this paper was to analyze the publication patterns of the pediatric burns research literature over time using bibliometric methodology and to highlight the evolution of this sub-specialty.

2. Materials and methods

Medical Subject Headings (MeSH) and non-MeSH terms were used to search the title field within the Web of Science (WoS) database for pediatric burns papers. Appendix A details this search strategy. Data were retrieved for two time-periods. Period 1 – 01/01/1945 to 31/12/1999 and period 2 – 01/01/2000 to 31/12/2013. These time-periods were chosen as they divide the number of publications into two groups of similar size. The searches were performed in September 2014. Search results from WoS included entries from the ''Science citations index expanded''; ''social sciences citation index'' and ''arts and humanities citation index'' databases. The data downloaded from the WoS was assessed and analyzed using Microsoft Excel spread sheet software. Results are expressed as mean with range in brackets throughout the manuscript.

3. Results

There were 2327 articles published on pediatric burns between 1945 and 2013. Almost 50% (1133) of these publications were published in the 54 years between 1945 and 1999 (period 1). The remaining 1194 articles were published in the 14 years between 2000 and 2013 (period 2, Fig. 1). The maximum number of publications in any year was 121 in 2010.

3.1. Top cited articles

Tables 1 and 2 list the 10 top cited articles in each time period. The mean number of citations was 77 (range 45–278) and 49 (range 33–145) for period 1 and period 2, respectively. The articles in the top 50 cited list were analyzed according to the WoS categories; ''surgery'', ''critical care medicine'', ''pediatrics'' and '''dermatology'' are ranked in the top 4 in both time-periods. The category of ''dermatology'' and ''critical care medicine'' increased in importance in period 2. In these top 50 cited lists, the majority of publications were clinically based (48 and 47 publications in period 1 and period 2, respectively). There were three publications in these top cited articles, where an inter-institutional collaboration was formed. These three articles were published in 1962, 1970 and 2000.

3.2. Top cited authors

The first two and senior two authors were considered the most important in this study. Table 3 lists those authors who have more than three publications in the top 50 cited articles for each time-period. There were 26 and 20 authors with more than one publication in the top 50 cited publications in periods 1 and 2, respectively. Of the 12 authors appeared in the top 50 list in both time-periods: two authors in particular have amassed 47 publications. There were 103 and 90 authors with a single publication in periods 1 and 2, respectively.

3.3. Top cited journals

The total number of journals publishing these articles was 339 and 302 for periods 1 and 2, respectively. There were 29 and 9 journals that had published greater than 50% of all publications for periods 1 and 2, respectively. These journals have

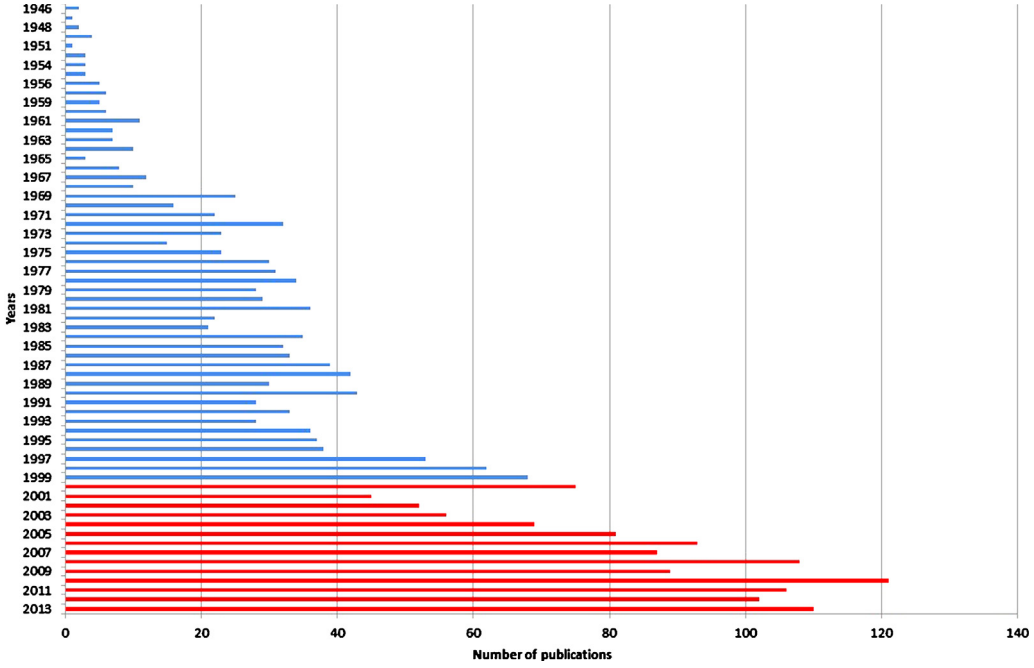

Fig. 1 – Publication trend from 1945 to 2013. This graph demonstrates the number of pediatric burns publications per year from 1945 to 2013. The blue bars represent period 1 (1945–1999) and the red bars represent period 2 (2000–2013). (For interpretation of the references to color in figure legend, the reader is referred to the web version of the article.)

Table 1 – List of the top 10 cited articles in period 1.

Rank	Top 10 cited publications	Count
1	Alexander JW, MacMillan BG, Stinnett JD, et al. Beneficial effects of aggressive protein feeding in severely burned children. Annals of Surgery. 1980;192(4):505–17.	278
2	Herndon DN, Barrow RE, Kunkel KR, Broemeling L, Rutan RL. Effects of recombinant human growth hormone on donor-site healing in severely burned children. Annals of Surgery. 1990;212(4):424–9; discussion 30–1.	262
3	Wolf SE, Rose JK, Desai MH, et al. Mortality determinants in massive pediatric burns. An analysis of 103 children with > or =80% TBSA burns (> or =70% full-thickness). Annals of Surgery. 1997;225(5):554–65; discussion 65–9.	153
4	Kien CL, Young VR, Rohrbaugh DK, Burke JF. Increased rates of whole body protein synthesis and breakdown in children recovering from burns. Annals of Surgery. 1978;187(4):383–91.	134
5	Haller JA, Jr., Andrews HG, White JJ, Tamer MA, Cleveland WW. Pathophysiology and management of acute corrosive burns of the esophagus: results of treatment in 285 children. Journal of Pediatric Surgery. 1971;6(5):578–84.	122
6	Gilpin DA, Barrow RE, Rutan RL, Broemeling L, Herndon DN. Recombinant human growth hormone accelerates wound healing in children with large cutaneous burns. Annals of Surgery. 1994;220(1):19–24.	114
7	Feldman KW, Schaller RT, Feldman JA, McMillon M. Tap water scald burns in children. Pediatrics. 1978;62(1):1–7.	113
8	Ogle CK, Ogle JD, Mao JX, et al. Effect of glutamine on phagocytosis and bacterial killing by normal and pediatric burn patient neutrophils. JPEN Journal of Parenteral and Enteral Nutrition. 1994;18(2):128–33.	112
9	Burke JF, Quinby WC, Jr., Bondoc CC. Primary excision and prompt grafting as routine therapy for the treatment of thermal burns in children. The Surgical Clinics of North America. 1976;56(2):477–94.	100
10	Tompkins RG, Remensnyder JP, Burke JF, et al. Significant reductions in mortality for children with burn injuries through the use of prompt eschar excision. Annals of Surgery. 1988;208(5):577–85.	93

been classified as 'burns', 'plastics', 'surgery', 'pediatric surgery', 'pediatrics', 'trauma' and other journals. The journals classified as 'burns' and 'trauma' have increased in importance, while the other journal classifications have decreased. In period 1, burns and trauma journals published 18.3% and 3.6% of the publications. This has increased to 37.2% and 9.4% for period 2. 'Pediatric' journals have declined from 6.9% in period 1 – 0% in period 2. Similarly 'plastics', 'surgery' and 'pediatric surgery' have declined from 4.4%, 4.5% and 3.7% for period 1 – 1.6%, 1.1% and 1.9%, respectively (Table 4). Table 5 lists the journals that have published more than 50% of the articles for period 2.

Burns has published the highest number of articles across both time-periods. The *Journal of Pediatric Surgery* has published 20 and 22 publications for periods 1 and 2, respectively. There has been a 6-fold increase in publications in *The Journal of Burn Care Research* (previously *Journal of Burns Care and Rehabilitation*) between time-periods 1 and 2.

Of the top 50 cited articles, the Annals of Surgery has published 10 and four articles in time-periods 1 and 2, respectively. Burns has published 6 and 13 articles in periods 1 and 2, respectively. In period 1 the *Journal of Trauma* (subsequently *Journal of Trauma, Injury, Infection and Critical Care*, then *Journal of Trauma and Acute Care Surgery*) published 8 of the top 50 list, but in period 2 had only four. In period 1, the top 50 cited articles were published in journals found in the following categories; surgery (13), trauma (8), pediatrics (8), burns (6), plastics (2), pediatric surgery (2) and others (11). The

Table 2 – List of the top 10 cited articles in period 2.

Rank	Top 10 cited publications	Count
1	Saxe G, Stoddard F, Courtney D, et al. Relationship between acute morphine and the course of PTSD in children with burns. Journal of the American Academy of Child and Adolescent Psychiatry. 2001;40(8):915–21.	141
2	Hoffman HG, Doctor JN, Patterson DR, Carrougher GJ, Furness TA, 3rd. Virtual reality as an adjunctive pain control during burn wound care in adolescent patients. Pain. 2000;85(1–2):305–9.	123
3	Sheridan RL, Hinson MI, Liang MH, et al. Long-term outcome of children surviving massive burns. JAMA: The Journal of the American Medical Association. 2000;283(1):69–73.	112
4	Finnerty CC, Herndon DN, Przkora R, et al. Cytokine expression profile over time in severely burned pediatric patients. Shock. 2006;26(1):13–9.	105
5	Suman OE, Spies RJ, Celis MM, Mlcak RP, Herndon DN. Effects of a 12-wk resistance exercise program on skeletal muscle strength in children with burn injuries. Journal of Applied Physiology. 2001;91(3):1168–75.	66
6	Pham TN, Warren AJ, Phan HH, et al. Impact of tight glycemic control in severely burned children. The Journal of Trauma. 2005;59(5):1148–54.	63
7	Barret JP, Dziewulski P, Ramzy PI, et al. Biobrane versus 1% silver sulfadiazine in second-degree pediatric burns. Plastic and Reconstructive Surgery. 2000;105(1):62–5.	59
8	Saxe GN, Stoddard F, Hall E, et al. Pathways to PTSD, part I: Children with burns. The American Journal of Psychiatry. 2005;162(7):1299–304.	58
9	Cubison TC, Pape SA, Parkhouse N. Evidence for the link between healing time and the development of hypertrophic scars (HTS) in pediatric burns due to scald injury. Burns: Journal of the International Society for Burn Injuries. 2006;32(8):992–9.	55
10	Holland AJ, Martin HC, Cass DT. Laser Doppler imaging prediction of burn wound outcome in children. Burns: Journal of the International Society for Burn Injuries. 2002;28(1):11–7.	53

Table 3 – First two authors or senior two authors with three or more publications in the top 50 cited articles for each time-period.

	Author	Number of publications
Period 1 (1945–1999)	Herndon, DN	13
	Barrow, RE	5
	Burke, JF	4
	Warden, GD	4
	Wolfe, RR	4
	Kien, CL	3
	Wolf, SE	3
	Young, VR	3
Period 2 (2000–2013)	Herndon, DN	22
	Jeschke, MG	14
	Barrow, RE	7
	Barret, JP	4
	Mlcak, RP	4
	Saxe, GN	4
	Sheridan, RL	4
	Stoddard, FJ	4
	Tompkins, RG	4
	Finnerty, CC	3
	King, L	3

others included mainstream medical journal such as *New England Journal of Medicine* (2), *JAMA (Journal of the American Medical Association)* (1) and the *British Medical Journal* (1). In period 2, the results differ significantly with the journals categorized as Burns (13), Trauma (12), Pediatric (7), Surgery (6), plastics (1), pediatric surgery (1) and others (10). This other journals included *Lancet* (2) and *JAMA* (1).

3.4. *National contribution*

The USA and the UK rank first and second in both time-periods, with a small increase in the number of publications from both countries. Australia, Canada and South Africa have at least doubled their output in period 2 over period 1. Turkey and the People's Republic of China have made the most progress over time, with in excess of a 5-fold increase in publications in the two time-periods. Table 6 lists the top 10 countries with respect to output for each time-period.

Table 4 – Comparison of publications and journals by timescale.

	Period 1 (1945–1999)	Period 2 (2000–2013)
Number of articles	1133	1194
Number of journals	339	302
Journals with most publications (>50% published[a])	29	9
• Burns journals	2	2
• Plastic surgery journals	3	1
• Surgery journals	3	1
• Pediatric surgery journals	3	1
• Pediatric journals	6	0
• Trauma	1	4
• Other mainstream journals	11	0
Mean citation count for top 50	77	49
(Range)	(45–278)	(33–145)
Median citation count for top 50	67	42
Pubmed total output	13,135,780	10,137,305
Web of Science total output	29,975,378	25,138,668

[a] Journals with the highest number of publications accounting for >50% of the cumulative publications for the given time period.

Table 5 – Top 9 journals (50.47% of articles in 3.29% of journals) for period 2 (2000–2013).

Journal title	Count	%
Burns	227	19.52
Journal of Burn Care Research[a]	206	17.71
Critical Care Medicine	36	3.10
Journal of Trauma And Acute Care Surgery[a]	28	2.41
Shock	28	2.41
Journal of Pediatric Surgery	22	1.89
Journal of Craniofacial Surgery	19	1.63
Injury Prevention	17	1.46
Annals of Surgery	13	1.12
Total	587	50.48

[a] Including precursor journals.

4. Discussion

There has been a dramatic expansion of the medical literature in recent years. This development has been reflected in the area of pediatric burns, with more than 50% of pediatric burns articles published in the last 14 years. Despite this surge in publications the mean citation count of the top 50 cited articles for period 2 has not reached the same heights as for period 1. This can be explained by the shorter duration that these publications have been available to be cited (there was no article published after 2006 in the top 50 list for period 2). This finding is similar to that found by Joyce et al. in 2014 [9] but represents a stark contrast to a bibliometric analysis of the general pediatric literature, which identified that more recent articles appeared to be more commonly cited [4]. In part this may reflect the magnitude of pediatrics as a specialty with a publication count for the same time period in excess of 200 times that of pediatric burns.

As pediatric burns have become a specialty of its own, with pediatric burns research and publications maturing, there has been a converging of knowledge, both in terms of authors and

Table 6 – Countries ranked by number of publications.

Rank	Period 1 (1945–1999)	Count	Period 2 (2000–2013)	Count
1	USA	467	USA	537
2	UK	97	UK	101
3	France	36	Australia	81
4	Germany	36	Turkey	44
5	Australia	29	Canada	42
6	Russia	22	Netherlands	37
7	Canada	21	Peoples R China	32
8	Switzerland	20	Germany	31
9	South Africa	13	South Africa	27
10	Spain	11	France	22

journals. The expertise of the authors is apparent with 20 authors having two or more publications in the top cited lists for both time periods. In fact, two expert authors have spanned both time periods with 28 highly cited publications between them. Interestingly, despite the dramatic rise in the number of publications in period 2, many of the most cited publications in both periods were more clinical in nature rather then laboratory based studies, perhaps reflecting the relative 'youth' of pediatric burns as a sub-specialty, with a more clinical focus.

The consolidation of burns research into dedicated journals demonstrates the acceptance of this sub-specialty within the realm of burns research. Journals specialized in burns and trauma have increased in importance as a repository for pediatric burns research. In particular *Burns* has remained the journal that published the highest number of articles in both time-periods, currently accounting for almost one fifth of the total pediatric burns literature. The number of top cited articles published in *Burns* has doubled from period 1 to period 2. Perhaps more importantly, this journal appears the have the ability to attract and develop through the review process quality articles (as measured by citation count). The *Journal of Burn Care Research* has also increased in prominence as an end point for pediatric burns researchers, with a 6-fold increase in published articles.

This consolidation of pediatric burns research into more specialized journals does not mean that the journals who traditionally published pediatric burns research should be ignored. The *Annals of Surgery*, for example, published 10 of the top cited articles in period 1. While its importance in pediatric burns research has decreased, it has still published 4 of the most highly cited articles for period 2. Mainstream medical journals remain of importance in pediatric burns, as some of the top cited papers are found in some of the most prestigious journals. The *New England Journal of Medicine, JAMA* and the *British Medical Journal* have published one tenth of the highly cited articles for period 1, while the *Lancet* and *JAMA* have ownership of 3 of these works.

The US and the UK remain world leaders in research and publications across both time periods. This trend was also seen in a study on pediatric surgical conditions [3]. Given in infrastructure and funding available in the US it is not surprising that it dominates the fields of medical and scientific publishing [10]. Countries like Australia have improved their research output in recent years as clinicians who have an avid interest in research have been appointed in university affiliated positions. These ''academic surgeons'' manage to combine busy clinical jobs with a research component. Awareness of importance for research and improved funding availability has aided this growth of scientific knowledge. This may well account for the increased output from Turkey and People's Republic of China. Internet availability, integrated search engines and on-line publications undoubtedly has aided propagation of medical knowledge and facilitation of pediatric burns research worldwide.

One of the limitations of this study is that searching the WoS database can retrieve non-relevant articles. These articles were few and far between and were removed from the top cited publication analysis.

5. Conclusions

Pediatric burns research appears to have evolved from a widely dispersed, non-consolidated associated entity into a sub-speciality that has been welcomed and incorporated into the mainstream burns journals.

Conflicts of interest

None.

Appendix A. The search strategy used in the title field within the Web of Science (WoS) database.

TI=(((Infant) AND (Burn)) OR ((Infant*) AND (Burn)) OR ((infancy) AND (Burn)) OR ((Newborn*) AND (Burn)) OR ((Baby*) AND (Burn)) OR ((Babies) AND (Burn)) OR ((Neonat*) AND (Burn)) OR ((Preterm*) AND (Burn)) OR ((Prematur*) AND (Burn)) OR ((Postmatur*) AND (Burn)) OR ((Child[MeSH]) AND (Burn)) OR ((Child*) AND (Burn)) OR ((Schoolchild*) AND (Burn)) OR ((School age*) AND (Burn)) OR ((Preschool*) AND (Burn)) OR ((Kid*) AND (Burn)) OR ((Toddler*) AND (Burn))OR ((Adolescent[MeSH]) AND (Burn)) OR ((Adoles*) AND (Burn)) OR ((Teen*) AND (Burn)) OR ((Boy*) AND (Burn)) OR ((Girl*) AND (Burn)) OR ((Minors[MeSH]) AND (Burn)) OR ((Minors*) AND (Burn)) OR ((Puberty[MeSH]) AND (Burn)) OR ((Pubert*) AND (Burn)) OR ((Pubescen*) AND (Burn)) OR ((Prepubescen*) AND (Burn)) OR

((Pediatrics[MeSH]) AND (Burn)) OR ((Paediatric*) AND (Burn)) OR ((Paediatric*) AND (Burn)) OR ((Peadiatric*) AND (Burn)) OR ((Schools[MeSH]) AND (Burn)) OR ((Nursery school*) AND (Burn)) OR ((Kindergar*) AND (Burn)) OR ((Primary school*) AND (Burn)) OR ((Secondary school*) AND (Burn)) OR ((Elementary school*) AND (Burn)) OR ((High school*) AND (Burn)) OR ((Highschool*) AND (Burn)) OR ((Infant) AND (Burns)) OR ((Infant*) AND (Burns)) OR ((infancy) AND (Burns)) OR ((Newborn*) AND (Burns)) OR ((Baby*) AND (Burns)) OR ((Babies) AND (Burns)) OR ((Neonat*) AND (Burns)) OR ((Preterm*) AND (Burns)) OR ((Prematur*) AND (Burns)) OR ((Postmatur*) AND (Burns)) OR ((Child[MeSH]) AND (Burns)) OR ((Child*) AND (Burns)) OR ((Schoolchild*) AND (Burns)) OR ((School age*) AND (Burns)) OR ((Preschool*) AND (Burns)) OR ((Kid*) AND (Burns)) OR ((Toddler*) AND (Burns)) OR ((Adolescent[MeSH]) AND (Burns)) OR ((Adoles*) AND (Burns)) OR ((Teen*) AND (Burns)) OR ((Boy*) AND (Burns)) OR ((Girl*) AND (Burns)) OR ((Minors[MeSH]) AND (Burns)) OR ((Minors*) AND (Burns)) OR ((Puberty[MeSH]) AND (Burns)) OR ((Pubert*) AND (Burns)) OR ((Pubescen*) AND (Burns)) OR ((Prepubescen*) AND (Burns)) OR

((Paediatrics[MeSH]) AND (Burns)) OR ((Paediatric*) AND (Burns)) OR ((Paediatric*) AND (Burns)) OR ((Peadiatric*) AND (Burns)) OR ((Schools[MeSH]) AND (Burns)) OR ((Nursery school*) AND (Burns)) OR ((Kindergar*) AND (Burns)) OR ((Primary school*) AND (Burns)) OR ((Secondary school*) AND (Burns)) OR ((Elementary school*) AND (Burns)) OR ((High school*) AND (Burns)) OR ((Highschool*) AND (Burns)) OR ((Infant) AND (Scald)) OR ((Infant*) AND (Scald)) OR ((infancy) AND (Scald)) OR ((Newborn*) AND (Scald)) OR ((Baby*) AND (Scald)) OR ((Babies) AND (Scald)) OR ((Neonat*) AND (Scald))

OR ((Preterm*) AND (Scald)) OR ((Prematur*) AND (Scald)) OR ((Postmatur*) AND (Scald)) OR ((Child[MeSH]) AND (Scald)) OR ((Child*) AND (Scald)) OR ((Schoolchild*) AND (Scald)) OR ((School age*) AND (Scald)) OR ((Preschool*) AND (Scald)) OR ((Kid*) AND (Scald)) OR ((Toddler*) AND (Scald)) OR ((Adolescent[MeSH]) AND (Scald)) OR ((Adoles*) AND (Scald)) OR ((Teen*) AND (Scald)) OR ((Boy*) AND (Scald)) OR ((Girl*) AND (Scald)) OR ((Minors[MeSH]) AND (Scald)) OR ((Minors*) AND (Scald)) OR ((Puberty[MeSH]) AND (Scald)) OR ((Pubert*) AND (Scald)) OR ((Pubescen*) AND (Scald)) OR ((Prepubescen*) AND (Scald)) OR

((Pediatrics[MeSH]) AND (Scald)) OR ((Paediatric*) AND (Scald)) OR ((Paediatric*) AND (Scald)) OR ((Peadiatric*) AND (Scald)) OR ((Schools[MeSH]) AND (Scald)) OR ((Nursery school*) AND (Scald)) OR ((Kindergar*) AND (Scald)) OR ((Primary school*) AND (Scald)) OR ((Secondary school*) AND (Scald)) OR ((Elementary school*) AND (Scald)) OR ((High school*) AND (Scald)) OR ((Highschool*) AND (Scald)) OR ((Infant) AND (Scalds)) OR ((Infant*) AND (Scalds)) OR ((infancy) AND (Scalds)) OR ((Newborn*) AND (Scalds)) OR ((Baby*) AND (Scalds)) OR ((Babies) AND (Scalds)) OR ((Neonat*) AND (Scalds)) OR ((Preterm*) AND (Scalds)) OR ((Prematur*) AND (Scalds)) OR ((Postmatur*) AND (Scalds)) OR ((Child[MeSH]) AND (Scalds)) OR ((Child*) AND (Scalds)) OR ((Schoolchild*) AND (Scalds)) OR ((School age*) AND (Scalds)) OR ((Preschool*) AND (Scalds)) OR ((Kid*) AND (Scalds)) OR ((Toddler*) AND (Scalds)) OR ((Adolescent[MeSH]) AND (Scalds)) OR ((Adoles*) AND (Scalds)) OR ((Teen*) AND (Scalds)) OR ((Boy*) AND (Scalds)) OR ((Girl*) AND (Scalds)) OR ((Minors[MeSH]) AND (Scalds)) OR ((Minors*) AND (Scalds)) OR ((Puberty[MeSH]) AND (Scalds)) OR ((Pubert*) AND (Scalds)) OR ((Pubescen*) AND (Scalds)) OR ((Prepubescen*) AND (Scalds)) OR ((Paediatrics[MeSH]) AND (Scalds)) OR ((Paediatric*) AND (Scalds)) OR ((Paediatric*) AND (Scalds)) OR ((Peadiatric*) AND (Scalds)) OR ((Schools[MeSH]) AND (Scalds)) OR ((Nursery school*) AND (Scalds)) OR ((Kindergar*) AND (Scalds)) OR ((Primary school*) AND (Scalds)) OR ((Secondary school*) AND (Scalds)) OR ((Elementary school*) AND (Scalds)) OR ((High school*) AND (Scalds)) OR ((Highschool*) AND (Scalds)))

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