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The evidence-base for complementary medicine in children: a critical overview of systematic reviews

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ABSTRACT

Background The use of complementary and alternative medicine (CAM) in paediatric populations is common yet, to date, there has been no synthesis of the evidence of its effectiveness in that population. This overview of systematic review evaluates the evidence for or against the effectiveness of CAM for any childhood condition.

Methods Medline, AMED and Cochrane were searched from inception until September 2009. Reference lists of retrieved articles were hand-searched. Experts in the field of CAM were contacted. No language restrictions were applied.

Results 17 systematic reviews were included in this overview, covering acupuncture, chiropractic, herbal medicine, homeopathy, hypnotherapy, massage and yoga. Results were unconvincing for most conditions although there is some evidence to suggest that acupuncture may be effective for postoperative nausea and vomiting, and that hypnotherapy may be effective in reducing procedure-related pain. Most of the reviews failed to mention the incidence of adverse effects of CAMs.

Conclusions Although there is some encouraging evidence for hypnosis, herbal medicine and acupuncture, there is insufficient evidence to suggest that other CAMs are effective for the treatment of childhood conditions. Many of the systematic reviews included in this overview were of low quality, as were the randomised clinical trials within those reviews, further reducing the weight of that evidence. Future research in CAM for children should conform to the reporting standards outlined in the CONSORT and PRISMA guidelines.

INTRODUCTION

Several surveys have suggested that, in paediatric populations, the usage of complementary and alternative medicine (CAM) is high.[1–3] Herbal medicine, homeopathy, reflexology and acupuncture are among the most popular treatments.[2 4 5] The reasons for this high prevalence of use are diverse and might include dissatisfaction with conventional medicine and positive reports from friends and family.[6 7] Children whose parents use CAM are almost five times more likely to use CAM than children whose parents do not use it.[8]

Whatever the motivations are, this level of popularity begs the question whether any of the treatments in question are effective.

In this overview, we aimed to critically review the literature pertaining to the effectiveness of CAM for children. In particular, we wanted to evaluate the evidence from systematic reviews on this subject.

METHODS

We searched AMED using the EBSCO interface, Medline using the OVID interface and the Cochrane Library from inception to August 2009. Search terms were constructed using a series of keyword terms covering synonyms for 'child' and 'paediatrics' and also for key childhood diseases in order to identify those reviews which do not mention 'children' in the title; 'Homeopathy for enuresis', for example (see appendix 1). We defined CAM using the definition from the House of Lords Select Committee Report[9] where "CAM is a title used to refer to a diverse group of health-related therapies and disciplines which are not considered to be a part of mainstream medical care. CAM embraces those therapies that may either be provided alongside conventional medicine (complementary) or which may… act as a substitute for it." We did not include vitamins and supplements or exercise therapy in our definition of CAM but did include acupuncture/acupressure (of any form), Alexander technique, aromatherapy, (Bach) flower remedies, chiropractic, craniosacral therapy, herbal medicine, homeopathy (any combination of homeopathic tinctures), hypnotherapy/hypnosis, massage (of any form), naturopathy, osteopathy, spiritual healing, Tai chi, traditional Chinese medicine and yoga.

Search terms were adapted to run in each database. We included studies of infants, children and adolescents. We also sought systematic reviews from key researchers and clinicians in the field and searched our extensive departmental database. No language restrictions were applied.

We included systematic reviews (and meta-analyses) of randomised clinical trials (RCTs) of CAM for children. We only included systematic reviews of RCTs to align with Cochrane systematic review methodology and because non-randomised studies are more likely to produce effect estimates that indicate more extreme health benefits than randomised trials.[10] This decision increases the reliability and validity of the review while reducing bias. However, this approach does have the limitation of excluding all other forms of evidence, something that may be more problematic when higher levels of evidence in the form of RCTs are not available.

We defined 'children' as babies, infants and adolescents. Reviews were defined as systematic if they included a repeatable and specific method of literature searching and used repeatable and explicit inclusion criteria. Non-systematic reviews, overviews and clinical trials were excluded. We also excluded reviews that were superseded by a more up-to-date review of the same topic for

example, Richardson *et al*, Gotlib and Rupert[11 12] or reviews that included studies on children as well as adults for example, Lee and Done[13].

Abstracts of reviews located were read by one reviewer (KH) and those appearing to meet the inclusion criteria were retrieved and read in full by both reviewers. The reference lists of articles included in the overview were searched for additional studies. Two reviewers (KH and EE) independently extracted the data and judged the methodological quality of the reviews. Disagreements between the two reviewers regarding these judgements were resolved through discussion.

RESULTS

After the removal of duplicates, our searches identified 420 articles. The majority were excluded because they were not reports of systematic reviews (figure 1). The included reviews fall into several categories:

1. Those of (a specific) CAM for a specific condition (table 1).[14–22]
2. Those of a range of treatments (including CAM) for a specific condition (table 2).[23–28]
3. Those of a specific CAM for any paediatric condition (table 3).[29–32]

Although we conducted searches designed to capture a wide range of CAMs we only identified a small number of different CAMs. Twenty systematic reviews met the inclusion criteria and were included in this overview.

Methodological aspects of the included reviews

There was diversity in the quality of conduct and reporting of the systematic reviews included in this overview. For many of the reviews the QUORUM[33] or PRISMA[34] guidelines were not adhered to and in two, referencing errors and inconsistencies cause considerable confusion.[31 32] (The QUORUM guidelines, now replaced with PRISMA guidelines were published to provide a standard for the satisfactory reporting of systematic reviews.) The use of power calculations, allocation concealment procedures and general assessments of methodological quality were markedly absent making assessment of the effectiveness of treatments problematic. These methodological issues are highlighted by the inconsistency and level of disagreement over the same RCTs. In some cases the same RCTs are discussed in multiple reviews and results are considered positive in some while not in others. This occurs, for instance, when only intra/within-group and not inter/between-group differences are presented. This is problematic because clinical effectiveness in an RCT can only be rigorously examined through analysis of the differences in outcome between treatment and control groups.

Acupuncture

Systematic reviews of acupuncture in children are of variable quality which makes any conclusions on the effectiveness of acupuncture for any condition problematic. In addition, RCTs of acupuncture commonly have methodological problems which further limit the ability to draw meaningful conclusions. For nocturnal enuresis for example, one systematic review identified only one (low quality) RCT (Jadad score of 1)[35] which reported that conventional treatment with antidiuretic medication was superior to acupuncture.[15] Conflicting results were reported by Glazener *et al*[25] in a review of seven RCTs where acupuncture was shown to be superior to sham treatment and to desmopressin. However, these trials were undermined by their poor quality highlighted by an absence of blinding, allocation concealment and inadequate power.

For postoperative nausea and vomiting (PONV) the evidence is also mixed. One review[23] of three RCTs for post-tonsillectomy or adenoidectomy vomiting showed no evidence of effectiveness. However, another systematic review reported positive findings from five placebo-controlled and two non-placebo-controlled RCTs for PONV.[32] These findings should be interpreted with caution, however, because no statistics were provided to support the results, methodological quality was inaccurately assessed and referencing inconsistencies and inaccuracies were present. For chemotherapy-induced nausea, the results from one RCT are more promising with acupuncture significantly reducing the need for anti-emetics[26] although this should be independently replicated.

Acupuncture was reported to be effective for pain relief, but no statistics were provided for any RCT and it is unclear whether intergroup analyses are presented.[32] The same review reported improvement in laryngospasm and rhinitis while stridor was worsened by acupuncture.

Chiropractic

Fewer systematic reviews were available for chiropractic in children but the results were mixed and unconvincing. Three RCTs of chiropractic for colic were identified in two systematic reviews.[17 31] Two of which were methodologically poor and the third, which was conducted more rigorously, did not suggest chiropractic is effective for that condition. None used validated outcome measures and relied upon parent self-report of colic symptoms despite the fact that parents were not blinded to group assignment. A third review[16] found no RCTs of chiropractic for otitis media, despite the claims made by chiropractors that it is an effective treatment for that condition.

Two further reviews[25 31] concluded that there is insufficient data to recommend chiropractic as an effective treatment for nocturnal enuresis in children. In the Glazener *et al*[25] review the first RCT reported a significant difference in favour of chiropractic while the second did not report intergroup differences and inadequate data were provided to perform secondary analyses. In addition, there were differences in the

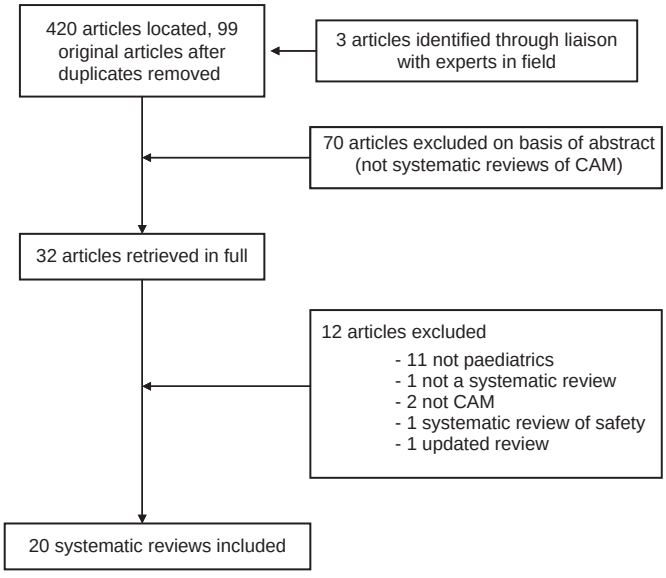

Figure 1 Flowchart showing systematic review selection.

Table 1 Specific CAMs for specific conditions

First author (year)	Type of CAM	Conditions	No. of RCTs	Meta-analysis	Result	Comment
Accardi and Milling (2009)[14]	Hypnosis and imagery	Procedure-related pain	13	No	Hypnotherapy was consistently more effective than control interventions 8 RCTs reported significant reductions in pain, 1 reported significantly reduced length of stay compared to controls and 1 significantly reduced observer-related stress	Trials of hypnosis cannot be blinded or placebo-controlled
Bower *et al* (2005)[15]	Acupuncture	Nocturnal enuresis	11	Yes (but meta-analysis of interest included only 1 RCT)	Only one study compared acupuncture to conventional treatment (antidiuretics) and conventional treatment was more effective	The only RCT had a poor Jadad score=1
Ernst (2009)[17]	Chiropractic	Infant colic	3	No	Only one trial reported significant reduction in crying in treatment compared to control group but methodologically poor	Two trials were weak, the methodologically best study suggested ineffectiveness. None used validated outcome measures
Ernst (2009)[16]	Chiropractic	Otitis	0	No	No RCTs were identified therefore no evidence of effectiveness	Despite lack of evidence, many chiropractors claim to be able to treat otitis effectively
Hofmann *et al* (2003)[18]	Ivy leaf extract	Bronchial asthma	3	No	Verum better than placebo in reducing airway resistance ($p<0.05$)	Only 1 primary study was placebo-controlled, others compared ivy leaf drops with ivy leaf suppositories or ivy leaf syrup
Jacobs *et al* (2003)[19]	Homeopathy	Childhood diarrhoea	3	Yes	Duration of diarrhoea shortened by homeopathic remedies (WMD 0.66, 95% CI 0.16 to 1.15)	All primary studies were by the first author of this review. Effect of debatable clinical relevance
Linde *et al* (2006)[22]	Echinacea (*E purpurea*)	Common cold	2	Yes (but meta-analysed with trials including adults not children so results not presented in this review)	Trend towards improvement in Echinacea group in one study, the second study reported no significant difference in reduction of severity or duration of symptoms between groups (MD=−0.05, 95% CI −0.24 to 0.15). There was also no significant difference in outcome scores at any time point	Only two trials of children. Positive results from one trial with minimal risk of bias but other trial failed to demonstrate effectiveness of Echinacea and did not provide data for all comparisons of interest
Underdown *et al* (2006)[20]	Massage	Promoting physical and mental health	23	Yes	Meta-analyses revealed no significant increases in weight, length, head circumference or mid-arm/leg circumference. A significant improvement in sleep hours was noted in the intervention group (WMD −0.62, 95% CI −1.12 to −0.12) 13 Chinese studies were identified as being at high risk of bias and had uniformly positive results for weight, length, head circumferences, sleep hours and crying hours	In most studies parents were not blinded to group allocation Very high risk of bias in 13 Chinese studies, authors surmise selective reporting of results
Vickers *et al* (2004)[21]	Massage	Promoting growth and development of preterm/low birth weight infants	14	Yes	Infants receiving massage gained more weight than controls (WMD 5.0 g, 95% CI 3.5 to 6.7) and had a reduced length of stay (WMD 4.5 days, 95% CI 2.4 to 6.5). No difference noted for orientation, state regulation. No difference noted in infants receiving gentle touch without rubbing/stroking	Weight gain differences between groups of low clinical relevance. Authors conclude insufficient evidence of effectiveness overall

severity of enuresis at baseline between the two groups and so these findings should be interpreted with caution.

Two trials reported conflicting results for the treatment of asthma; one poor quality study reported benefit while the other more rigorous RCT did not.[31] Methodological problems associated with the review limit the interpretation of these results.

Herbal medicine

Although there are numerous systematic reviews of herbal remedies in adult populations, there is a paucity of such evidence for paediatric populations. Our searches revealed only two systematic reviews.[18 24] The first assessed the effectiveness of ivy leaf extract for childhood bronchial asthma from

Table 2 SRs including CAMs for specific conditions

First author (year)	Type of CAM	Condition	No. of CAM RCTs	Meta-analysis	Result	Comment
Bolton *et al* (2006)[23]	Acupuncture	Post-tonsillectomy and adenoidectomy vomiting	3	Yes	No evidence of efficacy (OR=0.83, 95% CI 0.45 to 1.4)	No information on methodological quality of trials provided
Garrison and Christakis (2000)[24]	Herbal tea (containing chamomile, vervain, licorice, fennel, balm-mint)	Colic	1	Yes but only one trial	Reduction in colic symptoms as per Wessel criteria (RR=0.57, 95% CI 0.37 to 0.89). No significant differences noted for number of night waking	Few databases searched Adequate assessment of methodological quality Only one RCT of CAM No adverse effects reported, although authors note could lead to a reduction in milk intake
Glazener *et al* (2005)[25]	Hypnosis, acupuncture, chiropractic	Nocturnal enuresis	7	Yes (although only one study in each analysis)	Significant improvement after hypnosis in one trial although not placebo-controlled Intergroup differences not reported in other hypnosis trial. Acupuncture superior to sham treatment and conventional drugs (dermopressin) One of two chiropractic studies reported significant improvement	Acupuncture trials of poor quality (absence of blinding, inadequate power, allocation concealment unclear) thus undermining positive findings. Significant differences in severity of enuresis between groups in chiropractic studies. Second chiropractic study did not test intergroup differences and insufficient data provided for re-analyses
Lee and Done (1999)[13]	Acupuncture and acupressure	Postoperative nausea and vomiting	4	No	No significant benefit compared to placebo or conventional anti-emetics	Three studies of good methodological quality although fourth was not placebo-controlled
Mishra *et al* (2000)[28]	*Withania somnifera* (Ashwagandha) and *Boerhaavia diffusa* (Punarnava)	Growth promotion	1	No	Increase in haemoglobin and total protein in Withania group compared to placebo ($p<0.01$) Increase in haemoglobin and handgrip strength at 60 days noted in Withania and Boehaavia group compared to placebo ($p<0.05$)	No analysis of methodological quality of included trials
Rheingans (2007)[26]	Hypnosis, acupuncture (other CAMs not RCTs)	Symptom management in cancer	10 (RCTs)	No	Seven hypnosis RCTs do not report between-group differences One RCT reported a significant reduction in duration of nausea ($p=0.01$) and number of vomiting episodes ($p=0.02$) in hypnosis group compared to control and another RCT reported that the hypnosis group used fewer anti-emetics than the control group ($p=0.04$) One study of acupuncture reported reduced need for anti-emetics in treatment group ($p=0.02$)	Also included non-RCTs, for example, case series Excluded studies of herbal preparations Very poor analysis of methodological quality General improvement in symptoms noted in experimental groups but between-group comparisons rarely reported Studies frequently not placebo-controlled Between-group comparisons rarely reported Often unclear whether placebo treatment or comparison between therapies No mention of adverse effects
Yip *et al* (2009)[27]	Hypnosis	Induction of anaesthesia	1 (17 non-CAM)	Yes	Non-significant trend for reduced anxiety during induction (RR=0.59, 95% CI 0.33 to 1.04)	Only one trial included

three RCTs[18] concluding that it is more effective than placebo. However, there were considerable methodological problems with the trials included and only one was placebo-controlled.

A systematic review of treatments for colic included one study of herbal treatments.[24] That RCT tested a herbal tea containing chamomile, vervain, licorice, fennel and balm-mint, and found it to be effective in reducing colic symptoms as per the Wessel criteria but did not significantly reduce the number of night wakings in the treatment compared to the control group. The authors expressed concern about the volume of tea required to create this effect (32 ml/kg/day) and the impact that this could have on milk consumption.

A Cochrane review of *Echinacea purpurea* for the common cold included two RCTs of children.[22] The first trial included children with early symptoms of common colds (mean age 7-years-old) and randomised participants to one of three groups: *E purpurea* juice

Table 3 Specific CAMs for any paediatric condition

First author (year)	CAM treatment	No. of RCTs	Meta-analysis	Result	Comment
Altunc *et al* (2007)[29]	Homeopathy	16	No	2 of 3 RCTs for ADHD reported results in favour of homeopathy although relied upon parent self-report One RCT of otitis reported a significantly greater decrease in parent-rated symptom scores compared to the control group 2 of 3 RCTs of diarrhoea reported effects in favour of homeopathy One RCT reported benefits for postoperative agitation compared to placebo	A total of 9 different conditions were treated. Independent replications were missing. Primary studies were of mixed methodological quality and so no convincing evidence of effectiveness in any condition
Libonate *et al* (2008)[32]	Acupuncture	24	No	Pain reduction was noted in 2 studies In 7 of 12 studies, a significant reduction in postoperative nausea or vomiting was reported although only 5 were placebo-controlled One RCT reported significant improvement in nocturnal enuresis Other RCTs reported worsening of stridor as a result of acupuncture and improvement of laryngospasm and rhinitis No improvement in asthma symptoms were noted	No statistics provided to support results and insufficient assessment of methodological quality Referencing inaccuracies make analysis of review difficult
Galantino *et al* (2008)[30]	Yoga	24	No	A trend was reported for improvement in motor planning and mental, social acuity and motor performance (improved reaction time, planning and execution times, motor speed) although some were poorly conducted studies with small sample sizes Six studies with adequate methodological quality reported improvements in concentration and memory Significant improvements in IQ and social parameters were reported in one study of children with learning disabilities although several methodological problems were present Three studies reported positive effects of yoga for anxiety although were also of fairly low methodological quality Significant improvements in grip strength noted in two studies of low methodological quality One study reported significant weight loss in obese children after a 12-week yoga program	Comprehensive database searches were performed and the Jadad score was utilised There was considerable variation in number and length of yoga sessions and no standardisation of yoga approaches. In addition, treatment adherence was rarely reported None of the studies were of high quality but because the review failed to mention power calculations and allocation concealment and rarely presents p values and other statistics, judgement of quality is limited
Gotlib and Rupert (2008)[31]	Chiropractic	10	No	Two trials reported conflicting results for the treatment of asthma; one reported benefit while the other did not. The same conflict was reported by two studies of enuresis and 2 studies of infantile colic. Chiropractic was not effective for jetlag	The most rigorous studies were negative. Two of the 10 studies were feasibility studies with no data on effectiveness. Methodological quality was not assessed

from flowering plants, *Andrographis paniculata* with *Eleutherococcus senticosus* and no treatment. The authors did not report a conclusion for the comparison between herbs although the Cochrane authors do conclude a non-significant trend towards better symptom control in the Echinacea group compared to no treatment. The second trial compared *E purpurea* with a placebo syrup in children aged between 2 and 11 years. Healthy children were randomised to group and asked to commence treatment (7.5–10 ml/day depending on age, for 10 days) should they experience common cold symptoms. The study was rigorously designed, conducted and written-up but did not report significant differences in the severity or duration of cold symptoms between groups. In addition, the frequency of adverse effects (AEs) was significantly greater in the experimental group than in the control.

The effectiveness of *Withania somnifera* (Ashwagandha) was investigated by a systematic review that included one trial of children.[28] Sixty healthy children aged between 8 and 12 years were randomised to one of three groups: *W somnifera* (Ashwagandha), *W somnifera* (Ashwagandha) or *Boerhaavia diffusa* (Punarnava) or placebo. A series of biological and haematological parameters were measured and a significant increase in haemoglobin and total protein was noted in the Withania group compared to the placebo group ($p<0.01$). In addition, an increase in haemoglobin and handgrip strength at 60 days was

reported in Withania and Boehaavia group compared to placebo ($p<0.05$). However, there is no information on whether a power calculation was conducted, which given the small numbers in each group (n=20) and the high number of comparisons made, may reduce the reliability of the results. Nonetheless, these results are promising and further research is warranted into the effectiveness of these lesser-known herbs.

Homeopathy

Our searches identified two systematic reviews of homeopathy in children.[19 29] The first of these assessed the effectiveness of homeopathy for childhood diarrhoea, concluding that duration of diarrhoea was significantly reduced in the treatment compared to control groups in three RCTs.[19] However, all of the RCTs included in the review were conducted by the author of the systematic review. This calls the methodological quality of the review into question and it therefore requires independent replication. Furthermore, when the same three RCTs were analysed in another systematic review of homeopathy,[29] only two were reported to show significant intergroup differences, but these were in favour of homeopathy.

Two of the three RCTs of homeopathy for attention deficit hyperactive disorder reported results in favour of homeopathy although the primary outcome measure was the Connor's Parent Symptom Questionnaire, thus relying upon parent self-report, a potential source of bias. One RCT of otitis and one of postoperative agitation also reported findings in favour of homeopathy yet the former again relied upon parent-report of symptoms.

Hypnotherapy

The hypnotherapy trials were generally of better quality than the other CAMs, but because of the nature of the intervention, none were placebo-controlled and hypnotherapy was compared with distraction or standard medical care. One review of 13 RCTs concluded that there is consistent evidence of effectiveness of hypnosis for procedure-related pain in children.[14] Eight of these RCTs reported significant intergroup reductions in pain; one reported a reduction in length of stay and another, observer-related distress. However, it is unclear whether observer-related stress was the primary outcome and not procedure-related pain, for which the data are not presented.

The review conducted by Rheingans[26] failed to report intergroup differences in seven of the nine included RCTs. The two studies for which these analyses were present showed hypnotherapy to be effective in reducing PONV or the use of antiemetics. In addition to a lack of clarity in the type of analyses presented, this systematic review also provided a very poor analysis of the methodological quality of included trials making it difficult to make conclusions on the quality of the evidence presented.

Hypnotherapy was shown to be effective in treating enuresis in one of two RCTs[25] and in one RCT for assisting the induction of anaesthesia.[27]

Massage

Two large Cochrane reviews have been published on massage for children. The first of which assessed the effectiveness of massage for promoting physical and mental health in infants aged less than 6 months.[20] Data were meta-analysed and revealed no significant increases in weight, length, head circumference or mid-arm/leg circumference. However, massage was associated with a significant improvement in sleep hours compared to the control. Thirteen Chinese studies were reported to have a very high risk of bias and were meta-analysed separately as a consequence. These RCTs all had highly positive results on all parameters which led the review authors to surmise that selective reporting of results may have taken place.

The second Cochrane review assessed the effectiveness of massage in promoting growth and development of preterm and/or low birth weight infants.[21] For that review, searches of Chinese databases were not conducted. Infants receiving massage had a reduced length of hospital stay and gained more weight than controls although the difference was of low clinical relevance. No difference was noted for orientation, state regulation or in infants receiving gentle touch without rubbing/stroking.

Yoga

One large, comprehensive, systematic review of 24 RCTs of yoga was identified.[30] A trend was reported for improvement in motor planning and mental, social acuity and motor performance (improved reaction time, planning and execution times, motor speed) although some were poorly conducted studies with small sample sizes. Six RCTs with adequate methodological quality reported improvements in concentration and memory and one methodologically poor RCT reported significant improvements in IQ and social parameters in children with learning disabilities. Positive effects of yoga for anxiety and grip strength were reported in three and five RCTs, respectively although they were also of fairly low methodological quality.

Although the reviewers conducted systematic database searches, they failed to report the findings of the included studies adequately. This means, as with many of the systematic reviews in our analysis, it is unknown whether the RCTs have adequate power, whether allocation concealment was adequately carried out and insufficient statistics are provided to support the results. p Values are rarely provided and judgement of the overall quality of the included RCTs limited. In addition, there is considerable variation in the duration and type of yoga sessions across all the studies which makes their comparison problematic and it difficult to make a judgement of the effectiveness of yoga as a treatment for any condition.

DISCUSSION

Our analyses do not reveal consistent evidence to suggest that CAM is effective for paediatric conditions. In fact, for some conditions, CAM seems to worsen symptoms, as was noted in children with stridor treated with acupuncture. However, despite great diversity in the quality of the evidence and resoundingly negative evidence for some CAM therapies, there are positive results for others. For instance, there are some encouraging findings that suggest acupuncture may be helpful for PONV, that homeopathy may relieve childhood diarrhoea, massage may increase sleep hours and that hypnotherapy may be effective in reducing procedure-related pain. In addition, there is limited evidence to suggest that Echinacea may also be effective in treating the common cold but external replication is required to further test this conclusion. Although there were some positive results for yoga, trials were of poor quality and a lack of standardisation of yoga practices makes their comparison problematic, thus necessitating additional, rigorous testing in the form of RCTs.

Although there are a plethora of RCTs of CAMs in children, there has been relatively little evidence synthesis assessing

the weight of the evidence for a given CAM. More systematic reviews of CAM in children should be undertaken but they should, unlike the majority included in this report, be conducted according to the PRISMA guidelines.[34] Indeed, we found that several of the systematic reviews had poorly developed search strategies, did not describe the strategies or imposed language restrictions causing bias and reducing the number of included RCTs. The fact that there was very little duplication of RCTs between reviews suggests that searches were frequently not designed or conducted appropriately. These limitations further reduce the ability to draw conclusions about the effectiveness of CAM in children.

It is not just the quality of the systematic reviews that makes analysis of CAM data complex, the quality of the RCTs included plays an even greater role. Studies assessing the RCTs of homeopathy have suggested that RCTs of better methodological quality tend to yield less positive results than RCTs of high quality.[36 37] Moreover, publication bias is a common problem in CAM research,[38] which combined with the selective reporting of results including failure to define the primary outcome, further reduces the robustness of findings.

There are several limitations to this overview. The decision to align with Cochrane methodology and exclude non-RCTs reduces the risk of bias but also reduces the coverage of this overview: CAM therapies that have not been tested in clinical trials are not represented. This report is also ultimately reliant on the quality of the systematic reviews and not the RCTs themselves: an overview of systematic reviews rather than of RCTs may have understated the quantity of evidence on CAM for children. In addition, we did not conduct an exhaustive search of all relevant databases nor potential CAMs and we do not report a full assessment of the systematic reviews. We also did not systematically go back to the original papers included in the review and so are unable to make judgements about their methodological quality if the reviews failed to do so. However, we did not set out to conduct a systematic review of systematic reviews, we aimed to provide a critical overview of the key systematic reviews of CAM for children. Furthermore, we did contact experts in the field of CAM paediatrics who identified a further three reviews which we subsequently included in our analyses. Another limitation relates to the definition of CAMs. We had to rely on the review and RCT's definition of the CAMs we included and therefore the ability to make comparisons between the acupuncture or homeopathy provided in one trial compared to that in another is reduced.

Any assessment of effectiveness of a treatment should be undertaken in tandem with consideration of safety. However, unlike in conventional medicine where AEs are routinely collected as part of clinical care and research, this is rarely the case in CAM.[39] Most of the systematic reviews included in this overview did not report AEs. It is not clear whether this is a result of a lack of information in the original reports or in the quality of the systematic review. Indeed, it has previously been noted that RCTs of CAM frequently fail to report AEs of treatments[40] and we know that reports of AEs of CAM probably represent the tip of the iceberg because at present it is impossible to provide reliable incidence figures.[41] For acupuncture, for example, AEs are more common than previously reported, estimated at 5.36 per 10 000, compared to previous estimates of 0.05 per 10 000 treatments.[42] Moreover, AEs of CAM extend beyond the actual treatments themselves. It has been shown that children who consult naturopathy and chiropractic practitioners are significantly less likely to receive the recommended vaccinations and were significantly more likely to be diagnosed with a vaccine-preventable disease.[43]

Before recommendations for the use of CAM in children can be made, there needs to be a greater emphasis on the rigorous testing of therapies using standardised techniques and a concerted emphasis on the reporting of AEs in practice and research. For children, this is a particularly pertinent issue given that they are unable to give informed consent to treatment and thus rely upon appropriate decisions about their care being made on their behalf.

Competing interests None.

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Appendix 1 Search strategy

botanical extract$.ti,ab.
botanical preparation$.ti,ab.
(Chinese adj3 medicin$).ti,ab.
Chinese drug$.ti,ab.
Chinese formul$.ti,ab.
Chinese herb$.ti,ab.
Chinese medic$.ti,ab.
Chinese plant$.ti,ab.
Chinese prescri$.ti,ab.
Chinese remed$.ti,ab.
(herb$ adj3 mixture$).ti,ab
herbal extract$.ti,ab
herbal medicine$.ti,ab.
herbal preparation$.ti,ab.
herbal remed$.ti,ab.
medicinal plant$.ti,ab.
non-prescription drug$.ti,ab
pharmacognosy.ti,ab
phytodrug$.ti,ab
phytomedicine$.ti,ab.
phytopharmaceutical$.ti,ab.
Phytotherapy.ti,ab
plant extract$.ti,ab.
Plant preparation$.ti,ab
plant exudate$.ti,ab
(TCMs or TCM).ti,ab.
(homeop$ or homoeop$ or homoop$).ti,ab.
Complementary medicine$.ti,ab
Complementary therap$.ti,ab
Alternative medicine$.ti,ab
Alternative therap$.ti,ab
Acupressure.ti,ab
Acupunctur$.ti,ab
Chiropract$.ti,ab
Osteopath$.ti,ab
Alexander techinique$.ti,ab
Aromatherap$.ti,ab
Flower remed$.ti,ab
Bach remed$.ti,ab

Continued

Appendix 1 Continued

Craniosacral therap$.ti,ab
Hypnotherap$.ti,ab
Massage.ti,ab
Naturopath$.ti,ab
Reflexology$.ti,ab
Spirit$ heal$.ti,ab
Tai chi.ti,ab
Yoga.ti,ab
OR 1/53
Adolescent$.ti,ab
(Baby or babies).ti,ab
Child$.ti,ab
Infant$.ti,ab
Juvenile$.ti,ab
Neonat$.ti,ab
Newborn$.ti,ab
Paediatric$.ti,ab
Pediatric$.ti,ab
(1 year$ old$ or 2 year$ old$ or 3 year$ old$ or 4 year$ old$ or 5 year$ old$ or 6 year$ old$ or 7 year$ old$ or 8 year$ old$ or 9 year$ old$ or 10 year$ old$ or 11 year$ old$ or 12 year$ old$ or 13 year$ old$ or 14 year$ old$ or 15 year$ old$ or 16 year$ old$).ti,ab
((one or two or three or four or five or six or seven or eight or nine or ten) adj year$ old$).ti,ab
Colic$.ti,ab
Enuresis.ti,ab
Cystic fibrosis.ti,ab
Otitis.ti,ab
Croup.ti,ab
Idiopathic arthriti$.ti,ab
Muscular dystrophy.ti,ab
Ricket$.ti,ab
(whooping cough or pertussis).ti,ab
Encopresis.ti,ab
OR 55-73
Systematic review.ti,ab
Meta-analysis.ti,ab
OR 71-72
48 AND 70 AND 73

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