

# JCCP

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## JOURNAL OF CLINICAL CHIROPRACTIC PEDIATRICS



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INTERNATIONAL CHIROPRACTORS ASSOCIATION

# JCCP JOURNAL OF CLINICAL CHIROPRACTIC PEDIATRICS

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# JCCP JOURNAL OF CLINICAL CHIROPRACTIC PEDIATRICS

The *Journal of Clinical Chiropractic Pediatrics* welcomes original and scholarly manuscripts for peer-review and consideration for publication. Topics must pertain to the field of pediatrics which includes pregnancy and adolescence. Manuscripts should not have been published before or submitted to another publication.

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**Controlled, Large Scale Studies** — usually, but not necessarily, performed at a college or research facility. May be double-blinded.

**Commentaries** — presentations of opinion on trends within the profession or current events, pertaining to pediatric and adolescent chiropractic care.

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experimental investigations performed on humans the manuscript must include a statement that informed consent was obtained from the individuals involved in the investigation.

**Patient Anonymity** — Patient names or any information that could identify a specific patient should be avoided. Photographs accompanying a manuscript must have a consent form signed by the individual or parent or guardian in the case of a minor. These are to include any requests for blocking faces, etc.

**Acknowledgements** — Any illustrations from other publications must be acknowledged. It is the author's responsibility to obtain written permission from the publisher and/or author for their use.

All manuscripts deemed appropriate for publication by the editor will be sent *blind* to at least two reviewers. If the manuscript is accepted, the author will be notified. If substantive changes are required, the paper will be returned to the author and the author must re-submit a clean copy of the revised manuscript. Author will be given a tentative

date for publication if accepted.

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8. Digital files to be sent to [svallonedc@aol.com](mailto:svallonedc@aol.com).



# Chiropractic Wellness Care — Practice-Based Research

Principal Investigator: Cheryl Hawk, DC, PhD  
Coinvestigators: Katherine Pohlman, DC, MS, U of Alberta  
Jay Greenstein, DC, CCSP, private practice  
Program Coordinator: Michelle Anderson

Wellness care, or “maintenance care,” is widely accepted by the profession as an integral part of chiropractic practice. However, to date, a cause-and-effect relationship between wellness care and improved long-term health outcomes has yet to be clearly demonstrated. This study is designed to add to the evidence base on this important topic.

## Purpose of this Study

The purpose of this study is to assess changes in Health-Related Quality of Life over a 12 month period of chiropractic patients who do and do not participate in wellness care. It is being conducted in the offices of U.S. chiropractors who are members of the Integrated Chiropractic Outcomes Network (ICON). For this study, we define *chiropractic wellness care* as a course of long-term care provided to a patient who is either asymptomatic or whose original presenting complaint has been resolved or stabilized and is provided for the purpose of preventing disease, optimizing function, and supporting the patient’s wellness-related activities and/or minimizing recurrences of previous complaints.\*

## Study Design

Baseline data are collected in practitioners’ offices; follow-up is conducted by the central office at Logan, by phone and email. Each doctor enrolls 5 consecutive new patients. **New patients of any age are eligible!** Data are collected at 4 points: first visit and 1, 6 and 12 months later. Outcomes are assessed primarily via questions from the CDC’s Behavioral Risk Factor Surveillance System (BRFSS). Patients are entered in a drawing for a \$100 gift card when they complete the follow-up.

## Would You Like to Join the Study?

We have rolling enrollment so you can still join!  
Simply email or call Program Coordinator Michelle Anderson:  
***michelle.anderson@logan.edu*** or **636-230-1946**.

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\* Hawk C, Schneider M, Evans MW, Jr., Redwood D. Consensus process to develop a best-practice document on the role of chiropractic care in health promotion, disease prevention, and wellness. J Manipulative Physiol Ther 2012;35:556-567.

# Editorial

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This issue of the JCCP has a variety of offerings ranging from several commentaries, three case reports contributed by students from the New Zealand College of Chiropractic, to a cost analysis of routine care for infant colic in the UK versus costs of chiropractic manual therapy as a management strategy.

Included in this issue is also a case study that explores the responsibilities of the chiropractor in monitoring a child when a parent takes their medical management into their own hands, which in this case involved an alteration in medication levels in response to changes that occurred after chiropractic care.

On the one hand, I applaud the students and their educators at NZCC for appreciating the importance of teaching and encouraging scientific writing at the student level in hopes of cultivating an enthusiasm for participation in research and scientific documentation of the rich experiences we each experience daily in our clinical practices. I also express appreciation for the latter article added to our cache of documentation as many chiropractors engage in a legislative battle individually in states and on a national

level to preserve the reimbursement for chiropractic services for children who are covered under the state and federal Medicaid plans. An example of safety and efficacy of treatment as well as cost effectiveness, like this, will hopefully sway the vote in favor of continuing to provide care to this vulnerable population.

Many of the papers in this and previous issues have been the result of collaborative efforts between field practitioners and seasoned researchers/authors. The experience has been a rewarding one for many of the participants. The end results you can judge for yourself. We continue to ask our colleagues to consider collaboration and continue to contribute to the body of literature that serves to support chiropractors in the field as well as to represent our profession to those who continue to seek information about the benefits and efficacy of chiropractic care.



*Sharon Vallone, DC, FICCP*  
Co-Editor



# Costs of Routine Care for Infant Colic in the UK and Costs of Chiropractic Manual Therapy as a Management Strategy Alongside a RCT for this Condition

Joyce Miller, DC, FACO, FCC, FEAC (Paeds)

## ABSTRACT

**Background:** There is a small body of published research (six research studies and a Cochrane review) suggesting that manual therapy is effective in the treatment of infant colic. Research from the UK has shown that the costs of NHS treatment are high (£65million [USD100 million] in 2001) with no alleviation of the condition.

**Objectives:** The objectives of this study were to: investigate the cost of the inconsolable nocturnal crying infant syndrome which is popularly known as infant colic in the first 20 weeks of life, estimate the costs of different types of treatment commonly chosen by parents for a colicky infant for a week of care or an episode of care, investigate the cost of chiropractic manual therapy intervention aimed at reducing the hours of infant crying alongside a randomised controlled trial (RCT) showing effectiveness of treatment

**Design:** Economic evaluation incorporating a RCT

**Methods:** A cost analysis was conducted using data from a RCT conducted in a three-armed single-blinded trial that randomized excessively crying infants into one of three groups: a) routine chiropractic manual therapy (CMT), b) CMT with parent blinded or c) no treatment control group with parent blinded. These costs were compared with costs of caring for infant colic from Unit Costs of Health and Social Care, UK, 2011. It has been widely estimated that 21% of infants in the UK present annually to primary care for excessive crying and this calculated to 167,000 infants (to the nearest 1,000) used in the cost analysis as there were 795,249 infants in the UK in mid-2010 according to the UK Office of National Statistics, 2011.

**Results:** 100 infants completed the RCT and this resulted in treatment costs of £58/child (\$93). An additional cost of GP care of £27.50 was added for initial evaluation of the general health of the child and suitability for chiropractic management, totaling £85.50 per child in the RCT. Clinical outcomes are published elsewhere, but care showed both statistically and clinically significant efficacy in reduced crying time by an average of 2.6 hours resulting in a crying time of less than two hours a day (reaching "normal" levels which could be classified as non-colic behavior). Cost per child's care was £85.50 extrapolated to £14,278,500 for the full cohort of 167,000. If chiropractic care had been given privately, costs were calculated as £164/child per episode of care and this equalled £27,388,000 for the entire cohort. Medical costs through a normal stream of care amounted to £1089.91 per child or £182,014,970 for the cohort (including all costs of care, not just NHS). No benefits of effectiveness were accrued from any of those types of treatment. If the Morris NHS data were extrapolated to 2010, applying wage inflation, the cost would be £118 million (USD180 million) yearly. An episode of an average of four treatments of chiropractic manual therapy with documented efficacy of CMT cost from 8% to 24% of NHS care or routine care.

**Conclusion:** chiropractic manual therapy was a cost-effective option in this study. A much larger randomized study of routine medical care versus routine chiropractic care is recommended to determine whether there is confirmation of these findings.

## Introduction

As effective treatment for children with infant colic remains elusive, the costs of managing the condition is gaining increasing attention. Although it is uncommon for clinicians to be quizzed about the cost-effectiveness of their treatments,<sup>1</sup> particularly where the clinicians' services are covered by a national health plan, it is increasingly appropriate to ask this question, when prudence in

health care expenditure is required.

Cost-effectiveness has been defined as the incremental cost required per additional unit of health benefit produced as compared with the next most effective treatment.<sup>2</sup> This issue is influenced by the seriousness of the condition under treatment, the costs of the condition if untreated, the efficacy of the treatments, durability of treatment along with patient satisfaction with the treatment.<sup>2</sup> Parents choose specific therapies for their child and all have a cost, some easier to identify than others.

In the United Kingdom (UK), there are direct costs to the National Health Service (NHS) for treating the

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crying baby<sup>3</sup> as well as indirect costs of family travel, lost sleep, lost work time and potential costs of low self-efficacy, depression, anxiety, exhaustion, anger and marital distress and possibly even child maltreatment.<sup>4</sup> An estimate of the direct NHS costs of treating the crying baby less than 12 weeks of age in 2001 in the UK was £65 million (USD100 million) per annum.<sup>3</sup> No therapeutic benefits were accrued from those costs.<sup>3</sup> An updated economic evaluation, applying wage inflation, found that the same costs used in the earlier 2001 report in 2010 cost the NHS an estimated £118 million (\$180 million) yearly.<sup>5</sup>

However, the Morris (2001)<sup>3</sup> cost assessment was non-specific as it used only visits to GPs and Health Visitors and only the actual amount of time used to discuss crying problems. Further, the calculations were made for all children born in one given year. A cost assessment using the proportion of infants afflicted with the condition called infant colic using the type of resources parents routinely access is appropriate. An array of treatments for infants with colicky symptoms are chosen by sometimes desperate families. Parents access midwives, GPs, nurses, emergency hospital based services, pediatricians and CAM practitioners.<sup>6</sup> Therefore, it is appropriate to investigate a cost analysis of the condition which includes the variety of treatments without any evidence of efficacy, chosen by parents, along with specific calculations for a type of treatment which has shown some effectiveness, manual therapy. One useful way to determine cost is to follow the costs of care as they occur in a randomised controlled trial.<sup>7</sup> This study endeavored to investigate these costs.

## Methods

The objectives were to:

- investigate the cost of the inconsolable nocturnal crying infant syndrome which is popularly known as infant colic in the first 20 weeks of life
- estimate the costs of different types of treatment commonly chosen by parents for a colicky infant for a week of care or an episode of care
- investigate the cost of chiropractic manual therapy intervention aimed at reducing the hours of infant crying relative to a randomised controlled trial showing effectiveness of treatment.

A 20 week time span was chosen because the condition has been said to self-resolve or divert to other symptoms at 24 weeks of age, so for the purposes of this assessment, cost of treatment was calculated for five months (20 weeks) considering the condition starts between 1

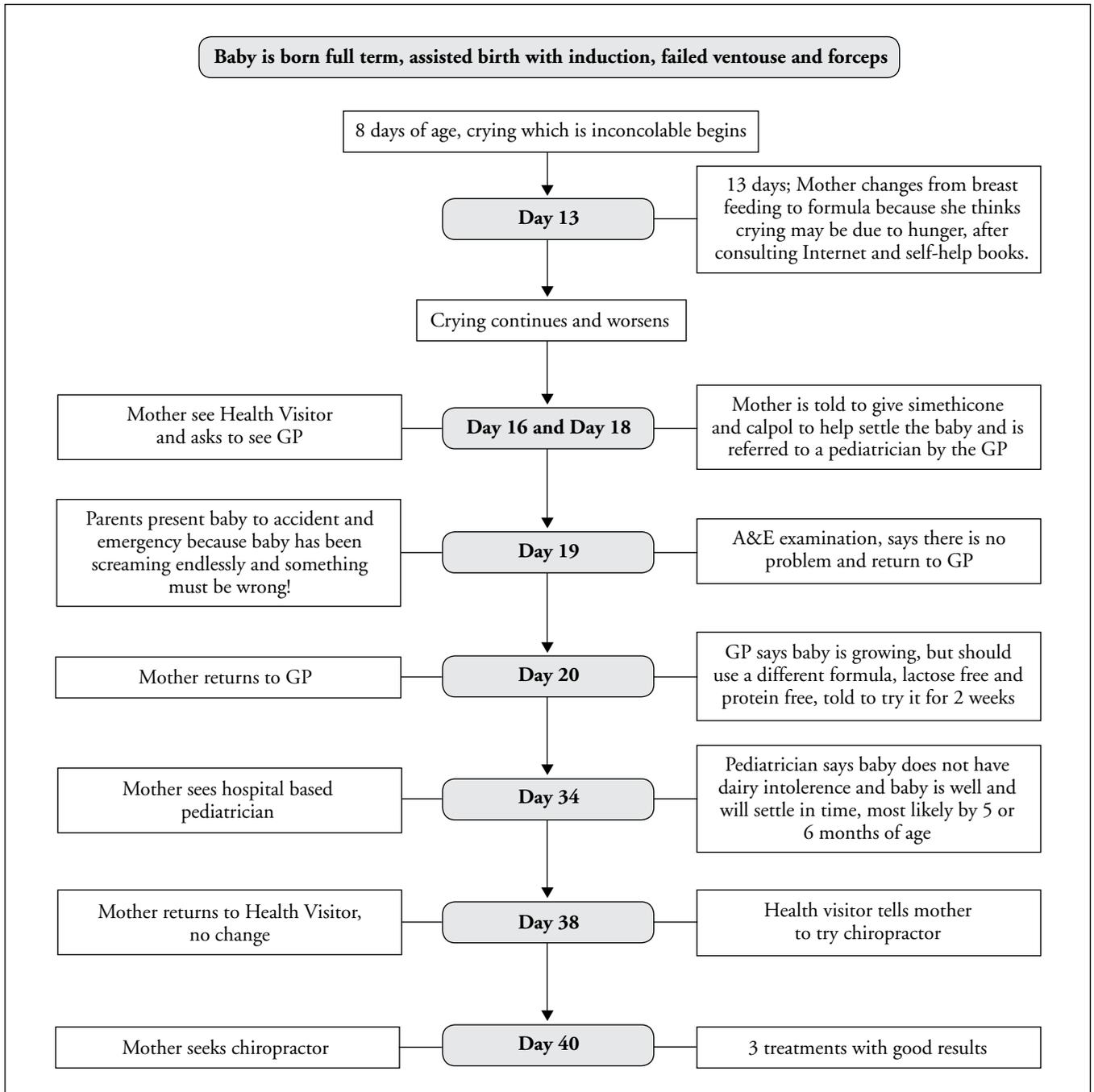
and 2 weeks of age. Also, where pertinent, the cost of care for one week was also determined so that a shorter episode of care can be calculated. These decisions were made in the effort to underestimate rather than overestimate the costs. That said, self-resolution of the condition has often been disputed and many long-term effects have been noted.<sup>8</sup>

Unfortunately, there is a risk for maltreatment in these cases and a recent report states that this affects 6% of excessively crying infants.<sup>9</sup> It must be noted that excessive crying is the chief reason that parents give for maltreatment of their child and the child less than one year of age is the most commonly abused member of society.<sup>10</sup> Therefore this is also included in the calculations and presented as an average of cost per child when spread over the entire cohort.

Because each cost is independently calculated, there is flexibility in choosing which therapies or issues are appropriate in any individual case. For example, costs of hypo-allergenic formula were calculated for only 5% of the colic population, as this was thought to be realistic considering the estimate of 5-15% occurrence of milk allergy in the young population.<sup>11</sup> However, NHS guidelines suggest a week's trial for all colic babies under clinical guidance and this number is calculated as well. Also, the figure of 1% of colic children was used to calculate the costs of non-allergenic (amino acid) formula. All are appropriate as it is realistic that 5% of the population may require a full course of hypo-allergenic formula and NICE guidelines recommend a week's trial for all colicky infants, and a small percentage require non-allergenic formula. The clinician may decide which are most appropriate, although realistically, all these costs may be incurred.

According to the Office for National Statistics, in 2011 there were 795,249 infants in the UK in mid-2010. Freedman et al. in 2009<sup>12</sup> calculated that 21% of infants present to health care for excessive crying and this resulted in the 167,000 infants (calculated to the nearest 1,000) used for the cost analysis. These numbers were used for calculations to answer the first two research questions. It must be kept in mind that Morris, in 2001, reported numbers for all infants.<sup>3</sup>

The third question was answered by using data from the RCT investigating manual therapy as an intervention into the condition of infant colic, a three-armed single-blinded controlled trial conducted on the south coast of England between 2010 and 2011.<sup>13</sup>



**Figure 1. Typical resources used by parents for a crying baby (flow diagram) based on author's experience and research literature.**

## Results

*Figure 1* is the author's conception of a "typical" pathway chosen by parents of a child with infant colic and is based upon clinical experience as well as research literature.<sup>6,14</sup> *Table 1* estimates potential costs for a cohort of infants with infant colic in the UK. According to systematic reviews of treatments for infant colic, these treatments re-

sulted in no significant recovery.<sup>15-17</sup> This table demonstrates the potential costs of a cohort of colicky infants in a possible flow-through typical types of health care along with potential costs of infant colic including change in feeding, stoppage of breast feeding and even non-accidental injury. Costs have been added for a total potential for routine costs that might accrue in a cohort of afflicted infants.

Type of management	Cost per child	Cost per cohort
NHS consultation, mean of midwife, Health Visitor, GP	£27.50/average (mean 4.25 visits) = £116.88/child	£19,518,025
Accident and Emergency visit <sup>1</sup>	£131/visit (no admittance)	\$21,877,000
Pediatrician (1 visit/baby)	£194/visit (outpatient medical specialist)	£32,398,000
Medications prescription -1	£41/child	£6,483,940
Medication-over the counter-1	Mean £6.95/unit x 3 units = £20.85/child	£3,481,950
Private CAM care (4/child)	Mean £164.41 mean 4 visits/child	£27,456,470
Hypoallergenic formula (5% of colic children)	£1,853/child; calculated for 5% of colic children	£15,472,550
Hypoallergenic formula for one week trial for all children*	One week of formula for all colic children = £160/week /child	26,720,000
Non-allergenic formula (1%)	£3,161/child, calculated for 1% of colicky children	£5,278,870
Change from breastfeeding to formula feeding	Mean £349.49/child in additional health care costs in the first year in 2013	£58,364,830
Non-accidental injury	Affects 11.6/100,000 = 19 in this cohort; £12.28/child first year, £1,000/child lifetime	£2,052,000/first year (£171 million in a lifetime)
Total possible costs	Cost per child is £1,089.91 in first year without full change in formula but single week's trial per guidelines	£182,014,970/cohort (includes one week trial of formula, not full change to formula feed needed in small number cases)

\* <http://www.nice.org.uk>. National Health Service, 2012 available at: <https://www.wp.db.gov.uk/.../2012/.../27-Childrens-Public-Health-Service>.

GP costs/visit from Unit Costs of Health and Social Care, UK,2011 was £36, mean for all practice practitioners was £27.50 so lower number used; A&E costs per visit with no admittance national average was £131 from 7.1 hospital costs in Unit Costs of Health and Social Care in 2010 (p119); Prescription cost/consultation was £41 from 10.8bGP-Unit Costs from Unit Costs of Health and Social Care 2011, p. 149. Costs of loss of breastfeeding calculated in 1999 units by Ball and Wright (1999) and adjusted to 2012 UK currency with inflation calculator.

**Table 1. Estimated cost of types of care chosen by parents for infant colic in a cohort of infants**

Table 2 differs from Table 1, in that it depicts per unit costs that parents might choose for their afflicted child. Although it does use the multiplier factor of the full cohort of infants with colic, it doesn't purport that this is a cohort of children moving through care, but only depicts some of the more common types of care which are chosen, so that costs can be compared. The reader may pick and choose which of these to add together for routine costs.

In the cost analysis paralleling a recent RCT,<sup>12</sup> costs were as follows:

- One GP visit to rule out illness and send the child to the university affiliated clinic: cost per child £27.50; cost for 100 children: £2,750
- Mean of 4 chiropractic treatments (£14.50/treatment) for child at £58/child = £5,800.
- Total cost was £8550/100 children which is £85.50/child
- If this were extrapolated to the entire cohort, the cost for chiropractic care for every child who suffered from infant colic in 2010 would be

£14,278,500 (approximately \$22 million) for an episode of manual treatment.

- This cost resulted in an average of 2.6 hours reduction in infant crying, bringing the weekly crying to a “normal” amount which is less than a colic diagnosis. The cost of manual therapy per hour reduction in crying was £33 (\$51).

## Discussion

This study sought to review costs of one of the most common conditions of infancy — colic. The costs of treatment of this condition are high and most are unrelated to any effective treatment. Only chiropractic manual therapy has demonstrated sufficient efficacy in this condition to be given an effectiveness rating of “moderate” by Cochrane reviewers.<sup>18</sup>

Although an attempt was made to review the wide range of treatments chosen by parents, perhaps more non-conventional therapies should be reviewed as well, known as complementary and alternative medicine (CAM). Parents in the USA spent \$149 million (£90 million) for CAM therapies or remedies for their children in 1996.<sup>19</sup> That was almost two decades ago and by all counts, CAM has grown significantly since then. If 3.7% of those visits were allotted to chiropractic,<sup>20</sup> the portion was \$5.5 million (£3.3) in 1996, which is equivalent to \$8 million (or £5 million) in 2012 spent by parents on chiropractic manual therapy for children. By all counts, CAM usage, particu-

larly manual therapy usage has increased since then and economics should be reconsidered.<sup>20</sup>

Manual therapy has been found to be cost-effective in other studies.<sup>21-24</sup> However, there has been no attempt at investigation of a cost-benefit analysis of chiropractic manual therapy for the treatment of the infant inconsolable nocturnal crying infant syndrome (a proposed moniker to replace the outdated term, infant colic).

Of course, even a treatment that has shown effectiveness in a blinded RCT and a Cochrane review does not guarantee success in every child. However, the weakest manual therapy RCT resulted in 43% less crying<sup>25</sup> and safety is more or less assured from the track record<sup>26</sup> of the therapy as well as the close monitoring of the baby and family. Close monitoring over the difficult weeks may be one of the benefits for the family and society, which may keep the child safe, even if treatment is not completely efficacious.<sup>9</sup>

If examination by the GP to determine that no other illnesses were present and if no further treatment beyond manual therapy were sought, this could result in a savings of £50,721,500 in 2001 (approximately £60 million in 2012 [USD96 million]). The annual cost of manual therapy is approximately equivalent to the annual cost of the most common drug treatment, simethicone alone at current rates. Although the two treatments, simethicone and

Type of Management and mean number of units or time	Cost per unit	Total cost
NHS Consultation (Mean 4.25 contact/baby)	£27.50	£19,518,025
UK Private health care (Mean contacts 4.25)	£164.41	£47,898,315
Average university-affiliated chiropractic clinic cost	£58/child	£9,686,000
Private chiropractic care (Mean worldwide) (Mean contacts: 4)	£132.26	£11,043,710
NHS prescribed simethicone (5 months)	£2.14/RX	£14,293,452
Other over-the-counter products:		
• Dentinox (5 months)	£4.19/unit	£13,994,600
• Gripe water	£3.49/unit	£16,232,400
• Lactase (10 weeks, one unit per 2 weeks)	£9./unit	£15,030,000
Hypo-allergenic feed, cost per child following GP evaluation	£1,853*	£49,475,100
Non-allergenic formula, cost per child following GP evaluation	£3,161*	£84,398,700

\* cost data calculated by Taylor et al., 2012; Hospital and specialist services not included; costs should not all be added in as all would not be utilised. In order to make comparisons, the cohort cost was based upon 21% of the population or 167,000 infants, even though this number may not be exact for this year.

**Table 2. Costs of specific types of management of infant colic in 2012, both per unit and per cohort.**

manual therapy cost approximately the same, three double blind studies show no effectiveness for that medication<sup>15-17</sup> while manual therapy has shown moderate effectiveness for the condition.<sup>18</sup> Of course, a £60 million savings is a small number compared to the NHS annual budget of £104 billion in 2010<sup>27</sup> and perhaps should be looked at more in light of helping families than pure economic savings.

It is, perhaps, difficult to contemplate a deviation of care from the well-established medical model with all of its advanced technological capabilities and resources, particularly in dealing with the needs of a newborn. Manual skills, which individualize variable palpatory pressures may uncover functional problems in the infant.<sup>28</sup> The final common pathway of the gentle manual therapeutics used for infants is one of release, joint release when immobility is observed and myofascial release when a muscle is tonic. When these were factors preventing normal biomechanical actions in the child,(s)he tends to feel relief. Treatments are low-tech and thus, relatively, low cost.

Chiropractic manual therapy (CMT) doesn't include any usage of drugs or medications. However, CAM users are more likely to be medication users as well.<sup>19-20</sup> This would raise the costs of an episode of care; it should also alert CAM practitioners that the child could be suffering from a side-effect from medication and this should be carefully observed. Cincotta and colleagues<sup>29</sup> pointed out that there is potential for cross-reactivity in medications with CAM herbal or homeopathic remedies (anything that is taken internally) and that this isn't an issue with purely mechanical therapies such as chiropractic and this is one less risk with manual therapy. Herbal and homeopathic medicines have shown life-threatening episodes with infants.<sup>30-31</sup> Likewise, Birdee and colleagues<sup>20</sup> stressed concern of drug-herb interactions as over-all CAM use was associated with medication use in the last three months and this might lead to significant adverse effects.

One of the longest-term potential costs of ill-health is a change from breastfeeding to formula feeding. A diagnosis of colic has been shown to predict shorter duration of breastfeeding,<sup>32</sup> and this, perhaps, could be argued to be the greatest cost of all, since it predicts not only higher costs for medical care in the first year of life, but may also continue lifelong.<sup>32-34</sup>

There are limitations to this study. It is linked to a RCT and although this is a common method to determine cost effectiveness, it is not the only method.<sup>35</sup> It should be kept in mind that any specific therapy may be part of a bundle

of therapies and total costs may be difficult to unpick. The main limitation in cost-effectiveness studies is the accuracy of the data upon which the review is based. In this case, the review is completely transparent, so that if any new costs surface, they can be added or changed. Anyone who feels that some types of care are not routinely accessed can simply delete them from the estimate. As usual, caution should be used when interpreting these data as with any very large numbers, there is room for considerable inaccuracy and these should be looked upon as trends as much as specific numbers. The trends, however, are quite clear. The costs of the excessively crying baby are very high and a small demonstration project study may be warranted to determine whether chiropractic manual therapy continues to show promise in reducing these costs whilst providing relief for the child and family.

Once an infant is determined to be healthy and suffering from no illness, the most cost-effective choice may be a short trial of chiropractic manual therapy. So far, the performance of manual therapy is better than other treatments and in a worst case scenario, a baby not helped for this condition, has extremely low risk of coming to any harm with this type of therapy.

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# A Chiropractor's Guide to the Epidemiology, Clinical Diagnosis and Treatment of Pediatric Cough

Emily J. Smith Nguyen, DC, DICCP and Dana J. Lawrence, DC, MMedEd, MA

## ABSTRACT

**Background:** Pediatric cough is responsible for many visits to the doctor. Chiropractors are often seen as a “gatekeeper” for helping parents determine appropriate care. Although many causes of cough are self-limiting, some are serious and require prompt referral.

**Objective:** To provide information necessary for determining the cause, diagnosis and appropriate treatment of pediatric cough.

**Discussion:** A cough is a physiologic reflex and important defense mechanism designed by the body to remove material or secretions from a person's airway. It is an indication of an underlying illness or problem that will need careful diagnosis. All children cough at some time and most resolve naturally; however, parents frequently seek physician care when coughing arises. The cause of cough in children can vary more widely than those seen in adults.

**Conclusion:** There are many causes for coughs in infants and children. The knowledgeable physician can identify cause with an appropriate history and examination. Once a proper diagnosis is made, effective treatment can be administered.

**Key Words:** cough; asthma; allergy; vaccination; respiratory; pediatrics; chiropractic; complementary and alternative medicine

## Introduction

Chiropractic is one of the most commonly used complementary and alternative medicine (CAM) therapies,<sup>1</sup> and as a result there are a wide variety of conditions for which patients may seek the services of a chiropractor. The doctor of chiropractic is often a gatekeeper when parents are unsure what type of care is needed. Therefore, it is important for chiropractors to be knowledgeable about the presenting symptoms of pediatric conditions, including cough, and to be aware of the options for treatment, both medical and chiropractic/CAM. This paper provides an overview of the etiology, diagnosis and management of childhood cough.

## Discussion

A cough is a physiologic reflex and important defense mechanism designed by the body to remove material or secretions from a person's airway.<sup>2-4</sup> It is a sign of an underlying condition or problem.<sup>4</sup> All children develop coughs, and most will resolve naturally;<sup>5,6</sup> however, parents frequently seek consultation when coughing arises.<sup>5,7</sup> The cause of cough in children can vary more widely than when

seen in adults.<sup>4</sup> There are different types of cough, broadly divided into acute and chronic. Acute cough is considered a cough duration of less than 3 weeks, while chronic cough lasts more than 3 weeks.<sup>8-11</sup> Cough can then be further subdivided into categories of specific (those with a clearly definable cause) and non-specific (those without a clearly definable cause) forms.<sup>12</sup> Chiropractors may also look for descriptive factors of “wet/dry,” “with/without wheeze,” and “recurrent” which can help to further define the cause of the cough.<sup>13,14</sup> Most causes of chronic cough are benign; however, there are certain serious illnesses in which chronic cough is a presenting signal.<sup>5</sup> Though clinically important, acute cough is rarely the first symptom of a more serious or underlying disease.<sup>15</sup> A cough can significantly interfere with the quality of life in a child, though the report of severity seems to express the impact on parents or teachers more than the reality of the child's symptom intensity.<sup>4</sup>

## Physiology of Cough

The cough reflex consists neurologically of an afferent limb (bringing messages toward the cough center via the Trigeminal, Glossopharyngeal, Superior Laryngeal, or Vagus nerves),<sup>16</sup> a central cough center (located in the upper brainstem and pons)<sup>3,9,11</sup> and efferent limb (taking messages away from the cough center via the Phrenic, Vagus, and spinal motor nerves to the larynx, intercostal muscles, diaphragm, and muscles of the abdominal wall and pelvic floor).<sup>16</sup> Ciliated epithelium covers the airway

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from the pharynx to the terminal bronchioles<sup>3,11</sup> and this is innervated by sensory afferent nerve fibers that have the greatest concentration at the larynx, carina, and bifurcations of the large and medium-sized bronchi,<sup>9,11</sup> in both the mucosa and smooth muscle.<sup>17</sup> It is possible that during acute infection the mucosal epithelium is stripped away by viral and bacterial agents to expose the cough receptors in the subepithelial mucosa.<sup>18</sup> These receptors are sensitive to mechanical stimuli (touch, foreign body, inflammation, intrinsic or extrinsic pressure from a tumor or lymph node)<sup>3,19,20</sup> and chemical irritation (noxious gas or citric acid in the case of acute infection).<sup>3,19-21</sup> Stimulation of the afferent limb can result in the suppression of a cough or the initiation of a voluntary cough.<sup>11,22</sup> Stimulation of the cough reflex results in inspiration and glottic closure followed by contraction of the muscles of the chest wall, diaphragm, abdomen, and pelvic floor, which dramatically increases intrathoracic pressure.<sup>3,11</sup> The high intrathoracic pressure causes a sudden opening of the glottis and the explosive release of the pressurized air from the lungs.<sup>11</sup> The complications generated from the high intrathoracic pressure during a cough most commonly include vomiting, exhaustion, headache, and insomnia, and far less commonly facial petechiae, subconjunctival hemorrhage, pneumothorax, pneumomediastinum, pulmonary emphysema, muscle pain, rib fracture, and loss of consciousness.<sup>19,23</sup>

### Epidemiology

Each are explained in detail below but for a list of causes of cough in children,<sup>5</sup> see *Table 1*. Healthy children will commonly experience upper respiratory tract infections up to several times per year.<sup>8,24</sup> Viral infection is more common than bacterial, so in otherwise healthy children the onset

<b>Causes of Cough in Children<sup>5</sup></b>
• Infections
• Asthma
• Allergies
• Environmental Irritants
• Foreign Body Aspiration
• Congenital Malformations
• Immunodeficiency Disorders
• Cystic Fibrosis
• Bronchiectasis
• Cardiac Failure
• Drugs
• Airway Encroachment
• Psychogenic Cough

**Table 1.**

of an acute cough is often the result of a self-limiting viral infection involving the upper respiratory tract.<sup>15</sup> There are in excess of 200 different viruses that can lead to cough; however, the most commonly involved are rhinovirus, coronaviruses, respiratory syncytial virus, parainfluenza viruses, or adenoviruses.<sup>10</sup> Recurrent or unresolved viral/bacterial infections are a frequent cause of chronic cough. Bacteria that may be involved are Chlamydia, Mycoplasma, Bordetella pertussis, and Mycobacterium tuberculosis; geographic variation worldwide may lead to different organisms causing cough.<sup>5</sup>

A pneumonia infection caused by Chlamydia is usually contracted during the birth process and is characterized by a prominent cough and tachypnea that develops in an otherwise well infant at 3 to 16 weeks of age.<sup>5</sup> A history of conjunctivitis affects about half of the children with this condition. Psittacosis (ornithosis) is an acute respiratory tract infection with associated fever caused by Chlamydia psittaci. It is often transmitted after contact with birds. The leading cause of pneumonia, an infection of the lower respiratory tract, is Mycoplasma pneumoniae. B pertussis causes a contagious, chronic cough, while B parapertussis and some adenoviruses cause a pertussis-like syndrome. M tuberculosis is the main cause of pulmonary tuberculosis, and remains common in developing countries. Though this form of tuberculosis is often asymptomatic, some children may experience a chronic cough.<sup>5</sup>

Other infectious causes of chronic cough include fungal infection (histoplasmosis, blastomycosis, coccidioidomycosis), parasitic infestation (visceral larva migrans, ascariasis) and sinusitis; these are certainly less frequently seen in the United States.<sup>5</sup> The most common bacteria involved in sinusitis infections are Streptococcus pneumonia, non-typable Haemophilus influenza, Branhamella catarrhalis, Streptococcus pyogenes, and in cases of chronic sinusitis Staphylococcus aureus and anaerobic bacteria.<sup>5</sup> The cough is caused by post-nasal drip and irritation of the branches of the Vagus nerve that innervate the sinuses and/or stimulation of the cough receptors in the airway mucosa.<sup>25,26</sup>

Asthma is a common diagnosis for children with cough. However, ongoing research suggests that the diagnosis of asthma with the criteria of non-specific chronic cough may be overused, and that the presence or lack of a wheeze may be the best criteria for determining if the cough is truly asthma.<sup>17,27</sup> A recurrent cough, 2 or more episodes of cough without a cold in the past year accompanied by a wheeze, is more accurately considered to be asthma.<sup>8,17,27</sup> However

the cough and wheeze can be triggered independently.<sup>17</sup> The cough is thought to be caused by direct sensitivity to triggers, bronchospasm, mucosal airway inflammation, excess mucus production<sup>17,19</sup> and respiratory water loss<sup>28</sup> whereas wheeze is caused by bronchoconstriction and respiratory heat loss.<sup>29</sup> More respiratory illnesses, more atopy, decreased expiratory end-tidal flow, and decreased lung function following cold air challenge were found in those having recurrent cough with wheeze. In those who had recurrent cough without a wheeze, the factors of IgE, skin prick, expiratory flow and cold air challenge were equal to non-symptomatic children.<sup>27</sup> A recurrent cough does not predict the chance of developing a wheeze or the level of atopy.<sup>27</sup> Most of those with an early-onset wheezing recurrent cough resolve between ages 2-3 years and 6 years of age. In those where the cough persists to age 6 a high IgE and positive skin prick test were found and for those whose cough persists between 6 and 11 years of age associated markers of allergy were present.<sup>27</sup>

The greatest risk factor for developing a recurrent cough without a wheeze is parental smoking.<sup>27</sup> Risk factors to develop recurrent cough with a wheeze include male gender, maternal allergy, wheezing lower respiratory tract illness early in life (especially if before 2 years of age), high IgE, strong family history of asthma and allergy to dust, cat and fungus.<sup>27,30-35</sup> Wheezing has not been shown to be associated with pollen or food allergy, though they may have the commonality of high IgE.<sup>27,31,33</sup> If atopic dermatitis is also present, in addition to the wheezing and/or elevated serum IgE, food allergy should be carefully considered.<sup>36</sup> Avoidance is one approach to managing allergies and preventing asthma.<sup>34</sup> Controlling exposure to indoor allergens and environmental tobacco smoke could reduce wheezing by 65% in this population.<sup>31</sup> The effect of tobacco smoke on the respiratory health of children is enormous, contributing to the number of lower respiratory tract infections, recurrent wheezing/asthma, coughs, bronchitis and pneumonia, as well as many other illnesses.<sup>27,30-35</sup> There is also a strong association (80-85%) between seasonal patterns of viral/bacterial upper respiratory infections and asthma exacerbations.<sup>37</sup> This particularly affects school-aged children and occurs more frequently at the times of the year when school is in session.<sup>37</sup>

If coughing follows a choking episode there is a possibility of foreign object aspiration.<sup>5,13</sup> This often occurs suddenly and with a wheeze and/or breathlessness and cyanosis. In the toddler or preschool age child, the foreign object may consist of food, peanut, candy, small toys or

other small objects. Suspicion should be raised if a sudden onset cough develops and becomes chronic, even if the precipitating choking episode was not witnessed.<sup>38</sup> In infancy the foreign object is typically aspiration of milk or formula and choking often accompanies feeding.<sup>39</sup> If this cough is chronic in nature, the aspiration may be due to gastroesophageal reflux<sup>40</sup> or less commonly from congenital malformations such as tracheoesophageal fistula or laryngeal cleft.<sup>5</sup> Other chronic cough congenital airway malformations include vascular ring,<sup>3</sup> bronchiogenic cyst, pulmonary sequestration,<sup>41</sup> and immotile cilia syndrome,<sup>10</sup> but these are rare.<sup>3,5,10,41</sup>

Immunodeficiency disorders can be primary, such as failure of antibody production, failure of cell-mediated immunity, or defects in the polymorphonuclear leukocyte, macrophage, or complement systems; or secondary such as malignancy, splenectomy, malnutrition, infection by HIV, or treatment with cytotoxic drugs or corticosteroids.<sup>42</sup> Children with immunodeficiency disorders are more susceptible to infections (*Pneumocystis carinii* and *Legionella pneumophila*) and recurrent or persistent respiratory tract infections.<sup>42</sup>

Approximately one in 2,500 Caucasian children have a chronic cough due to the autosomal recessive trait disease cystic fibrosis.<sup>43</sup> Characteristics of this disease include chronic obstruction and infection of the respiratory tract, as well as intestinal malabsorption.<sup>43</sup>

Though uncommon, bronchiectasis can cause a chronic cough in children secondary to cystic fibrosis, foreign body aspiration, immunodeficiency, pertussis, pneumonia or tuberculosis.<sup>6</sup> This disease is characterized by permanent dilation and distortion of the bronchi, as well as inflammation and exudate accumulation within.<sup>5</sup>

Undiagnosed or inadequately treated congestive heart failure can occasionally cause a chronic cough in children due to pulmonary edema.<sup>5</sup>

A small percentage of individuals (5-10%) taking angiotensin-converting enzyme inhibitors (captopril and enalapril) develop a chronic cough.<sup>44,45</sup>  $\beta$ -Adrenergic antagonists (propranolol) can bring on asthma symptoms.<sup>45</sup>

Compression of the airway due to extrinsic masses (mediastinal tumors or adenopathy) can lead to chronic cough; however this is rare in children.<sup>5</sup>

Psychogenic cough is a somatic manifestation of a range

Location	Symptoms present	Cause of disease/Diagnosis	Symptoms absent
Upper Respiratory Tract	Stridor, barking or croupy cough, high fever, progressive upper airway obstruction, LIFE THREATENING	BACTERIAL TRACHEITIS caused by S. Aureus, H. Influenza B, or Streptococci	
Upper Respiratory Tract	Stridor, barking or croupy cough	VIRAL CROUP/ RECURRENT SPASMODIC CROUP	High fever, progressive airway obstruction
Upper Respiratory Tract	Coryzal symptoms, child "well", bronchitis, tracheitis	HEAD COLD	bronchitis
Upper Respiratory Tract	Features of allergy during pollen season	ALLERGIES	Fever
Upper Respiratory Tract	Choking episode (may not have seen or heard), sudden onset, asymmetrical wheeze or hyperinflation, cough	FOREIGN OBJECT ASPIRATION, must refer for bronchoscopy	
Lower Respiratory Tract	Persisting (past 4-5 days), cough, fever, signs of respiratory distress, TACHYPNOEA	PNEUMONIA, refer for chest x-ray	Stridor, wheeze
Lower Respiratory Tract	Cough with crackles, audible wheeze, during winter/virus season	BRONCHIOLITIS	Audible wheeze
Lower Respiratory Tract	Wheeze, atopic features, family history, dypnoea	ASTHMA	Atopic features, under 2 years old
Lower Respiratory Tract	Wheeze	BRONCHIAL HYPER-REACTIVITY	Isolated dry or nocturnal cough

**Table 2. Location, Symptoms and Causes of Acute Cough<sup>13</sup>**

of psychological problems,<sup>46</sup> such as anxiety, school phobia, and attention-seeking behavior.<sup>5,13,46</sup> It may be a symptom of Tourette's syndrome or other tic disorders, especially if there are other features present.<sup>47</sup>

Table 2 presents information about location, symptoms and causes of acute cough.<sup>13</sup>

## Diagnosis

Epidemiology of cough in a child can vary from benign to life-threatening<sup>5,6</sup> and can differ greatly from the cause of cough in an adult.<sup>4</sup> Therefore it is important to take a thorough history and perform a thorough physical examination in order to determine diagnosis and establish the next step.<sup>5,13</sup> Although concerned parents may be willing and able to describe their child's cough over the phone, the accuracy of a correct diagnosis has been questioned. Observing the child and hearing the cough first-hand are vital to properly identify the type, nature and cause of the cough.<sup>4,13,14</sup>

Taking a proper history can help to differentiate the diagnostic possibilities.<sup>5,13</sup> Asking questions (*see Table 3*) such as age of onset, timing of cough, nature of cough and functional inquiry will eliminate a lot of the possible diseases, according to the responses of parents.<sup>5</sup> Additional questions to aid in proper diagnosis<sup>5</sup> (*see Table 4*) include:

- Season effects
- Nature of sputum
- Stridor
- Wheeze
- Exposure to infection
- Exposure to pertussis, mycoplasmal infection or tuberculosis
- Immunization history\*
- Past health, including any previous hospital stays or significant illnesses<sup>5,8</sup>

\* A prospective cohort study of school aged children presenting to primary care with a cough lasting 14 days or more found that around a third had serological evidence of recent Bordetella pertussis infection, and nearly 90% of these children had been fully immunized.<sup>48</sup>

- Drug history
- Family history
- Psychosocial history<sup>5</sup>

At McMaster University, Hamilton, Ontario, Canada, a 1997 study on Children and Adult Perceptions of Childhood Asthma found that in children under 11 years of age, it is important to question both parents and children in order to get an accurate assessment of symptoms. However, for children over 11 years of age, parents provide little if any information beyond that obtained through questioning the child.<sup>49</sup> This can be important because the diagnosis of asthma is often made according to the improvement of symptoms after use of bronchodilators.<sup>5,17</sup> Therefore, accuracy of the asthma diagnosis is dependent on symptom perception and in order to effectively manage asthma the methods of evaluation need to be standardized to avoid undertreatment.<sup>8,50,51</sup> For example, an Ostschweiz, Kinderspital, Switzerland 1995 survey found that for all asthma-related symptoms, significantly more boys than girls received treatment.<sup>52</sup> Since asthma has the ability to quickly become life-threatening,<sup>53</sup> it is vital to know who is at risk.

A prospective study from Brown University School of

Medicine evaluated the accuracy of pulsus paradoxus (PP), which is an abnormally large decrease (more than 10 mm Hg) in systolic blood pressure and pulse wave amplitude during inspiration, and its correlation with clinical score, peak expiratory flow rate, oxygen saturation, and decision to admit to the hospital. PP was found to be a useful objective indicator of the severity of asthma and a PP greater than 15 mm Hg predicted admission for further treatment or relapse with an 89% specificity.<sup>54</sup>

**Examination**

Examination<sup>5,13</sup> (see Table 5) begins with observation. Signs of poor growth or nutrition, clubbing of fingers, chest deformity, and signs of atopy are signs of a more chronic problem, such as a serious underlying disease, chronic asthma or allergies.<sup>5,13</sup>

Height, weight and head circumference should be charted to determine any changes in growth patterns.<sup>5,13</sup>

Ear/nose/throat exam (See Table 5) looking for signs of upper respiratory infection, allergic rhinitis, nasal polyps,<sup>5,13</sup> common cold/vasomotor rhinitis or bacterial sinusitis.<sup>5</sup>

1. Age of Onset	2. Timing of the Cough	3. Nature of Cough	4. Functional Inquiry
<p><b>Birth - 1 month:</b></p> <ul style="list-style-type: none"> <li>• Congenital malformation</li> <li>• Infection</li> <li>• Aspiration of breast milk or formula</li> </ul> <p><b>Pre-school:</b></p> <ul style="list-style-type: none"> <li>• Foreign body aspiration</li> <li>• Pertussis</li> </ul> <p><b>School-age:</b></p> <ul style="list-style-type: none"> <li>• Infection (M. pneumoniae)</li> <li>• Psychogenic cough</li> </ul> <p><b>ALL ages:</b></p> <ul style="list-style-type: none"> <li>• Recurrent viral infection</li> <li>• Asthma</li> </ul>	<p><b>Feeding:</b></p> <ul style="list-style-type: none"> <li>• Aspiration</li> </ul> <p><b>Exercise:</b></p> <ul style="list-style-type: none"> <li>• Asthma</li> </ul> <p><b>Aggravated by dust/pollen/animals:</b></p> <ul style="list-style-type: none"> <li>• Asthma</li> <li>• Allergies</li> </ul> <p><b>Nocturnal:</b></p> <ul style="list-style-type: none"> <li>• Asthma</li> <li>• Post-nasal drip</li> <li>• Congenital heart failure</li> </ul> <p><b>Morning:</b></p> <ul style="list-style-type: none"> <li>• Suppurative lung disease</li> <li>• Sinusitis with post-nasal drip</li> </ul> <p><b>Gone at night/sleep:</b></p> <ul style="list-style-type: none"> <li>• Psychogenic cough</li> </ul> <p><b>Increases with people around:</b></p> <ul style="list-style-type: none"> <li>• Psychogenic cough</li> </ul>	<p><b>Productive,<sup>5</sup> “wet”:<sup>13</sup></b></p> <ul style="list-style-type: none"> <li>• Inflammatory,<sup>5</sup> suppurative lung disease<sup>13</sup></li> </ul> <p><b>Dry/Brassy/Croupy/Hoarse:</b></p> <ul style="list-style-type: none"> <li>• Upper airway disorder</li> </ul> <p><b>Throat-clearing:</b></p> <ul style="list-style-type: none"> <li>• Post-nasal drip</li> </ul> <p><b>Paroxysms:</b></p> <ul style="list-style-type: none"> <li>• Pertussis</li> <li>• Pertussis-like syndrome</li> <li>• Cystic fibrosis</li> <li>• Chlamydial infection</li> </ul> <p><b>Non-productive/Isolated/ Explosive/“Barking”/ “Honking”:</b></p> <ul style="list-style-type: none"> <li>• Psychogenic cough</li> </ul>	<p><b>Vomiting after paroxysms of cough:</b></p> <ul style="list-style-type: none"> <li>• Pertussis (not usually asthma)</li> </ul> <p><b>Bulky, greasy stools/ Failure to thrive:</b></p> <ul style="list-style-type: none"> <li>• Cystic fibrosis</li> </ul> <p><b>Recurrent regurgitation/ choking:</b></p> <ul style="list-style-type: none"> <li>• Aspiration</li> </ul> <p><b>Prolonged fever/weight loss:</b></p> <ul style="list-style-type: none"> <li>• Chronic suppurative lung disease</li> </ul> <p><b>Low-grade fever/night sweats/ weight loss:</b></p> <ul style="list-style-type: none"> <li>• Tuberculosis</li> </ul>

**Table 3. Four History Questions that Aid in Diagnosis<sup>5</sup>**

<p><b>Seasonal effects:</b></p> <ul style="list-style-type: none"> <li>• Spring/summer is likely asthma</li> <li>• Winter is likely a viral respiratory tract infection</li> </ul> <p><b>Nature of sputum:</b></p> <ul style="list-style-type: none"> <li>• Clear sputum is likely asthma</li> <li>• Purulent sputum is likely suppurative lung disease</li> <li>• Bloody sputum is likely aspirated foreign body/TB/CF/bronchiectasis<sup>19</sup></li> <li>• Pink/foamy sputum is likely due to pulmonary edema<sup>16</sup></li> </ul> <p><b>Stridor or wheeze:</b></p> <ul style="list-style-type: none"> <li>• Larynx or trachea lesion (stridor)</li> <li>• Obstruction of small airways, such as asthma (wheeze)</li> </ul> <p><b>Exposure to infection:</b></p> <ul style="list-style-type: none"> <li>• Children who attend daycare or school are more likely to have recurrent viral respiratory infection</li> <li>• Exposure to pertussis, mycoplasmal infection or tuberculosis may result in the corresponding disease</li> </ul> <p><b>Immunization history:</b></p> <ul style="list-style-type: none"> <li>• May or may not protect from correlating disease</li> </ul>	<p><b>Past health history:</b></p> <ul style="list-style-type: none"> <li>• If responded well to antibiotics it was likely a bacterial infection</li> <li>• If responded well to bronchodilator then likely asthma</li> <li>• If no response to medication then could be result of inadequate dose, wrong medication for disease or improper use of a bronchodilator<sup>5,8</sup></li> </ul> <p><b>Drug history:</b></p> <ul style="list-style-type: none"> <li>• Medications such as angiotensin-converting enzyme inhibitor or <math>\beta</math>-adrenergic antagonist; corticosteroids or cytotoxic drugs likely immunodeficiency</li> </ul> <p><b>Family history:</b></p> <ul style="list-style-type: none"> <li>• History of atopy suggests asthma</li> <li>• History of immunodeficiency or cystic fibrosis suggest that disease</li> </ul> <p><b>Psychosocial history:</b></p> <ul style="list-style-type: none"> <li>• Any current stress</li> <li>• Overcrowding in home which can lead to infection</li> <li>• Exposure to cigarette smoke<sup>5</sup></li> </ul>
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**Table 4. Additional Health History Questions<sup>5</sup>**

Temperature (*see Table 5*) should be taken since a fever may indicate an underlying infection.<sup>5,13,55</sup>

Heart rate can be taken by evaluating the pulse at the back of knees, groin, neck, temple, wrist, top or inner side of the foot. Heart rates above/below normal levels may be indicative of a heart-related problem.<sup>56</sup> Normal at rest heart rates<sup>60</sup> are listed in *Table 5*.

Respiratory rate should be evaluated to rule out respiratory dysfunction and/or pulmonary disease. In infants and toddlers this is best observed by watching movements of the abdomen due to their diaphragmatic breathing. Observing or palpating the movement of the thoracic cage may be necessary in older children.<sup>57</sup> Normal respiratory rates<sup>13</sup> are listed in *Table 5*. Presence of tachypnoea (rapid respiratory rate) is indicative of asthma, pneumonia or congestive heart failure.<sup>5,13</sup> The lack of tachypnoea is the best way to rule out pneumonia.<sup>17,58</sup>

Inspection of the chest (*See Table 5*) should be performed without clothing from the waist up. A gown or body suit can be used for the comfort of the adolescent patient.<sup>57</sup> The thoracic index of the chest, the ratio of the transverse diameter to the anteroposterior diameter, varies with age. The rounded thorax seen in infancy lends itself to an equal ratio. The ratio at 1 year of age is 1.25 and increases to 1.35 by 6 years of age and remains the same into adulthood.<sup>57</sup> Pectus excavatum, a congenital deformity where the sternum is “caved in” and pectus carinatum, a developmental deformity where the sternum is

“bowed out” may be observed anteriorly.<sup>57</sup> Chronic airway obstruction due to cystic fibrosis or chronic severe asthma may result in an increased anteroposterior diameter and abnormal thoracic index ratio, as well as sternal bowing and Harrison’s sulcus (symmetrical horizontal grooves) above the costal margin.<sup>13</sup> It is normal to see the xiphoid process protruding anteriorly in the small child due to thin thoracic cage musculature.<sup>57</sup> The respiratory pattern, rate and depth can be observed for symmetry of chest movements as well as noting any rib cage height asymmetry that may suggest scoliosis.<sup>57</sup>

Inspection of the posterior thorax is also important. A so-called “Pottenger saucer” may be observed in those with chronic respiratory disorders. This is a mid-scapula dishing of the thoracic spine.<sup>59</sup> Chiropractic correction of this complex vertebral subluxation pattern has been shown to improve breathing issues in affected children.<sup>60</sup>

Palpation of the chest (*See Table 5*) includes examining any areas of reported tenderness,<sup>57</sup> checking for any deformities<sup>13</sup> or abnormalities, assessing respiratory excursions and feeling for vocal<sup>57</sup> or tactile fremitus.<sup>13,57</sup> Palpation should start with any areas of tenderness and if there are none begin with the level of the clavicles and progress downward both anterior and posterior.<sup>57</sup> Respiratory excursions can be evaluated anteriorly with thumbs placed at the anterior costal margin and hands wrapped around the side of the rib cage. Posterior evaluation begins with the thumbs placed parallel to the tenth rib. Expanding the rib cage with a deep breath will allow for evaluation

of symmetrical respiratory movement.<sup>57</sup> Palpation for fremitus or vibrations can be performed using the ball of your hand over anterior and posterior areas of the lung fields. When evaluating an infant this can be done while the patient is crying and if the patient is older ask them to repeat the words “ninety-nine” or “one” while palpating, noting any areas of increased or decreased fremitus.<sup>57</sup> Percussion of the chest (*See Table 5*) can help to determine if the lungs are filled with air, water or are solid.<sup>57</sup> When normal air-filled lungs are percussed the sound is resonant. Percussion is performed using a single finger to tap the chest wall for infants or finger-on-finger method for older children.<sup>57</sup>

Auscultation (*See Table 5*) uses the stethoscope to evaluate the three types of normal breath sounds: vesicular, bronchovesicular and bronchial or tubular<sup>57</sup> for quality, nature and symmetry of the entry of air, as well as presence of crackles/rales or wheeze.<sup>5,13</sup> If the child is able, listen over the lung fields while patient speaks “ninety-nine” or “eee”. It should sound muffled. Then have the patient whisper “ninety-nine” and the words should only faintly be heard with the stethoscope.<sup>57</sup>

Further testing (*See Table 5*) that could be performed includes oxygen saturation,<sup>13</sup> chest radiograph, spirometry/pulmonary function test,<sup>5</sup> sputum sample<sup>5,13</sup> allergy testing,<sup>5,13</sup> CBC,<sup>5</sup> nasopharyngeal swab, serology, serum immunoglobulins, Mantoux test, sweat chloride test, upper gastrointestinal series,<sup>5</sup> and bronchoscopy.<sup>5,13</sup> Though culture and polymerase chain reaction (PCR) are considered the gold standard for diagnosis of pertussis in infants, children and adults who have been coughing for less than 20 days, delayed testing (using serological ELISA) is the only option and cannot be used to diagnose pertussis if the patient has been vaccinated within a year of the test.<sup>61</sup> Since most of these tests are not typically performed in a chiropractor's office, a prompt referral to a medical professional should be made if respiratory symptoms suggest an underlying serious disease.<sup>15</sup>

### Treatment: Medical

Treatment of a cough should be directed toward the underlying cause, rather than symptoms, whenever possible.<sup>5</sup> Red flags suggesting immediate referral are listed in *Table 6*.<sup>8,62</sup> If symptoms of a “wet” cough are progressive and severe beyond 2-3 weeks, with recurrent fever after initial resolution, a referral should be made for further evaluation.<sup>8</sup>

Most children with a dry, non-specific, isolated cough

will improve with time and no medical treatments have been determined to be particularly effective or necessary.<sup>15</sup> In general, acute coughs due to infection are self-limiting and should improve by the second week, though lessened symptoms may persist past 14 days.<sup>63</sup> If a cough is due to and exacerbated by environmental irritants (such as tobacco smoke), it is recommended to remove them from the child's environment.<sup>5,30-36</sup> The same can be said for avoidance of allergens<sup>35</sup> and may be combined with antihistamines<sup>11,64</sup> and intranasal corticosteroids.<sup>64</sup> An empirical trial of reflux medication for a chronic cough is not recommended if there is not an official diagnosis of gastroesophageal reflux disease.<sup>8,65</sup> There are specific evidence based guidelines for treatment of conditions such as cystic fibrosis, immunodeficiency, primary ciliary dyskinesia and tuberculosis.<sup>8</sup> If other causes have been ruled out and a positive bacterial sputum culture has been obtained, a course of antibiotics may be effective to treat bacterial bronchitis.<sup>5,66</sup> The psychogenic cough may respond to behavior modification or psychological counseling<sup>5,47</sup> and decongestants or antihistamines may benefit the cough caused by post-nasal drip.<sup>11</sup> However, a trial of nonspecific symptomatic therapy is not recommended unless absolutely necessary (interfering with the child's life).<sup>11,19,51</sup> Options include short-term use of cough-suppressing codeine<sup>2,10,22</sup> or non-narcotic cough suppressants such as dextromethorphan.<sup>11,19,51</sup> Use of expectorants and mucolytic agents is not recommended in children and their effectiveness is doubtful.<sup>10,11,19,51,67,68</sup>

Asthma symptoms often lessen by the second decade of life; however evidence has shown that although the severity of asthma symptoms fluctuates with time, the inherited tendency towards respiratory symptoms never disappears.<sup>69</sup> Even during symptom-free periods, airway obstruction and/or bronchial hyper-responsiveness may still be present.<sup>69</sup> Those who have onset of asthma as an adult usually began to have respiratory issues as a child.<sup>69</sup> The more severe the asthma was as a child, the greater the chance of it persisting into adulthood.<sup>69</sup> Compliance with recommended asthma treatment, especially during adolescence, is low and most are not being adequately treated, according to medical standards.<sup>69</sup> Anti-asthma treatment typically involves the use of bronchodilators and the diagnosis of asthma is dependent upon the response to this treatment.<sup>5,17</sup> A child with a chronic cough and no wheeze may or may not have bronchoconstriction and therefore may or may not respond to bronchodilators.<sup>17,50</sup> Evidence of the airways ability to adapt/change should be demonstrated prior to diagnosis.<sup>1,7,70</sup> At this time, there are no good randomized placebo controlled trials in children that demonstrate the value of  $\beta$  agonists as a medication used to suppress

**1. Observation:**

- Signs of poor growth or nutrition
- Clubbing of fingers
- Chest deformity
- Signs of atopy<sup>5,13</sup>
  - Dark circles under eyes
  - Wrinkle beneath the lower eyelid
  - Crease across the nose
  - Open mouth breathing<sup>5</sup>

**2. Listen to the cough:**

- “Wet”
- “Dry”<sup>13</sup>
- With a wheeze
- Without a wheeze<sup>13,14</sup>

**3. Growth rate:**

- Height
- Weight
- Head circumference<sup>5,13</sup>

**4. Ear/Nose/Throat Exam:**

- Signs of upper respiratory infection
  - Runny nose
  - Inflamed tympanic membranes
  - Inflamed throat
- Allergic rhinitis<sup>5,13</sup>
- Nasal polyps
  - Suggestive of cystic fibrosis
  - Immotile cilia syndrome<sup>51</sup>
- Common cold/vasomotor rhinitis
  - Clear nasal discharge
- Bacterial sinusitis
  - Purulent nasal discharge<sup>5</sup>

**5. Temperature:**

- Normal is 98.6 degrees F or 37 degrees C<sup>5,13,55</sup>

**6. Heart Rate (Normal levels, at rest):**

- Newborn (0-3 months): 100-150 beats/min
- Infant (3-6 months): 90-120 beats/min

- Infant (6-12 months): 80-120 beats/min
- Child (1-10 years): 70-130 beats/min
- Child over 10-adult: 60-100 beats/min<sup>56</sup>

**7. Respiratory rate (Normal levels, at rest):**

- 0-2 months: 60 breaths/min
- 2-12 months: 50 breaths/min
- 12 months and older: 40 breaths/min<sup>13</sup>

**8. Inspection of chest:**

- Congenital or developmental deformities
  - Pectus excavatum
  - Scoliosis<sup>57</sup>
- Deformities suggesting chronic lung issue
  - Increased AP diameter<sup>5,13</sup> or abnormal thoracic index<sup>57</sup>
  - Sternal bowing
  - Pectus carinatum
  - Harrison’s sulcus above the costal margins<sup>13</sup>
  - Pottenger saucer<sup>59</sup>

**9. Palpation of chest:**

- Areas where tenderness was reported
- Areas of deformity or abnormality
- Respiratory excursions
  - Anteriorly with thumbs along anterior costal margin
  - Posteriorly with thumbs parallel to tenth rib
- Vocal or tactile fremitus/vibration
  - Anterior and posterior over lung fields while crying/speaking
    - Decreased/absent fremitus
      - Bronchial obstruction
      - Fluid in the pleural space
      - Decreased patient voice
    - Increased fremitus
      - Larger bronchi
      - Consolidated/fluid-filled lungs<sup>57</sup>
  - Vibrations during a cough
    - Airway partially obstructed by retained secretions<sup>13</sup>

*continued***Table 5. Examination**

or relieve coughing through bronchodilation.<sup>17</sup> Without the use of a control group to compare symptoms and peak expiratory flow rates, the resolution while on medication could be simply coincidental and demonstrate the natural resolution of an upper respiratory tract infection.<sup>50</sup> It is more likely that the  $\beta$  agonists were beneficial if the cough symptoms return upon discontinuation of the medication and then short-term use of  $\beta$  agonists may prove useful.<sup>8,50</sup> In a retrospective case study of 2,000 consecutive pediatric Hamad General Hospital, Doha, Qatar, emer-

gency room acute asthma visits, most (88.5%) had tried  $\beta$  agonists before arriving and most (92.5%) responded to one or more salbutamol (albuterol) treatments and IV steroid.<sup>71</sup> Early start of home therapy for acute asthma is associated with reduced necessity for a hospital stay.<sup>71,72</sup> Only 7.5% required hospitalization and 82% of these had been symptomatic for more than 24 hours.<sup>71</sup> Hypoxemia present on arrival was directly associated with prolonged hospital stay.<sup>72</sup> Of the 2,000 children seen, 71% were boys,<sup>71</sup> showing an increased incidence of treatment (not necessarily

<p><b>10. Percussion of chest:</b></p> <ul style="list-style-type: none"> <li>• Hyper-resonant sound             <ul style="list-style-type: none"> <li>– Normal in infants<sup>57</sup></li> <li>– Air-trapping (asthma)<sup>5,13</sup></li> </ul> </li> <li>• Dull or flat sound             <ul style="list-style-type: none"> <li>– Fluid-filled lungs or pleural space<sup>5,13, 57</sup></li> <li>– Solid mass in lungs or pleural space<sup>57</sup></li> </ul> </li> </ul> <p><b>11. Auscultation of chest:</b></p> <ul style="list-style-type: none"> <li>• Normal breath sounds             <ul style="list-style-type: none"> <li>– Vesicular                 <ul style="list-style-type: none"> <li>• Low-pitched and soft intensity</li> <li>• Heard over most of the lung fields</li> </ul> </li> <li>– Bronchovesicular                 <ul style="list-style-type: none"> <li>• Medium-pitched and medium intensity</li> <li>• Below clavicles and between scapulae</li> </ul> </li> <li>– Bronchial or tubular                 <ul style="list-style-type: none"> <li>• High-pitched and loud intensity</li> <li>• Over the trachea<sup>57</sup></li> </ul> </li> </ul> </li> <li>• Abnormal breath sounds             <ul style="list-style-type: none"> <li>– Presence of a wheeze                 <ul style="list-style-type: none"> <li>• If generalized/expiratory suggests asthma</li> <li>• If localized suggests inhaled foreign body<sup>5,13</sup></li> <li>• Bronchitis</li> <li>• More common in infants/toddlers due to small bronchial tree<sup>57</sup></li> </ul> </li> <li>– Presence of crackles/rales</li> <li>– Inspiratory suggests pneumonia or pulmonary edema<sup>5</sup></li> <li>– Asymmetry of entry of air<sup>13</sup></li> <li>– Acute or chronic bronchial obstruction<sup>5,13</sup></li> </ul> </li> </ul> <p><b>12. Additional tests (referral):</b></p> <ul style="list-style-type: none"> <li>• Oxygen saturation<sup>13</sup></li> <li>• Chest radiograph             <ul style="list-style-type: none"> <li>– Cardiac disease</li> <li>– Lung collapse/consolidation/hyperinflation</li> <li>– Underlying pneumonia</li> <li>– Foreign body</li> <li>– Cystic fibrosis</li> <li>– Tuberculosis</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Spirometry/pulmonary function test             <ul style="list-style-type: none"> <li>– With or without bronchodilator responsiveness or bronchial hyper-reactivity to determine presence of asthma<sup>5</sup></li> </ul> </li> <li>• Sputum sample<sup>5,13</sup> <ul style="list-style-type: none"> <li>– Gram's stain, microscopy, and culture<sup>51</sup> <ul style="list-style-type: none"> <li>• Presence of eosinophilia suggests asthma</li> <li>• Presence of neutrophilia suggests infection<sup>5</sup></li> </ul> </li> </ul> </li> <li>• Allergy testing             <ul style="list-style-type: none"> <li>– Skin prick or specific IgE testing<sup>5,13</sup></li> </ul> </li> <li>• CBC             <ul style="list-style-type: none"> <li>– Neutrophilia/increased numbers of band forms/toxic granulations                 <ul style="list-style-type: none"> <li>• Suggests bacterial infection<sup>5</sup></li> </ul> </li> <li>– Neutropenia                 <ul style="list-style-type: none"> <li>• Suggests immunodeficiency disorder<sup>8,42,62</sup></li> </ul> </li> <li>– Marked lymphocytosis                 <ul style="list-style-type: none"> <li>• Suggests pertussis</li> </ul> </li> <li>– Eosinophilia                 <ul style="list-style-type: none"> <li>• Allergic disease</li> <li>• Parasitic infestation</li> <li>• Chlamydial infection<sup>5</sup></li> </ul> </li> <li>– Elevated erythrocyte sedimentation rate                 <ul style="list-style-type: none"> <li>• Suggests active infection or inflammation<sup>5</sup></li> </ul> </li> </ul> </li> <li>• Nasopharyngeal swab             <ul style="list-style-type: none"> <li>– B pertussis</li> </ul> </li> <li>• Serology             <ul style="list-style-type: none"> <li>– Mycoplasmal infection</li> </ul> </li> <li>• Serum immunoglobulin's             <ul style="list-style-type: none"> <li>– Immunodeficiency</li> </ul> </li> <li>• Mantoux test             <ul style="list-style-type: none"> <li>– Tuberculosis</li> </ul> </li> <li>• Sweat chloride test             <ul style="list-style-type: none"> <li>– Cystic fibrosis</li> </ul> </li> <li>• Upper gastrointestinal series             <ul style="list-style-type: none"> <li>– Tracheoesophageal fistula</li> <li>– Gastroesophageal reflux<sup>5</sup></li> </ul> </li> <li>• Bronchoscopy             <ul style="list-style-type: none"> <li>– Foreign body aspiration<sup>5,13</sup></li> </ul> </li> </ul>
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**Table 5. Examination (continued)**

prevalence of asthma) sought for boys.<sup>52,71</sup> It is recommended that action plans (outlining tests and medication use) be utilized by parents and medical professionals in order to decrease the necessity for more extensive, expensive and perilous acute care.<sup>8,51,53,73</sup> Denial of the significance of a child's symptoms and delaying medical care for an acute asthma attack can prove fatal.<sup>53,71,72</sup>

Symptoms of habitual snoring and obstructive sleep apnea syndrome are common in children who suffer with

allergies.<sup>74</sup> If a child with multiple allergies and asthma is receiving optimal pharmacotherapy, there is no indication that immunotherapy provides an additional benefit. It is therefore suggested that immunotherapy, for cat- and dust-mite allergic asthmatic children, be combined with anti-inflammatory drug therapy<sup>75</sup> (inhaled corticosteroids<sup>76</sup>). Long-term immunotherapy use (3-5 years) is more effective than short-term use.<sup>75</sup> In an attempt to prevent the onset of asthma in high risk (wheeze prior to the age of two) young children, inhaled corticosteroids were

**Red Flags that Should Prompt Referral<sup>8,62</sup>**

- Neonatal onset of the cough
- Chronic moist, wet or productive cough
- Cough that started or persisted after a choking episode
- Cough occurring during or after a feeding
- Neurodevelopmental problems also present
- Auscultatory findings
- Chest wall deformity
- Haemoptysis (vomiting blood)
- Recurrent pneumonia
- Growth faltering
- Finger clubbing
- General ill health or comorbidities (cardiac disease or immunodeficiency)

**Table 6.**

given to preschool children for two years in a multi-center, double blind, placebo controlled, randomized trial, followed by a year of observation and no treatment. Unfortunately, though the inhaled corticosteroid treatment helped at the time to increase episode-free days and lower the rate of exacerbation and the supplementary use of additional medications, during the observation year there was no significant difference between the two groups. Slowed growth occurred in the steroid group during treatment, but it nearly evened out once steroid treatment stopped. Though the steroids did help lessen asthma symptoms while taking them, it did not prevent asthma from developing.<sup>77</sup> Since use of anti-inflammatory medication (often inhaled corticosteroids) is typical in those with chronic asthma and moderate to severe symptoms, it is important to note that the bone mineral density of these children has been found to remain equivalent to those in the control group.<sup>76,78</sup>

Pertussis (whooping cough) is highly contagious and infants are at the highest risk of severe disease and death due to the effects of the paroxysmal cough.<sup>5,24,79</sup> It is therefore recommended that any infant under 3 months of age who is diagnosed with pertussis be admitted to the hospital.<sup>61</sup> In order to begin preventive treatment for pertussis, a bacterial confirmation should be provided.<sup>61</sup> In 2005, the recommendation for pertussis treatment consisted of respiratory isolation for the first five days of antibiotic treatment (azithromycin for 5 days or clarithromycin for 7 days or erythromycin for 14 days).<sup>61</sup> This protocol was recommended for the infected party, as well as the same prophylactic antibiotic treatment for close contact family members, classmates/teachers, high-risk individuals, and anyone not fully immunized.<sup>61</sup> However, recent studies (2007) have found that 3 days of azithromycin and 7 days of clarithromycin were just as effective as the 14

days of erythromycin at eradicating *B. pertussis* from the nasopharynx.<sup>80</sup> For those that can't tolerate macrolide, 7 days of trimethoprim/sulfamethoxazole was also effective.<sup>80</sup> The short-term antibiotic treatment had fewer side effects and showed no difference in the clinical improvement or microbiological relapse than the long-term antibiotic treatment.<sup>80</sup> This same study also found that use of prophylactic antibiotics (in contacts older than 6 months of age) did not significantly improve the clinical symptoms or decrease the number of *B. pertussis* cases that developed.<sup>80</sup> When pertussis infection is confirmed it is also recommended that vaccines be updated for everyone who has been exposed since adults are considered the main reservoir of *Bordetella pertussis*, accounting for most of the contamination of young infants.<sup>61</sup>

The efficacy of the *B. pertussis* vaccine is often called into question.<sup>48</sup> A prospective cohort study of school aged children presenting to primary care with a cough lasting 14 days or more found that around a third had serological evidence of recent *Bordetella pertussis* infection, and nearly 90% of these children had been fully immunized.<sup>48</sup> Though medications have been used to lessen the primary (paroxysmal cough) and secondary (vomiting, frequency of whoop, frequency of cyanosis, development of serious complications, mortality, side effects due to medication, admission to hospital and duration of hospital stay) outcomes, there is insufficient evidence to draw conclusions about the effectiveness of any of the medication-based interventions.<sup>79</sup>

**Treatment: Chiropractic**

Though the skeletal make-up of a child appears to be a miniature version of an adult, there are important differences worth noting. The spinal column of an infant/child is composed primarily of cartilage and consists of 7 cervical, 12 thoracic and 5 lumbar vertebrae. Primary ossification of the spine begins in-utero and secondary ossification continues for approximately 25 years until spinal development is considered complete.<sup>60</sup> The pelvis consists of 2 ilium and 1 sacrum; however the 5 individual sacral units remain separate until fusion begins at puberty and ossification is completed at 25 years of age.<sup>60</sup> The cranium is made up of 8 bones: frontal, 2 parietal, sphenoid, 2 temporal, occiput and ethmoid.<sup>81</sup> Together the bones of the spine, pelvis and skull protect the delicate nervous system that lies within. The nervous system is complex, but there are certain areas of the spine that are neurologically related to cough. A "wet" cough occurs when expiration is difficult and there is an excess production of mucus.<sup>57</sup> The parasympathetic nervous system is associated with this

via the parasympathetic efferent vagal fibers that control bronchial gland secretion of mucus, and via the pulmonary branches of the Vagus nerve, which are responsible for bronchoconstriction in response to irritants and allergens.<sup>60</sup> Therefore symptoms of a “wet” cough may be associated with dysfunction of spinal levels occiput to C5, the sacrum (especially the second sacral segment), and ilia, which should be evaluated by a chiropractor.<sup>82</sup> A “dry” cough is one in which the cough is more “hoarse” sounding<sup>57</sup> due to bronchoconstriction. The sympathetic nervous system is associated with these symptoms because bronchodilation is triggered by the sympathetic efferent fibers.<sup>60</sup> These fibers arise from branches of the second to fifth thoracic ganglia, which rest anteriorly against the rib heads. Therefore compression of the sympathetic ganglia can occur with any significant anterior shifting of the second, third or fourth thoracic rib heads and interfere with the sympathetic nervous system's ability to produce bronchodilation, thus allowing bronchoconstriction to dominate.<sup>60</sup> This can explain why those with “Pottenger Saucer”, anterior dishing of this thoracic area, may be more likely to have “chronic respiratory disorders”.<sup>59</sup> It may also explain how structural changes in the alignment of the thoracic spine with growth and expansion of the thorax and/or addition of chiropractic care allows for the improvement of these symptoms.<sup>60</sup> Symptom triggers such as endocrine changes and menses are associated with the sympathetic nervous system and spinal levels C6-T3 (thyroid function) and T7-12 (suprarenal function) are areas that should be evaluated by a chiropractor.<sup>83</sup> Elimination of the dietary consumption of milk, sugar and chocolate products may also be helpful for this type of dry cough.<sup>83</sup> Other areas to assess due to their involvement are cranial bones sphenoid (Trigeminal nerve), temporal/occipital (Glossopharyngeal and Vagus nerves); as well as the spinal motor nerves that control the larynx, intercostal muscles, muscles of the abdomen and muscles of the pelvis.<sup>5,84</sup> Effectiveness of chiropractic varies but may include increased rate of healing from cough, decrease in severity of cough, decrease in frequency of cough onset or episodes, and decreased necessity for use of medications for cough, all as a result of receiving chiropractic care.<sup>57,81</sup>

A recent (2012) systematic search of existing literature to determine the top forms of CAM used in healthcare ranked chiropractic within the top four (others included herbal medicine, massage and homeopathy).<sup>1</sup> A 2008 study in west Texas showed that of the 1,731 subjects involved with the survey, 52.0% used CAM and of those 42.7% considered chiropractors their main type of CAM practitioner (followed by massage therapist at 33.3% and herbalist

at 8.3%).<sup>85</sup> Without the ability to prescribe medications, which are often unnecessary for cough,<sup>15</sup> chiropractors possess the expertise in non-pharmaceutical treatment options making the chiropractor an important partner in maintaining health and wellness.<sup>86</sup>

### Treatment: Other Complementary and Alternative Medicine (CAM)

The use of complementary and alternative medicine in children is becoming increasingly acceptable and popular both in the US and around the world.<sup>87</sup> Although past studies may have determined that CAM treatment was ineffective or unsafe, these studies were for children with chronic or serious illnesses, rather than for the more common use of CAM as intervention and treatment for low-risk illnesses.<sup>88</sup> Also, there is a distinct difference between the practices of the general population compared to those of specific ethnic minority groups, referred to as folk medicine or ethnomedicine, though the frequency of CAM use is the same in all groups.<sup>88</sup> A 2008 parent survey in southern Turkey found that 58.6% had used CAM at least once in the previous year.<sup>87</sup> Herbal remedies (82.7%) were the most common used CAM and 42% of these were used to treat cough.<sup>87</sup> Mother/mother-in-law was the one recommending this treatment in 52.5% of the cases. Interestingly, only 31.6% reported the use of CAM to the pediatrician and 38% of those surveyed said they preferred to use CAM rather than seeking advice from the pediatrician when their child was ill.<sup>87</sup> Since parents may be using CAM, whether or not it's reported, this should be taken into account when recommending treatments in order to minimize associated risks,<sup>87</sup> though most home-based remedies are complementary to biomedical treatment and few are dangerous if used in moderation.<sup>88-90</sup>

Herbalism is the use of plants for medicinal purposes. The tenets of herbalism include:<sup>90</sup>

- The whole plant is better than an isolated extract (any part of a plant can be used)
- Treat the whole person not just the symptoms
- Practice minimum effective treatment and minimum intervention
- Strengthen the body and encourage it to heal itself

Herbal remedy recommendations, as well as the effect/use for symptoms are listed in *Table 7* (for cough, asthma, and pertussis), and *Table 8* (for bronchitis, pneumonia and croup).<sup>90</sup> The use of CAM for treatment of asthma, allergy and immunologic conditions has grown in popularity.<sup>91</sup> Use of Echinacea is common for upper respira-

<b>Herbs for COUGH</b>	<b>Effect/Use</b>	<b>Herbs for ASTHMA</b>	<b>Effect/Use</b>	<b>Herbs for PERTUSSIS</b>	<b>Effect/Use</b>
Aniseed and fennel	Warm the system and shift the cough	Balm, lavender, chamomile, passiflora, and oats	Relaxation to decrease incidence of attacks	Coltsfoot and elecampane	Prevent infection by strengthening the body and clearing phlegm
Cayenne pepper added to food (a few grains)	Stimulate immune system and clear wet secretions from lungs	Infused Elecampane	Drink daily to treat asthma	Sundew infusion	Treat bacterial infection and relax respiratory muscles
Pasque flower and lobelia	Clear a fever and reduce inflammation	Grindelia, hyssop, wild cherry bark and motherwort	Treat a mild attack	Hyssop and lobelia	Alleviate spasmodic cough
Infusions of chamomile, catmint, hyssop and yarrow	Reduce fever	Turmeric sprinkled in warm water	Bronchodilator effect	Coltsfoot	Loosen the cough and expel mucus
Comfrey and coltsfoot (10 drops of each mixed with warm honey)	Expel mucus from respiratory system			Wild cherry bark	Reduce cough reflex
Infusion of elecampane and thyme	Treat a wet cough			Red clover	Reduce bronchi spasm
Strong infusion of ginger and fennel or thyme	Mucus is tough to shift			Thyme tincture	Loosen and expel mucus; antiseptic
Elecampane root tea, sweetened with honey and ginger	Reduce inflammation and mucus			Comfrey ointment on chest and back	Relax the lungs
				Lemon balm tea	Soothe anxiety
				Elecampane in syrup form	Helps cough
				Black root	Vomiting
				Massage comfrey ointment into chest and back after a bath	Relax and expand the lungs; expectorant and lessens irritation

**Table 7. Herbs for Cough, Asthma, and Pertussis<sup>90</sup>**

tory tract infections and symptoms of “common cold”, as is garlic.<sup>91</sup> Other CAM agents include angelica, German chamomile flower, ephedra, ginkgo, grape seed extract, licorice root, St. John’s Wort, kava kava rhizome, peppermint, stinging nettle and ginseng.<sup>91</sup> All were reported to have significant adverse effects but usually in the form of hypersensitivity reactions.<sup>91</sup> Traditional home and folk remedies have been passed down through the ages and

across all cultures and are deeply rooted in history and tradition.<sup>90</sup> Common practices include attempts made to maintain physical and emotional balance and harmony and religious practices with the use of ethnobotanical and other therapies in addition to biomedical therapy.<sup>88,89</sup> In the past, people would treat their ailments themselves with advice from those around them and locally gathered medicinal plants. If self-treatment failed, they would seek assistance

Herbs for BRONCHITIS	Effect/Use	Herbs for PNEUMONIA	Effect/Use	Herbs for CROUP	Effect/Use
Anise diluted in water	Soothes a hacking cough	Infusion of coltsfoot	Soothes cough, fights respiratory infection	Lobelia and black cohosh	Reduce spasm, soften phlegm, clear the lungs
Wild cherry bark extract	Relieves coughing	Raw garlic and onion	Expel phlegm and fight infection	Wild cherry syrup	Reduce spasm, help with phlegm
Coltsfoot added to licorice and honey	Alleviate cough	Infusion of boneset	Clear congestion and relieve aches/pains	Lavender or chamomile infused in hot water	Help breathing
Garlic oil rubbed on chest	Fight infection and encourage healing	Fenugreek with lemon and honey	Bring down fever and deal with any infection	Chamomile, catmint or wild cherry infused	Help sleep and lessen attack
Ginseng in hot water	Eliminate infection and ease coughing fits			Mix catmint, horehound, and wild cherry with honey or licorice	Help cough
Peppermint tea	Soothe the cough and bring out the infection			Foot bath with thyme or eucalyptus oil	Help cough

**Table 8. Herbs for Bronchitis, Pneumonia, and Croup<sup>90</sup>**

from a healer. Remedies are prepared as tisanes (mild infusion), powders, pills, compresses, poultices, essential oils, baths, or inhalations. The powdered, fresh or dried herbs, roots, twigs, berries, seeds, and bark can be made into tinctures, decoctions, infusions or ointments at home and used as a form of restorative and preventative medicine.<sup>90</sup> These therapies are often not effective from a biomedical point of view but when analyzed by the ethnomedical explanatory model, they make perfect sense.<sup>88,89</sup> Honey, for instance was found to be “better than no treatment” but provided no strong evidence either for or against its use.<sup>92</sup> Table 9 lists the traditional home and folk remedies, as well as effect/use, for symptoms of cough, pertussis, bronchitis and croup.<sup>90</sup>

Homeopathy is based on the principle that “like cures like”, meaning that the treatment given produces similar symptoms to that of the illness being treated.<sup>90</sup> Minute doses of certain substances are used to stimulate the body’s defense mechanism. Homeopathic remedies are made in stages of dilution and succession (vibration or shaking) to release its potency. The more a remedy is diluted, the higher its potency. In homeopathy, symptoms are seen as a positive sign of the body trying to heal itself and are therefore not suppressed, but rather stimulated to support the healing process.<sup>90</sup> Treatment works accord-

ing to the Laws of Cure:<sup>90</sup>

- A remedy starts healing from the top of the body and works downward
- It starts from within the body, working outward, and from major to minor organs
- Symptoms clear up in reverse order to their manner of appearance

The homeopathic remedies, as well as the symptoms, are listed in Table 10 for conditions of cough, asthma, and pertussis and Table 11 for bronchitis, pneumonia, and croup. These remedies are not intended to replace medication, especially for chronic asthma, chronic bronchitis, and pneumonia, but can be used for mild or acute attacks while seeking medical attention.<sup>90</sup>

Other forms of CAM that may be utilized include Ayurveda, Chinese Herbalism, Acupuncture, Aromatherapy, Flower Essences, Massage Therapy, Yoga and vitamins/minerals. Each of these offers a unique look at disease and recommendations for treatment with varying frequency. Many parents provide their children with some form of vitamin to take on a daily or frequent basis.<sup>93</sup> Fish oil, which provides Omega-3 fatty acids, is seen as a strong anti-inflammatory supplement.<sup>93</sup> Unfortunately, in a 1996 study, use of daily dietary fish oil supplementation on clinical course of asthma showed only slight improve-

Home/Folk Remedies for COUGH	Effect/Use	Home/Folk Remedies for PERTUSSIS	Effect/Use	Home/Folk Remedies for BRONCHITIS	Effect/Use	Home/Folk Remedies for CROUP	Effect/Use
Eat fresh garlic often	Cleanse the blood, improve immune system, encourage healing	Honey and licorice mixed with a little hot water	Drink to relieve cough	Honey and lemon	Fight infection and ease cough	Offer hot honey and lemon drink	Antibacterial in case that's the cause
Lots of honey	Antibacterial properties, soothes a sore throat	Garlic poultice placed on chest and back	Help expel the phlegm	Combine mustard seed powder and water to make a poultice	Apply to chest for decongestion	Sip a little cider vinegar mixed with a mug of warm water	Ease symptoms
Blackcurrant tea	Ease a sore throat and reduce mucus			Onions	Soothe inflamed membranes and cause a sweat	Blackcurrant tea	Helps cough and restores strength after illness
Ginger added to meals	Rids lingering mucus					Sit in the bathroom with hot water running (to create steam)	Opens airways and reduces symptoms
Pineapple	Expels excess mucus						
Lemon and honey	Soothe a sore throat and ease a tickly cough						

**Table 9. Traditional Home/Folk Remedies for Cough, Pertussis, Bronchitis, and Croup<sup>90</sup>**

ment in mild asthma over a 12 week period.<sup>93</sup> Supplementation with vitamins A, C, E and B complex have shown to be helpful in reducing cough symptoms.<sup>83</sup>

## Conclusion

Pediatric cough can be disruptive to the life of the child and all of those around him/her.<sup>4</sup> Parents will often consult a doctor for this symptom<sup>5,7</sup> and as a “gatekeeper” it is vital that the chiropractor be aware of the differences between benign and life-threatening conditions.<sup>86</sup> Though serious causes of cough that require prompt referral do exist,<sup>8,62</sup> many times the cause of cough is benign and conservative and alternative approaches to treatment may be utilized.<sup>5,6</sup> In order to alleviate symptoms effectively it is important to understand the condition,<sup>5,13</sup> its cause<sup>5</sup> and appropriate medical and alternative treatments.

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Homeopathy for <i>COUGH</i>	Effect/Use	Homeopathy for <i>ASTHMA</i>	Effect/Use	Homeopathy for <i>PERTUSSIS</i>	Effect/Use
Belladonna	Cough with fever; bright red cheeks and neck	Ipecac	Wheezy children who cough until vomit mucous	Pertussin	Given in one dose at end of disease to prevent "echo" effect
Pulsatilla	Thick yellow discharge; clingy and tearful	Arsenicum	Waking between 12-2am with difficult breathing	Aconite	During an attack or beginning of the illness
Ant. Tart	Rattle in chest, breathing painful	Bryonia	Asthma at end of a cold; hard, dry cough	Ant. Tart.	Rattling cough with gasping
Bryonia	Painful, dry cough made worse with movement	Nat. Sulf.	Asthma in damp weather with loose cough and yellowish mucous	Sanguinaria	Harsh, dry cough
Spongia	Loud, crowing cough	Lachesis	Asthma that starts in spring or autumn	Arnica	Bleeding or distress before coughing starts
Drosera	Tickling cough that worse when lying down			Drosera	Cough worse by lying down and pains below the ribs
Aconite	Sudden symptoms			Bryonia	Dry, painful cough and vomiting
Chamomilla	Soothe an inconsolable child; better if held				

**Table 10. Homeopathy for Cough, Asthma, and Pertussis<sup>90</sup>**

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Homeopathy for BRONCHITIS	Effect/Use	Homeopathy for PNEUMONIA	Effect/Use	Homeopathy for CROUP	Effect/Use
Pulsatilla	Worsens in stuffy rooms; cough dry at night and loose in the morning	Aconite	Sudden onset with anxiety and fever	Spongia	Traditional treatment and can be taken every 20 minutes during an attack
Ipecac	Nausea, vomiting and suffocation feeling	Bryonia	Sharp chest pains made worse with movement	Aconite	Taken alongside Spongia
Bryonia	Dry and stabbing cough with headache and great thirst	Sanguinaria	Pneumonia after flu, right lung affected and has rust-colored phlegm	Phosphorus	Thirst for cold drinks which may be vomited up
Phosphorus	Tight and tickly cough; pale, anxious and thirsty for cold water	Phosphorus	Rust-colored phlegm, weakness, trembling and thirst for cold drinks	Drosera	Deep and hoarse-sounding cough with gasping and retching
Aconite	Sudden onset bronchitis with dry cough and chills				

Table 11. Homeopathy for Bronchitis, Pneumonia, and Croup<sup>90</sup>

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# Down Syndrome and Chronic Ear, Nose and Throat Infections: A Case Report

Delsey Daruwalla

## ABSTRACT

**Objective:** The following case report introduces a child diagnosed with Down Syndrome (DS) and the functional changes seen after chiropractic intervention.

**Case Presentation:** A male child diagnosed with DS presented for a general check as well as to address ongoing nose and throat infections and the high usage of antibiotics.

**Intervention and Outcomes:** After one month of care the child had a reduction in nose and throat infections, decreased antibiotic use, experienced an improvement in quality and duration of sleep and had noticeable improvements in concentration observed by his teachers.

**Conclusion:** Chiropractic protocols may contribute to the overall improvement in a child with DS. Further research is warranted to determine the effectiveness of the adjustments delivered by a chiropractor and how alternative interventions influences the lives of children and furthermore adults with Down syndrome (DS).

**Keywords:** Down syndrome, trisomy 21, chiropractic, adjustments, alternative therapy.

## Introduction

Down syndrome (DS), also known as Trisomy 21 is a collection of physical and mental symptoms. It is the most commonly occurring chromosomal condition with a frequency of 1:1,000 live births and is characterized by delays in learning and in the development of the child. Even though there is a clear relationship between advancing maternal age and the risk of Trisomy 21, 70% of Down syndrome infants are born to mothers below the age of 35 years. This genetic disorder is due to the presence of a duplicate chromosome 21 which alters normal development. People affected by this condition vary in their abilities and achievements. This condition was found by John Langdon Down (1866), an English doctor, who reported the congenital condition to randomly affect babies born throughout the world, male and female alike. Along with chromosomal errors there are sought to be other associating factors increasing the risk of chromosome 21 malsegregation. Theoretical ideas are linked to advanced maternal age and recombination. Other studies suggest environmental insults, which over time affects the stability of ovary and oocyte leading to increased birth rates of children with Down syndrome.<sup>1,2,3</sup>

Health problems as a result of poor immune system development include systemic infections, ear infections and

respiratory infections. Another clinical concern, especially important to chiropractors providing care to children with DS is a high incidence of atlanto-axial instability due to the agenesis or the laxity of the transverse ligament typically seen in this population.<sup>4</sup> The standard treatment in the allopathic paradigm is surgical intervention fusing the upper cervical spine. However, there is a lack of the dissemination of information about alternative methods of treatment available to patients and their families. Education about conservative measures based on the non-allopathic model is often overlooked. This case recognises chiropractic offers a specific treatment modality for the functional disabilities that often accompany the diagnosis. The following study introduces an avenue for further public education on alternative options for one of the most prevalent genetic pediatric disorders seen today.

## Case Study

A 9-year-old boy presented in March 2010, diagnosed with Down syndrome Trisomy 21 at birth.

The child was delivered vaginally at 38 weeks. Labor was 5 hours long, no epidural or gas was administered and the child weighed 8.6 pounds. Chromosomal testing done at 2 days of age revealed that the neonate had Down syndrome. He was further tested for heart defects as it is a common complication in children with DS, however results were normal. At birth, it was noted that the neonate had features suggestive of DS such as small epicanthal folds on his eyes, a 'jandal toe' (which is the gap between the big and second toe). He was noted to have moderate hypotonia,

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which was improving with age according to the mother. His ears and eyes were set in the regular parameters of typical average children, nevertheless, his eyes looked more widely set due to a flat and small nose bridge. The child did not have the single palmer crease also known as simian crease which extends along the palm of the hand, typically associated with DS. All his limbs and digits were within normal ranges for a typically developing child. The patient also had mild upper register hearing loss. It was noted however, that the patient had never had an ear infection which is atypical in children with DS. He had suffered many nose and throat infections and had been prescribed antibiotics on several occasions. He experienced a poor quality of sleep due to a chronic nasal congestion (characterized as a “blocked nose”).

X-rays of his adenoids were obtained to determine whether or not he should have his adenoids and tonsils removed. This was because he suffered difficulties with chronic sinusitis, production of green dense mucous and the presence of large inflamed tonsils. Nevertheless at this stage he had neither his adenoids or tonsils removed. His sinusitis was treated on multiple occasions with Amoxicillin. At 3 months he contracted bronchiolitis. The neonate was hospitalized for two weeks, he was on oxygen, steroids (Redipred) and antibiotics. At 8 months of age he was suspected to have kidney reflux and was given penicillin based prophylactic antibiotics for 3 months.

The patient was breastfed for 15 months. There was no preferred head position, colic or uncontrolled crying. The doctors had advised the mother to breastfeed him as long as she could, because it would be beneficial for the development of the muscles in his mouth and face. Children suffering from DS have weak oral-motor muscular control thus resulting in a weak suckle. Therefore they control the flow of liquids by protruding their tongues. The muscle tone is lower than average, thus the tongue is larger and floppier. Tongue movement and oral-motor development is crucial in correct swallowing, breathing, chewing and speaking.<sup>5</sup> In this case, due to both a deficit in motor planning and tone, the patient had difficulty co-ordinating the movement of his tongue. A longer period of breastfeeding improved his oral motor development and thus the child was able to speak quite well. He had mild tongue protrusion and the tendency to chew on his fingers constantly, a typical feature of DS.

The patient was current with the national vaccination schedule and the mother disclosed that she had asked for the 15 month MMR vaccination to be administered separately. She also reported that the post-natal care

and information around DS was patchy. She had received an information packet in the hospital regarding the condition, but was left to read and comprehend the material on her own. No counseling services or any support was offered. It was through friends and acquaintances that the family were educated about their local Down Syndrome Association.

## Findings

Normal findings on palpation of the carotid and subclavian artery. Anterior head carriage and decreased right shoulder height was noted on inspection. Right lateral flexion of the cervical spine was decreased, however all other range of motion was normal. Cervical orthopedics such as cervical compression, distraction and shoulder depression were negative. All dermatomes, myotomes and reflexes were normal. In cranial nerve testing; smell was abnormal because of a blocked nose on day of presentation. Cranial nerve XI (accessory) was normal, however scalenes and sternocleidomastoid (SCM) muscles were noted taut bilaterally. His gait was normal.

Normally cervical extension and flexion radiographs are routinely taken to check for atlanto-axial instability, however the x-rays were not obtained by the chiropractor after weighing the risks versus benefit of exposing the child to x-rays. Taking into account his age and no signs of previous trauma, a decision was made (physician and parents concurring) not to obtain radiographs and assume instability in the upper cervical spine, thereby subsequently modifying the technique that is used to adjust.

## Proposed care plan

A care plan was proposed to support development, in hopes of minimizing some of the challenges typically associated with DS, as well as addressing ongoing nose and throat infections and the high usage of antibiotics. The recommendation was to come in twice a week for chiropractic spinal adjustments using Thompson drop assist table for the pelvis and diversified technique in the thoracic region. An activator (adjusting tool) was used when addressing the cervical spine due to presumed atlanto-axial instability. The temporomandibular joint (TMJ) would be addressed when accounted for to help affect the clearing of eustachian tubes and sinuses. The prognosis was good if the patient complied with the plan of care.

On his first visit he was found to have a right posterior inferior ilium which was corrected on the Thompson table. A diversified thoracic maneuver was carried out along with

a right posterior superior occiput. Correction of the occiput required a gentle pressure in the line of correction while the patient was supine. His right TMJ was addressed and the line of correction was anterior to posterior. The occiput and posterior inferior ilium listings were found on numerous visits. After 3-4 visits the child showed improvement in the length of sleep through the night which enabled adequate rest so that he was functioning optimally through the day. During this time he no longer had a continual blocked nose, sinusitis and the need to chew on his fingers had reduced. After six visits, his care was decreased to once every 2 weeks and then once every 3 weeks. The child was responding very well to care through that time.

At his 13th and 19th visit he was reported to have a cold and felt achy, during that time he came in twice a week and in 3 visits was doing well again. On both these occasions a significant posterior inferior right ilium, posteriority of T6, right anterior TMJ and a posterior superior right occiput was found. The ilium was adjusted with the patient prone on the Thompson table. The doctor contacted the posterior superior iliac spine on the right and adjusted in an anterior superior line of correction. Diversified maneuver was used on T6 going posterior to anterior. The anterior TMJ was adjusted with the doctor's third digit applying several high velocity, low amplitude impulses, anterior to posterior. The occiput was gently lifted as the doctor's contact point was the third digit at the right mastoid process. Several high velocity, low amplitude impulses were applied in an anterior inferior direction. After the 19th visit there have been no episodes of sinusitis, colds and he is no longer consuming antibiotics.

The mother and teachers noticed other behavioral changes. His teachers commended him on his increased performance. He was reported to have longer concentration periods, he was settled and calmer than before. His speech was improving, he no longer suffered a continuous blocked nose and did not have the need to chew his fingers on a regular basis.

No adverse events were reported or noted as a result of chiropractic care.

### Discussion

Patients with Down syndrome (DS) suffer from a variety of mental and physical impairments. The severity of impairment depends on the number of complications present.<sup>6</sup> Patients with DS frequently are diagnosed with congenital anomalies; most common is heart abnormalities where one out of three children have congenital heart

disease associated with DS.<sup>7</sup> Ventricular septal defect is the most common cardiac abnormality followed by atrial septal defect in DS.<sup>8-9</sup> Other musculoskeletal conditions such as atlanto-axial instability and subluxation can also complicate the disorder.<sup>6</sup>

Children with DS may subluxate more frequently due to several factors complicating the disorder. Some examples are, hypotonia, heart anomalies, dermatoglyphic features, underdeveloped nervous system, audio-logic deficits, ENT (ear, nose, throat) infections and more.<sup>10</sup> Chiropractic care is a health care profession that focuses primarily on "joint subluxation or mechanical lesion and restoring function".<sup>11</sup> The role of the practitioner is to treat and prevent illness or injury. It is the primary care for anyone pursuing a natural holistic approach to health.<sup>11</sup>

One of the biggest physical deficits in children with DS is oral-motor skills. The muscles of the tongue are hypotonic which create difficulty in producing or coordinating movements of the tongue during daily living activities. Typically the muscles of the tongue readjust its position in the mouth via sensory feedback. However, people with DS have underdeveloped nervous systems which cause difficulty in receiving and integrating sensory information. This would affect their ability to chew, swallow, breathe and speak thereby altering their lives in a multifaceted way.<sup>5</sup>

William Sutherland, an osteopath, had postulated that facial sinuses not only contain goblet cells that secrete mucous but are also comprised of one or more bones that mechanically pump to clear the sinuses. This mechanism can be compromised from mechanical or other forces which impact the drainage process. The mucous pools become dense which in turn increases the risk of infections. Inflammatory process along with purulent discharge leads to the enlargement of adenoids and tonsils.<sup>10</sup> The above scenario was observed in this particular case. The administration of antibiotics helps reduce the production of the discharge however does not resolve the initial accumulation of mucus within the sinuses. In DS the airways are narrow to begin with and furthermore narrowed by a blocked nose. This forces the child to breathe through the mouth which too is narrowed by a lowered hard palate arch.<sup>5</sup> This may be a strong perpetuating factor for the child's tongue to protrude. The dysfunction can be detected and corrected by gentle conservative methods. The pumping mechanism is then restored allowing the sinuses to clear resulting in the reduction of sinusitis attacks and concurrently the need for antibiotics.<sup>10</sup>

Children with DS are prone to upper respiratory infections and otitis media. It is reported that 38-78% of children with DS may have hearing loss. A study by the American Medical Association shows that the Human Respiratory Syncytial virus is the most common cause of respiratory tract infections.<sup>12</sup> The infections develop due to the dysfunction of the eustachian tubes. Their function is to equalize air pressure on both sides of the ear drum. Adding to this children with DS reportedly have a shortened cochlea, decreased spiral ganglion cell population and there may be maldevelopment of the stapes.<sup>13,10</sup> The medical management for otitis media is the insertion of tympanostomy tubes, however, studies indicate that conservative management should be the treatment of first choice because the efficacy is much lower than expected regarding medical intervention.<sup>14-15</sup>

When working with a child with DS, chiropractors avoid using rotation in the neck when delivering cervical spine adjustments. The reason for this is because of atlanto-axial instability, a complication normally verified by flexion and extension view radiographs. In children with DS, flexion causes anterior translation of C1 on C2 wider than 5mm; 5mm being the normal range. It is known that progressive anterior displacement of the atlas on the axis puts pressure on the spinal cord resulting in serious neurological complications.<sup>4,16</sup> As a chiropractor when adjusting the upper cervical spine, one must avoid rotational maneuvers; as it was done in this particular case, to ensure that no more force is applied to disrupt the transverse ligament.<sup>17-19</sup>

A limitation to this study would be the lack of material and data published on Down syndrome and alternative therapy, primarily chiropractic care. There needs to be more research and more specific questions such as; “does chiropractic care effect those with ear, nose and throat infections” and given that Down syndrome children are more prone to such infection is there a potential to help this high risk population.

In a literature search of databases such as google scholar, science direct, Mantis, index to chiropractic literature and pubmed, using key words/phrases such as Down syndrome and chiropractic care, Down syndrome and manipulation research, chiropractic and nose throat infections, Down syndrome atlanto-axial instability and chiropractic manipulation etc., no specific research pertaining to Down syndrome, nose, throat infections and chiropractic/manipulation therapy appeared. Therefore it is difficult to pull collective knowledge to relate to this case and leaves many

gaps in regard to claims that can be made around caring for chronic nose and throat infections in Down syndrome children with chiropractic care. It should be noted that there is an abundance of information on alternative therapy and ear infections however this was a case of a child with nose and throat infections and hence why the searches were done with the exclusion of “ear” infections.

## Conclusion

Down syndrome is a genetic disorder that affects those it afflicts in a multifaceted way. It affects multiple systems inside the body and is apparent externally with its physical features. Chiropractic care can play a major role in helping those associated with this condition. As research shows, patients can benefit through alternative methods of treatment. Speech therapists, physical therapists, chiropractors and many other alternative professions can enhance the development and quality of life in a person with Down syndrome. In this particular case there were no adverse effects to chiropractic care, infact many positive outcomes were seen.

More research is warranted as there are vast areas of conservative therapies that can be used to address conditions such as the one presented. Further investigation into understanding the mechanisms of the adjustments delivered and its physiological effects on the body can be useful in determining some grey areas around chiropractic and its potential effects. Such analysis could open other avenues in finding the long term effects of chiropractic care for patients with Down syndrome.

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# Resolution of Birth-Related Cranial Asymmetry Following Chiropractic Care: A Case Report

Cassandra Fairest

## ABSTRACT

**Objective:** To present the case of a 6-week-old patient with left-sided cranial asymmetry, decreased upper cervical range of motion with concomitant vertebral subluxations, and the resolution of symptoms following chiropractic care.

**Clinical Features:** A 6-week-old female presented with left-sided cranial asymmetry indicating deformational plagiocephaly, and favored left head rotation. Additional complaints included occasional regurgitation of stomach contents immediately after breastfeeding, groaning when placed supine in an inclined position, and unsettled sleep patterns. All other growth, reflexes, and milestones were normal at 6 week general practitioner and midwife examinations.

**Interventions and Outcomes:** Modified Diversified and Activator (force application) were techniques utilized to reduce vertebral subluxation findings. Objective indicators of vertebral subluxation at C1, C4, T4 and sacrum were identified through static palpation, motion palpation, and spinal examination. Improved upper cervical range of motion was immediately observed and subjective reporting of sleep patterns and regurgitation also improved immediately following the initial visit.

The patient experienced resolution of deformational plagiocephaly and concomitant symptoms following chiropractic care to address vertebral subluxations.

**Conclusion:** This case study demonstrates the effectiveness of chiropractic care for this child in the resolution of vertebral subluxation, deformational plagiocephaly and concomitant symptoms. Further research is warranted to assess the outcomes of chiropractic intervention in patients with similar cases, and to compare the resolution of symptoms of those patients that are treated with traditional medical interventions.

**Key words:** deformational plagiocephaly, nonsynostotic plagiocephaly, flat head syndrome, cranial asymmetry, craniosynostosis, facial asymmetry, torticollis, vertebral subluxation, chiropractic.

## Introduction

The purpose of this document is to report upon the left-sided cranial asymmetry of a 6-week-old female, and the subsequent resolution of symptoms following chiropractic care.

An Outcome Analysis of Cranial Molding Therapy in Nonsynostotic Plagiocephaly<sup>1</sup> states nonsynostotic plagiocephaly (also called deformational plagiocephaly, positional plagiocephaly, or the flat head syndrome) is caused by extrinsic factors such as cranial molding due to intrauterine compression, sleeping position and congenital muscular torticollis rather than intrinsic factors such as craniosynostosis. Deformational plagiocephaly and the facial asymmetry that results from it does not spontaneously resolve, and the deformation will worsen over time as the baby is usually placed in a supine position to sleep on the flattened area of the head.

## History

A 6-week-old female was presented by her mother

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for chiropractic evaluation. The primary concern was left-sided cranial flattening and favored left head rotation. Her mother reported that she was advised by their general practitioner (GP) and midwife to seek chiropractic care to assess the misshapen skull. GP had also advised of an alternative treatment of utilizing a cranial remolding helmet for up to two years, as necessary. Additional complaints included occasional regurgitation of an entire breastfeed immediately after feeding which she had done immediately prior to the visit, groaning when placed prone in an inclined position, and unsettled sleep patterns. There were no feeding difficulties, or side of preference to feed from. All other growth, reflexes, and milestones were normal at 6 week GP and midwife examinations.

The baby was delivered via emergency Cesarean section after a failure to descend. Further history ascertained after a spontaneous onset of labor, and subsequent full cervical dilation, the mother attempted to deliver the baby naturally for approximately 2 hours before fetal distress was discovered. An epidural was then administered, and the baby was delivered with forceps by Cesarean after 16 hours of labor. APGAR scores were 9 and 9, and the baby had a significant "cone head" at the vertex, resolution of which was complete by 7 days. The mother reported a non-incident pregnancy,

and there was no history of congenital conditions in either of the parents' families.

### Examination

The newborn was very calm upon physical examination, with obvious signs of left-sided cranial flattening and left head rotation. Upon rotating the head passively to the right, she would immediately turn it back to the left. Her mother commented that every photograph taken of the infant to this point had revealed left head rotation.

Objective indicators of vertebral subluxation at C1, C4, T4 and sacrum were identified through static palpation, motion palpation, and spinal examination. C1 had misaligned superior, anterior, and laterally to the left, giving a listing of ASL according to Upper Cervical Specific protocol.<sup>2</sup> C4 had misaligned posterior, inferior and rotated laterally to the right, giving a listing of C4BR according to Diversified protocol.<sup>3</sup> T4 was found to be posterior, inferior, and rotated laterally to the left, with a listing consistent of T4PR Diversified protocol. Sacrum was found through palpation and spinal examination to be posterior on the left, giving the Diversified protocol listing of LPSS.

### Intervention

The baby was checked by the chiropractor once a week for 10 visits, informed consent having been obtained at the report of findings. The level of C1 was adjusted seven times using Diversified technique (ie modified high velocity, low amplitude thrust) over the course of care, and on three visits no adjustment at all was required. Further visits up to 6 months following the initial period of care revealed no further adjustment was required to C1.

C4 was adjusted using modified Diversified technique on the first visit only, and not again during the 10 visits. T4 was adjusted using Activator as a force application, and was adjusted twice during the initial course of care. Sacrum was adjusted on the initial visit only, using modified Diversified technique.

Chiropractic spinal adjustments were the only intervention utilized during the course of treatment. Advice was given to the mother to encourage the infant to sleep on the "normal" side of her head, by rotating it passively if necessary when the infant was sleeping. No other exercises, soft tissue modalities, or cranial interventions were administered.

### Outcomes

Immediately subsequent to the first adjustment, the chiropractor observed the infant willingly rotated her head to the right. Further subjective reporting by the mother said that the infant slept for 10 hours that same night, and she did not regurgitate her stomach contents post-feeding following the first visit. By 9 weeks of age, a return of symmetrical head shape was becoming evident, upper cervical range of motion was within normal limits, and regular sleep patterns had been established. By 5 months of age, no cranial shape abnormality was detectable, and all other complaints had resolved. No adverse events were observed, nor reported.

### Method

An online literature search was conducted, using scientific journal databases Google Scholar, Mantis, Index to Chiropractic Literature, PubMed, ChiroACCESS, and ScienceDirect. Search key words and phrases included "plagiocephaly+newborn", "plagiocephaly+pediatrics", "plagiocephaly" "plagiocephaly+manual+therapies", "plagiocephaly+osteopathy", "cranial+asymmetry", "birth+trauma+cranial+asymmetry", "birth+trauma+plagiocephaly", "birth+trauma+chiropractic", "neonatal+birth+trauma", "birth+trauma+incidence", "cesarean+birth+trauma". Other internet searches using the above terms were also conducted.

### Discussion

Deformational plagiocephaly occurs in as many as 61% of healthy newborn infants, according to a study conducted in 2008.<sup>4</sup> The study concluded that asymmetries of the head and neck are very common in normal newborns.

Another study<sup>5</sup> demonstrated that the rate of skeletal injury during the birth process was as high as 33% (vaginal birth), and 34% (Cesarean birth). The overall conclusion of the study was unable to specify which type of birth caused the most significant birth trauma overall, as both vaginal and Cesarean births were demonstrated to present traumas of differing types and levels of debilitation. However, a cohort study investigating the risk of fetal injury from Cesarean birth<sup>6</sup> determined the risk to be as low as 1.1%; though the incidence of cranial and brachial plexus injuries documented in the study were relatively common and of notable concern.

Conventional treatment methods used for infants with deformational plagiocephaly include head repositioning,

helmet therapy, botox injections into the sternocleidomastoid muscle, and surgery; helmet therapy being the most widely used approach.<sup>1</sup> A recent outcome analysis concluded that helmet therapy should be started between 4 and 9.1 months, and that the helmet should be worn for more than 20 hours per day for an average of 7.83 months or more. Based on the analysis of this study, these guidelines provided the most successful treatment outcomes for helmet therapy.<sup>1</sup>

Genereux and Alacantra<sup>7</sup> presented a case report of a 4-day-old with facial asymmetry attributed to birth trauma, and the “dramatic improvement” in appearance, and additional complaints following chiropractic care, which included Logan Basic Technique, cranial bone adjusting, Active Release Technique, and Diversified Technique. The parents were also given instructions on providing specific daily massages at home. They concluded that further research is warranted to determine the benefits of chiropractic intervention, following a dramatic improvement of facial asymmetry following chiropractic care, as well as resolution of other concomitant complaints.

Quezada<sup>8</sup> described the case of an 8-month-old boy diagnosed with cranial plagiocephaly, and developmental delays equivalent to a 3-month-old. Sacro-occipital,<sup>9</sup> Upledger<sup>10</sup> and modified Diversified techniques were administered in an attempt to remold the occipital bone, and reduce vertebral subluxation indicators. The mother was instructed on how to administer light cranial massage and inversion therapy (this involves inverting the child with caution). Though change in occipital shape was minimal, the infant rapidly progressed developmentally to meet his milestones, and additional complaints also diminished.

Gordon<sup>11</sup> presented a case report of a 2-week-old male child who presented for chiropractic care with facial asymmetry, right-sided positional plagiocephaly, right-sided brachial plexus neuropraxia, and right-sided facial nerve palsy. “Conservative management” utilizing chiropractic craniosacral techniques demonstrated a steady reduction in plagiocephaly and in improvement in facial symmetry, upper limb posture and movement. Soft tissue therapy was performed on the sternocleidomastoid, scalene and suboccipital muscles, and also mobilization to the right shoulder, wrist, and hand.

In a study presented by McWilliams and Gloar,<sup>12</sup> a 6-year-old female suffering congenital torticollis, left facial asymmetry and plagiocephaly demonstrated a rapid resolution of symptoms following chiropractic care, involving

spinal adjustments (Diversified Technique) only. The conclusions of the study recommended that additional studies be undertaken to assess whether their clinical observations could be replicated.

Studies presented by Doucet and Alacantra<sup>13</sup> and Guliani and Rubin<sup>14</sup> document the cases of pediatric patients achieving resolution of symptoms of deformational craniosynostosis, colic, GERD and developmental delays. In both cases, Diversified Technique, Logan Basic Technique, and cranial therapy were utilized during the course of care.

In this case report, restoration of normal cervical range of motion through spinal adjustments enabled the patient to move her head to the right and to neutral positions, contrary to the fully left rotation that had been present for the first 6 weeks of her life. Due to cranial bones still being mobile, soft and easily pliable at this age, return of normal head shape was achieved by the infant passively and actively moving through all ranges of cervical motion while sleeping and laying in a supine position. This allowed the ‘flattened’ left temporal and facial bones to develop a more convex shape, reducing the amount of visible deformation. While this corrected the obvious cosmetic abnormality, any long-term negative neural changes were possibly also avoided with the resolution of cranial asymmetry.

## Conclusion

Chiropractic analysis of newborns could be a tool in helping to eliminate further growth anomalies from the long-term effects of deformational plagiocephaly, facial asymmetry, torticollis<sup>15</sup> and other trauma sustained during the birth process. This case study demonstrates the effectiveness of chiropractic care for the resolution of deformational plagiocephaly, vertebral subluxation, and concomitant symptoms.<sup>16</sup> Other studies documented in this case report<sup>4,5,7,8,11,12,13,14</sup>, and a consensus report on best practice recommendations<sup>17</sup> demonstrate the effectiveness of chiropractic care as a low-risk and non-invasive alternative to traditional care for a number of different pediatric conditions. Further research is warranted to determine whether other children with similar complaints may also benefit from chiropractic intervention, and also to compare the resolution of symptoms of those that are treated with traditional medical interventions.

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# Is Infant Colic An Allergic Response to Cow's Milk? What Is The Evidence?

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## ABSTRACT

**Background:** Despite enormous effort spent in determining a cause for infant colic, the source of the problem still eludes researchers.

**Objective:** To review the published evidence to establish whether infant colic is due to an allergic reaction to cow's milk.

**Method:** A literature search was completed using Medline, Cochrane Clinical Review and a hand search from 1980 to March 2013. Publications were included if they were systematic reviews, RCTs with a control group, or specifically related to dietary interventions.

**Results:** The majority of studies had faults due to non-randomization, non-blinding, too few participants, skewed populations and inadequate follow-ups. There appeared to be some relief of crying with change in diet in several studies, but crying time was still considered longer than normal.

**Conclusion:** There is no clear evidence that infant colic is a form of cow's milk protein allergy (CMPA). Research trials have been contaminated with a subgroup of infants who have been diagnosed with colic who actually have CMPA. Future studies need to subgroup the irritable infant to better understand the etiology of colic.

**Keywords:** infant colic, allergy, soy, dairy and dietary interventions

## Introduction

Infant colic is the leading cause of patient visits to clinicians in the first six months of life with one in six families consulting from one to seven physicians in the first 16 weeks of life.<sup>1,2</sup> Infant colic is defined as excessive crying in an otherwise healthy infant, commonly linked to paroxysmal abdominal pains.<sup>3</sup> The classic Wessel definition is an infant crying more than 3 hours a day more than 3 days a week for more than 3 weeks.<sup>1,2</sup> No link to the specific source of infant nutrition, either breast milk or formula milks has been found.<sup>4</sup> However, several studies have given conflicting evidence as to the relationship between diet and infant colic. Three systematic reviews disagree as to the evidence-based role for hypoallergenic diet.<sup>5,6,7</sup> Other studies disagree as to whether or not the prevalence of colic is higher in infants with a family history of atopy or allergies.<sup>8,9</sup> However, recent management strategies have stated that crying may reduce with the elimination of cow's milk protein (CMP) in the infant who is afflicted with infant colic.<sup>10</sup> Considering the conflicting advice to clinicians and parents, this review aims to examine the evidence in order to answer the clinical question, "Is infant

colic an allergic response to cow's milk protein?"

Cow's milk protein allergy (CMPA) is the most common food allergic disease of infancy.<sup>11</sup> Symptoms of CMPA are shown in 5-15% of infants,<sup>12</sup> with a range of prevalence between 2 and 7.5%.<sup>12</sup> Infant colic is said to afflict 5-40% of infants with the most common prevalence of 21%.<sup>1-7</sup> Soy protein is the most common substitute for milk protein. It is not only another common infant allergen,<sup>13</sup> but it has been found to be a cross allergen with milk protein.<sup>14</sup> The ESPGHAN Committee has recommended that soy protein be withheld from infants showing signs of allergy/intolerance.<sup>13</sup>

## Methods

A literature search using the key words *infant colic*, *allergy* and *dietary interventions* was completed using Medline, Cochrane Clinical Review and a hand search from 1980 to March 2013. Publications were included if they were systematic reviews, RCTs with a control group, or specifically related to dietary interventions. Those which showed any positive results were included. In all, 142 articles were sourced with 14 meeting the criteria of the search. Other general articles were used to supply background to the study.

## Results

Characteristics and results of included trials are found in *Table 1*. Pertinent features of infant colic and pertinent

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Authors	Type of Study/Number Subjects/Intervention	Results/commentary
Campbell <sup>15</sup>	RCT/ 41 infants referred for study; 19 of 3-14 weeks of age (11 from atopic families) accepted; ½ given Soya Milk (Cow and Gate Formula S) and ½ given C&G Premium. Those not improving on either were given milk free of whole protein (Cow and Gate Peptalac) on unblinded basis	Crying decreased to 9 hours per week or less with soya formula/problems of study were non-random selection process (over ½ from atopic families), no blinding of CMP-free formula, age of entry into trial too old and admits bias of natural history reduction in crying; poor quality RCT which did not give method of randomisation
Estep and Kulczycki <sup>16,17</sup>	2 studies substituting Neocate, amino acid based infant formula v standard milk formula and breast milk, N=6 in each study	Reduction in total cry/fuss time 45% = 148 mins/sample size of 6 is too small to apply to a general population; non-blinding
Evans, et. al. <sup>19</sup>	RCT, infants 3-18 weeks of age, Elimination of cow's milk in breast feeding mother in cross-over trial	Elimination of cow's milk had no significant effect on colic, wide range of ages of infants may have biased natural history
Forsythe <sup>20</sup>	RCT/17 infants <8 weeks/4 days on CMF alternating twice with 4 days extensively hydrolysed formula	Resulted in increased crying on CMF and reduced crying on HIF, but this attenuated on second round. This is a small sample with reducing effect even within the trial time of 16 days; no known effect in longer term.
Hill, et.al. <sup>21</sup>	Comparison trial of effects of 2 maternal diet programs, i.e. a low-allergen diet that excluded major food allergens v control diet that included these foods (n=77). Bottle fed infants on modified CM formula (Enfalac) or hypoallergenic formula (Progestimil) (n=38)	25% reduction in crying time, not resolution of colic was used as outcome measure, but 2/3 infants still had colic by Wessel's definition at end of the 7 day trial/method of randomisation not discussed; unblinded trial may have created significant bias.
Lothe and Lindberg and Jakobsson <sup>22</sup>	Intervention/N=60 infants 2-12 weeks of age/32 given casein hydrolysate formula (Nutramigen) replaced CM infant formula	Crying time reported by parents reduced significantly after 5 days. Authors concluded that colicky infants turn into children afflicted with cow's milk protein allergy or intolerance.
Berseth, et al. <sup>24</sup>	Randomised double blind parallel group study/158 infants 1-8 weeks of age of parent-defined fussy or extremely fussy infants randomised to soy formula (SF) or partially hydrolysed formula (PHF) for 28 days	Results recorded on electronic diary including fussiness, gas, spit-up, crying time and bowel habits; no intention-to-treat analysis. Significant reductions in fussiness rating and crying times in both groups at 28 days, but crying time still >3 hours. True blinding may not have occurred due to recognisable odour. Natural history not taken into account in 28 day trial. Dropout of 28% (SF) and 18% (PHF) is high but acceptable.

**Table 1. Summary of studies investigating infant colic and cow's milk protein allergy**

features of CMPA are shown in *Table 2*. The NICE guidelines for infant colic are presented in *Table 3*.<sup>24</sup>

A study into whether cow's milk allergy was the etiology of infant colic was undertaken by Campbell in 1989. This study followed 19 formula-fed subjects out of 41 who were referred for severe colic<sup>15</sup> and randomised to soy formula (SF) or cow's milk formula (CMF). If crying did not decrease, the infant was given a highly hydrolyzed formula (HF). This was a small sample in a region which produced 650 newborns annually and there would logically

have been a potential sample of at least 175 infants who might have had colic during the time frame of the study. The small sample may have occurred because the inclusion criteria required "severe" colic. Those eliminated were due to the lack of severe symptoms. There was no evidence of randomisation. It seems likely that many of those in the study didn't, in fact, have colic, but may have had CMPA. In the final analysis, 13 infants (2% of total infant population) were identified as "colic" babies, a number not inconsistent with the number expected to experience CMPA. Eleven of those 13 had a positive family history of atopy and all had

Infant Colic	Cow's Milk Allergy
<ul style="list-style-type: none"> <li>• Excessive crying, more than 3 hours a day at least 3 days a week, more than 3 weeks</li> <li>• Crying is inconsolable and more prominent at end of day</li> <li>• Occurs in both breast and formula fed infants</li> <li>• Begins at 5-10 days of age</li> <li>• Flailing of arms</li> <li>• Pulling up legs</li> <li>• Apparent pain, pained facies</li> <li>• Healthy infant</li> <li>• Sleep is not affected</li> </ul>	<ul style="list-style-type: none"> <li>• Excessive crying, more than 3 hours a day at least 3 days a week, more than 3 weeks</li> <li>• Crying, wailing, irritability more prominent after feeds, but occurs throughout the day/night, with disrupted sleep</li> <li>• Occurs in both breast and formula fed infants</li> <li>• Can begin anytime, generally 4 weeks onward or within 1 week of receiving CMP</li> <li>• Frequent regurgitation, vomiting, food refusal</li> <li>• Diarrhoea or constipation (blood in stool)</li> <li>• Atopic dermatitis, eczema, urticaria, pruritis</li> <li>• One first degree relative with allergy/asthma</li> <li>• May have some or all GI, cutaneous, respiratory symptoms, which may be progressive over time</li> <li>• Failure to thrive</li> </ul>

**Table 2. Pertinent features of infant colic and cow's milk allergy.**

crying that was more extensive and more sporadic than usually defined as common colic, seeming to an observer that these children may have responded to a change in formula because they actually were afflicted with CMPA/soy sensitivity and not colic. That said, the study's results cannot be considered reliable because of the skewed, non-randomised sample, no blinding of the parents, the usage of a non-validated record sheet and sample size too small to trust conclusions along with no intention-to-treat analysis and a 41% drop out rate which allowed significant bias into the study.

Estep and Kulczycki reported two trials of six infants each; standard formula milk was replaced with hydrolysed formula for 4 days which resulted in a reduction in crying time by 45%<sup>16</sup> and mother's milk was replaced with hydrolysed formula also significantly reducing crying time.<sup>17</sup> Although the significant reduction in crying with change to a hydrolysed formula may at first seem clinically useful,

a sample of six is too small to generalize to the total population. Furthermore, the fact that there was no blinding and parents knew what formula they were receiving increases the reporting bias. The crying was reduced to a minimum of 148 minutes daily, which is 23% more than two hours, which is the crying time considered normal. Some authors agree that a minimum time period needed to evaluate a change in formula is 2-4 weeks<sup>18</sup> as a change in formula generally has some at least short-term effect.<sup>23</sup>

The only trial recruiting exclusively breast fed babies was Evans.<sup>19</sup> This trial eliminated cow's milk in the mother's diet. Information was not provided about whether the mothers restricted soy protein from their diet as well milk protein. Since soy is the most common substitute for milk protein, the mothers most likely ate soy instead dairy. The range of ages of 3-18 weeks did not rule out natural history of the condition; however, there was no significant reduction in crying with the maternal change in diet. If soy was the substitute, no change in crying would be expected from a change in diet.

Colic
<p>A baby who is crying excessively and inconsolably, most often during the evening, either drawing its knees up to its abdomen or arching its back, should be assessed for an underlying cause, including infant colic (urgent action).</p> <p>Assessment of excessive and inconsolable crying should include:</p> <ul style="list-style-type: none"> <li>• general health of the baby</li> <li>• antenatal and perinatal history</li> <li>• onset and length of crying</li> <li>• nature of the stools</li> <li>• feeding assessment</li> <li>• woman's diet if breastfeeding</li> <li>• family history of allergy</li> <li>• parent's response to the baby's crying</li> <li>• any factors which lessen or worsen the crying.</li> </ul> <p>Healthcare professionals should reassure parents of babies with colic that the baby is not rejecting them and that colic is usually a phase that will pass. Parents should be advised that holding the baby through the crying episode, and accessing peer support may be helpful.</p> <p>Use of hypoallergenic formula in bottle-fed babies should be considered for treating colic, but only under medical guidance.</p> <p>Dicycloverine (dicyclomine) should not be used in the treatment of colic due to side effects such as breathing difficulties and coma.</p>

**Table 3. NICE guidelines for infant colic<sup>25</sup>**

The Forsythe trial was the only one restricted to infants less than 8 weeks of age, addressing the critique of the natural history confounder.<sup>20</sup> This trial alternated cow's milk formula with hydrolysed formula (HF) on a rotation of 4 days, repeating it twice. There was less crying recorded on the HF days in the first course, which attenuated on the second. A trial of 17 infants is too small to generalise to the entire colic population and the reduced effect in the second round provides scant evidence of value in dietary change. Again, the time period to test a formula should be between 2 and 4 weeks.<sup>18</sup>

Hill solved some of these problems with a larger trial (n=77) including both breast fed and formula fed infants.<sup>21</sup> The results were reported as successful with a 25% reduction in crying time. Although this was significant, two-thirds of the infants were still technically described as having colic according to the Wessell criteria. The crying time, although improved, remained higher than 3 hours a day. The lack of blinding added bias and with a sample size of 15, the results are too small to generalize.

Lothe, Lindberg and Jakobsson randomised 60 infants to be given either CMF or SF.<sup>22</sup> There was no change in 53% of infants when given either, but they did have reduction in symptoms when given a HF (Nutrimagen). The authors maintained that CMP is a major cause of moderate or severe infant colic and that these same "colicky" children become allergic to cow's milk later, some at 6 or 12 months of age. Change in formula is known to produce a temporary positive effect<sup>23</sup> but there was no follow-up to determine if the positive results persisted. There was also no evidence of randomisation. This trial highlights the fact that neither milk protein nor soy protein were well tolerated by the infants in this study.

The Berseth study was unique and elegant in its use of parent-defined fussy or extremely fussy babies (without using the more common Wessels' definition of infant colic) and set out to randomise 200 infants replacing cow's milk formula with soy formula or partially hydrolysed formula (PHF) for 28 days.<sup>24</sup> Only 158 entered the trial and there was a dropout rate of 28% (SF) and 18% (PHF). Because of the unique scent of the two different formulas, blinding cannot be said to be held. All infants were rated significantly lower on the fussiness rating scale at the end of the trial; however, on average, most still cried more than 3 hours a day (the Wessel criteria), so crying, although reduced, was maintained at higher than average levels. The authors suggest that change in formula is an appropriate first line in addressing fussiness in babies.

The NICE guidelines were proposed for routine post-natal care for infants in the UK and suggest consideration of hypoallergenic formula under a doctor's guidance.<sup>25</sup>

## Discussion

Change in diet as a strategy in infant colic has a long history. This is probably because most authors who discuss infant colic maintain a connection to the digestive system, although the connection has never been proven.<sup>26</sup>

There is even a systematic review of dietary management of infant colic.<sup>27</sup> This review calls for a universal definition of infant colic to improve application of the evidence, which is now confusing. Other systematic reviews of therapeutic trials point out that there is some evidence to support a casein hydrolysate formula in some types of infant colic.<sup>5,7,28</sup> When taking into account the quality of the trials, there is no convincing effect on infant colic of dietary change including changing to soy, hydrolysed, lactose-free or fibre-rich formula. Improvement is not expected if dietary change is from one common allergen to another. Therefore trials which replace milk with soy or lactose-free milk are not appropriate.<sup>18,29</sup> Furthermore, the ESPGHAN committee on nutrition has recommended that soy protein formula should not be used in infants with signs of food allergy/intolerance during the first 6 months of life.<sup>13</sup>

Another weakness in the trials where breastfeeding mothers were instructed to adopt a milk protein-free diet is that they were not also instructed to avoid soy protein. The majority of dairy-free alternatives are soy products. Others have pointed out that although some help may be perceived by parents when changing formula,<sup>23</sup> some experts recommend a trial of at least 2-4 weeks of allergy free diet.<sup>18</sup> None of the trials evaluated tested a change in formula for a long enough interval to be able to fairly evaluate the results. Moravej et al. in 2010 recommended that the only children who are likely to benefit from a formula change are those with a positive skin prick test.<sup>30</sup>

Thus, there is little convincing evidence that infant colic is a form of cow's milk/soy protein allergy. Instead, it is likely that a subgroup of infants who have been diagnosed with colic, in fact, have CMPA. As symptoms develop and therapies do not work and the child does not outgrow colic, then the diagnosis becomes one of exclusion in those infants. In the small number of cases where change to a hypoallergenic formula has subdued symptoms, it is likely that the child's condition had been misdiagnosed as infant colic, and should have been diagnosed as CMPA.

However, the Berseth study does point out that in infants with inconsolable crying along with digestive difficulties, there may be a place for a formula which does not address an actual CMPA but a cow's milk intolerance.<sup>24</sup> This study found that two different types of formulas, soy and partially hydrolysed, neither of which would be appropriate for actual CMPA, resulted in less crying along with slight reductions in reported gas and spit-up. They concluded that crying with feeding difficulties should be treated with dietary changes, identifying another subset of the excessively crying infant population in addition to simple colic and more complex CMPA. However, the strength of the evidence is weak and it is known that any change in diet may bring about a temporary report of fewer symptoms.<sup>23</sup>

The prevalence of infant colic is most commonly estimated at 21% of all infants.<sup>1</sup> The incidence of CMPA is 2-7.5% in infants in developed countries.<sup>31</sup> It is likely that a proportion of infants who have been diagnosed with colic actually are afflicted with CMPA. Because of broad inclusion criteria of most studies, the latter group may not have been excluded from colic trials; in fact, by including "severe" excessive crying, those suffering from CMPA may have been preferentially admitted to these trials. This may account for the small, but clear response rate in some dietary trials. Deletion of CMP/soy protein from the diet specifically helps those with CMPA and cow's milk intolerance, but not the broader range of colicky babies. This may account for the inconsistent results, depending on the trial and its inclusion criteria.

In cow's milk protein allergy, the condition should be recognized and treated without delay; these infants should not be entered into colic trials. Meticulous inclusion and exclusion criteria are required in future trials. Infants who cry all day along with symptoms of CMPA (integumentary, respiratory,<sup>12</sup> allergic constipation,<sup>32</sup> failure to thrive,<sup>18</sup> along with those with family history of atopy<sup>9</sup>) should be excluded from studies on colic. Those who appear allergic should be offered a skin prick test,<sup>30</sup> a trial of hypoallergenic formula or removal of dairy/soy products from the mother's diet if baby is breast fed. In agreement with Hill, the breastfeeding mother should also consider eliminating the other most common allergens including nuts, eggs, fish and wheat.<sup>18</sup> Colicky infants without CMPA signs or symptoms should not be managed with hypoallergenic formulas.<sup>33,34</sup>

Regarding the answer to the research question, is infant colic an allergic response to cow's milk protein? According to the evidence, the answer is no. However, in a small

percentage of infants, allergy/sensitivity to cow's milk is likely one cause of excessive crying of infancy. Despite this, the aetiology of colic remains unknown and future studies should define inclusion/exclusion criteria strictly to exclude infants afflicted with CMPA and cow's milk protein intolerance from the studies. Any role for hydrolyzed or amino acid formula is likely to be in a small group of infants who are afflicted with CMPA. Until subgrouping is effectively done in primary care practices and research trials, it is unlikely that infant colic will be fully understood.

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# Chiropractic Management of a 14-Year-Old Ballet Dancer with Bilateral Hip Pain and Restriction

Lily Baigent

## ABSTRACT

**Introduction:** The objective of this case report is to discuss the clinical course of a 14-year-old female ballet dancer who sought chiropractic care for bilateral hip pain and restriction on use.

**Case Presentation:** The bilateral hip pain and restriction was insidious and provocative on activity. A concurrent secondary complaint was bilateral knee pain on flexion and weight bearing with intermittent crepitus in her right hip the end range of motion. She had not previously received chiropractic care but was seeking primarily pain relief and to enhance her performance.

**Intervention and Outcomes:** Chiropractic management including full spine and extremity adjusting of the lower kinetic chain was applied to various levels throughout the 10 visit course of care, with subjective and physical findings recorded. There was rapid and persistent improvement as the care progressed. Eventual cessation of bilateral hip pain and restriction and secondary bilateral knee pain resulted in success in the patient's care objective.

**Discussion:** Adolescent patients with sport or overuse injuries may benefit from chiropractic management to assist them in improving joint biomechanics that can resolve injury, improve performance as well as aid in improving postural distortions. Additional studies and clinical trials should be conducted to establish the role and mechanism of chiropractic in helping adolescents with analogous presentations to this.

**Key words:** chiropractic, bilateral hip pain, bilateral hip restriction, bilateral knee pain, adjustment, manipulation, adolescent, ballet dancer, overuse injury, sport, recreation

## Introduction

Hip injuries are a relatively uncommon adolescent athletic injury, which most commonly affect dancers, runners and soccer players. Bilateral hip pain and restriction can be due to a variety of conditions commonly osteochondrosis, degenerative joint disease, avascular necrosis, bursitis, pelvic or lumbar pathology, but in this case report, it was concurrent with spinal and lower kinetic chain subluxations and altered biomechanics.

Adolescent sport injuries in general continue to rise and almost one third of all injuries incurred in childhood are sports-related. 65-80% of ballet injuries are in the lower kinetic chain, with 10-17% of injuries occurring in the vertebral column. The etiology of common lower limb conditions included an incorrect turnout, soft tissue imbalances, reduced quadriceps performance, and inversion sprains. Spinal conditions were reported to result from hyperextension and hyperlordosis of the lumbar spine as well as psoas insufficiency syndrome.

## Case History

A 14-year-old female presented for chiropractic care wanting relief from her bilateral hip and knee pain and to

enhance performance in ballet.

The child's mother provided the following historical data. The child was born following an uncomplicated 42 week pregnancy, with natural birth aided by vacuum extraction. Additionally, and potentially related to the current complaint, the child had a sprained left ankle and blunt

**Subluxation** — A lesion or dysfunction in a joint or motion segment in which alignment, movement integrity and/or physiological function are altered, although contact between joint surfaces remains intact. It is essentially a functional entity, which may influence biomechanical and neural integrity. In addition, the term *Subluxation complex (vertebral)* may be used: A theoretical model and description of the motion segment dysfunction which incorporates the interaction of pathological changes in nerve, muscle, ligamentous, vascular and connective tissue.\*

**Adjustment** — The chiropractic adjustment shall be defined as a specific controlled directional thrust to restore joint mobility in a hypomobile joint or motion segment with the intent to improve or correct vertebral malposition or to improve its juxtaposition segmentally in relationship to its articular mates thus reducing or correcting the neuroforaminal/neural canal encroachment factors inherent in the chiropractic vertebral subluxation complex.\*\*

\* World Health Organization. *WHO Guidelines on Basic Training and Safety in Chiropractic*, Geneva, 2005.

\*\* adapted from the International Chiropractors Association, Policy Statements

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## Table 1: Key Definitions

force trauma fracture at the left 5th metatarsal at 8 years of age with no residual complications. She had been a ballet dancer since the age of 5, was currently practicing ballet approximately 12 hours per week and aspired to be in an international ballet company.

Her current chief complaint was bilateral hip pain and restriction, with sharp pain at the anterior aspect of her hips on full abduction and external rotation. It was of insidious onset, with the patient being unable to recall when it started exactly, but had noticed that her hips made a clunking sound on encontre motion.

Her secondary complaint was bilateral knee pain located deep within the joint, finding it painful when she bore weight with her knees flexed. There was no history of trauma to her knees. The pain also began insidiously and she noticed the knee pain concurrently with her bilateral hip pain. Resting appeared to palliate the knee pain, while increased activity levels, essentially ballet, provoked the pain. The patient described the pain as a deep ache, occasionally sharp on motion and rated 5-6/10. Pain scale of 0 being no pain, 10 being excruciating, unbearable pain. She also stated feeling tight and restricted in her lower back.

### Examination

The patient's vital signs were within normal limits. Radiographic examination revealed no underlying pathologies. A complete spinal examination was completed with the following results; C1 had decreased static palpation on left rotation at left transverse process in relation to left mastoid when combined with extension on end range, decreased motion palpation of left lateral mass on left lateral flexion combined with extension, edema at the left atlanto-occipital articulation, left levator scapular musculature hypertonic and contralateral sub-occipital musculature hypotonic, T8 had decreased static palpation when prone, decreased motion palpation on extension and right rotation, right paraspinal musculature hypertonic, edematous articulation and increased heat. L1 had decreased static palpation when prone and decreased motion palpation on extension, left rotation, left lateral flexion and left lumbar paraspinals hypertonic. The left ilium had decreased static palpation when prone, decreased motion palpation at left sacroiliac articulation on extension, flexion and bilateral lateral flexion, superior edema at posterior superior iliac spine and point tenderness, left gluteus medius and left quadratus lumborum hypertonic. Postural analysis revealed elevated mastoid on left, elevated shoulder on right and elevated pelvis (iliac crests) on left. Moderate anterior head carriage

with a decrease in the normal anterior to posterior curves of the spine (decreased cervical and lumbar lordosis and thoracic kyphosis) was also noted. Gait analysis revealed restricted pelvic nutation ambulating with external foot flare on the left. There was bilateral over pronation of the feet with decreased longitudinal arches. While standing erect a valgus knee stress was noted. All orthopedic tests performed were negative except a positive Standing Kemp's test bilaterally. Standing Kemp's involves the practitioner standing behind the patient, gently rotating unilaterally and extending the lower back with gentle support on the sacrum. This is performed bilaterally with a positive finding showing local pain, radicular pain or symptoms indicating possible facet irritation, facet syndrome or disc herniation. Neurological tests including cerebellum function were performed and within normal limits.

A lower extremity examination was completed. There was hypertonicity of the piriformis bilaterally, hypertonicity of the psoas bilaterally and hypotonicity bilaterally of vastus medialis. Passive and active range of motion produced pain at the end range of hip flexion. Orthopedic tests of hip, knee, and ankle were performed with all negative results except for a positive Pace test on the left. Pace test involves the seated patient resisting leg adduction against applied practitioner. A positive result is inability, pain or radicular symptoms indicating possible piriformis myospasm or syndrome.

### Chiropractic Management

When determining a care plan for the patient, several key factors were recognized that could be contributing to the patient's postural distortions and functional deficits. The care plan consisted of full spine adjusting and lower extremity adjusting with any additional functional advice when required. Orthotics were discussed with the patient due to her lower kinetic chain imbalances but upon discussion with her mother, it was decided not to utilize them at this point as this was a source of external influence. Subjective findings were noted at the commencement of each visit and physical findings and subsequently progress was monitored throughout the course of care.

Subjective findings relate to the patient's perception of functioning on that day, the physical findings showing the indicators used to indicate a subluxation at the discretion of the chiropractic intern. This subluxation indicators used integrated spinal cord tension exaggerated by leg checks, decreased static palpation and decreased motion palpation of the relevant articulation, edema at the articulation, point tenderness, change in muscular tonus that correlate

Visit 1 — 11/04/2011		
Subjective Findings:	Physical Findings:	Levels Adjusted:
Lower back feeling tight and restricted, decreased hip motion.	<p><b>C1</b> – Decreased static palpation on left rotation at left transverse process in relation to left mastoid when combined with extension on end range, decreased motion palpation of left lateral mass on left lateral flexion combined with extension, edema at the left atlanto-occipital articulation, left levator scapular musculature hypertonic, contralateral sub-occipital musculature hypotonic.</p> <p><b>T8</b> – Decreased static palpation when prone, decreased motion palpation on extension and right rotation, right paraspinal musculature hypertonic, edematous and increased heat.</p> <p><b>L1</b> – Decreased static palpation when prone, decreased motion palpation on extension, left rotation and left lateral flexion, left lumbar paraspinals hypertonic (possibly concomitant to left ilium).</p>	(C1, T8 and L1 patterning indicators until next assessment) Left ilium (due to strongest indicators)
Visit 2 — 14/04/2011		
Subjective Findings:	Physical Findings:	Levels Adjusted:
Lower back slightly stiffer after adjustment but after 24 hour period following adjustment noted improvement in range of motion, felt more free.	<p><b>C6</b> – Decreased motion palpation on extension, left rotation and left lateral flexion, left scalenus musculature hypertonic and edematous and point tenderness on spinous process contact and left lamina-pedicle junction contact.</p> <p><b>T8</b> – Decreased static palpation, decreased motion palpation on extension and right rotation, right paraspinal musculature hypertonic, edematous and increased heat.</p> <p><b>L1</b> – Decreased static palpation, left paraspinal musculature hypertonic.</p> <p><b>Left ilium</b> – Decreased static palpation when prone, decreased motion palpation at left sacroiliac articulation on hip extension, flexion and bilateral lateral flexion, left gluteus medius, left quadratus lumborum hypertonic.</p> <p><b>Musculature findings</b> – hypertonic bilateral piriformis, bilateral vastus medialis and left psoas major with positive jump sign and facial grimace on contact. (Jump sign is associated 'jump' in response to touch stimulus to pain or discomfort).</p> <p><b>Left ilium</b> – Decreased static palpation when prone, decreased motion palpation at left sacroiliac joint on hip extension, flexion and bilateral lateral flexion, superior left PSIS (posterior superior iliac spine) edema and point tenderness at left sacroiliac joint, left gluteus medius, left quadratus lumborum hypertonic.</p>	C6 T8 Left ilium <i>Soft Tissue Work:</i> Concentric muscle stretches prescribed for piriformis, psoas major and vastus medialis.
Visit 3 — 18/04/2011		
Subjective Findings:	Physical Findings:	Levels Adjusted:
Noted increased range of motion, feeling less restriction and less muscle tension.	<p><b>T8</b> – Decreased static palpation, decreased motion palpation on extension and right rotation, right paraspinal musculature hypertonic, edematous and increased heat.</p> <p><b>Left ilium</b> – Decreased static palpation when prone, decreased motion palpation on extension and flexion, left quadratus lumborum, left gluteus medius hypertonic.</p> <p><b>Bilateral calcaneus</b> – Decreased lateral to medial motion palpation, Achilles tendon thickening bilaterally, callusing of superficial plantar surface at posterior medial surface, positive Helbing's sign bilaterally. (Helbing's sign assesses contour of Achilles tendon with a positive result being a medial contour indicating overpronation).</p>	T8 Left ilium <i>Extremity Adjusted:</i> Bilateral calcaneus

Table 2: Chiropractic Management Notes

Visit 4 — 20/04/2011		
Subjective Findings:	Physical Findings:	Levels Adjusted:
Hips have no pain, increased range of motion, no pain at endrange, noted no clunking.	<b>L1</b> – Decreased static palpation and left paraspinal musculature hypertonic. <b>Musculature findings</b> – hypertonic piriformis bilaterally.	No levels with sufficient indicators to adjust. <i>Soft Tissue Work:</i> Isometric contraction of bilateral psoas major muscle.
Visit 5 — 28/04/2011		
Subjective Findings:	Physical Findings:	Levels Adjusted:
Slightly stiff thoracolumbar spine.	<b>T8</b> – Decreased static palpation, decreased motion palpation on extension and right rotation, right paraspinal musculature hypertonic, edematous and increased heat. <b>Left ilium</b> – Decreased static palpation when prone, decreased motion palpation on extension and flexion, left quadratus lumborum and left gluteus medius hypertonic. Whilst supine, left ASIS (anterior superior iliac spine) palpated elevated relative to contralateral ilium, patient's positional bias on table was accommodated for. <b>Right talus</b> – Decreased motion palpation on dorsiflexion and plantar flexion of foot as well as abduction and adduction, increased edematous tissue overlying.	T8 Left ilium (with rotational component addressed) <i>Extremity Adjusted:</i> Right talus
Visit 6 — 09/05/2011		
Subjective Findings:	Physical Findings:	Levels Adjusted:
Mild stiffness in thoracolumbar spine.	<b>C1</b> – Decreased static palpation on left rotation at left transverse process in relation to left mastoid when combined with extension on end range, decreased motion palpation of left lateral mass on left lateral flexion combined with extension, left levator scapular musculature hypertonic, contralateral sub-occipital musculature hypotonic. <b>T8</b> – Decreased static palpation, decreased motion palpation on extension and right rotation, right paraspinal musculature hypertonic and edematous. <b>L1</b> – Decreased static palpation, decreased muscle palpation on extension, left rotation and left lateral flexion, left paraspinal musculature hypertonic. <b>Left ilium</b> – Decreased static palpation when prone, decreased motion palpation on extension and flexion, left quadratus lumborum, left gluteus medius hypertonic.	L1 Left ilium
Visit 7 — 30/05/2011		
Subjective Findings:	Physical Findings:	Levels Adjusted:
Experiencing pain in bilateral shins.  <b>NOTE:</b> Care plan reduced to 1 visit per month for maintenance and wellness due to decreased subjective findings in relation to initial presentation and decrease in subluxation indicators.	<b>T8</b> – Decreased static palpation, decreased motion palpation on extension and right rotation, right paraspinal musculature hypertonic and edematous. <b>L1</b> – Decreased static palpation, decreased muscle palpation on extension, left paraspinal musculature hypertonic. <b>Right ilium</b> – On static palpation while prone has point tenderness at right sacroiliac articulation.	T8 <i>Home Advice:</i> Alternate heat and ice on anterior shins, rest from activity.

Table 2: Chiropractic Management Notes (continued)

Visit 8 — 06/07/2011		
Subjective Findings:	Physical Findings:	Levels Adjusted:
Noted hips have improved range of motion and no pain, knee's decreased pain.	<p><b>T1</b> – Decreased static palpation while prone, decreased motion palpation on extension, left rotation and left lateral flexion, point tenderness overlying spinous process, left paraspinal musculature edematous and increased heat.</p> <p><b>T8</b> – Decreased static palpation, decreased motion palpation on extension and right rotation, right paraspinal musculature hypertonic and edematous.</p> <p><b>L1</b> – Decreased static palpation, decreased muscle palpation on extension and left paraspinal musculature hypertonic.</p> <p><b>Right ilium</b> – On static palpation while prone has point tenderness at right sacroiliac articulation.</p> <p><b>Left ilium</b> – Decreased static palpation when prone, decreased motion palpation on extension and flexion, left quadratus lumborum, left gluteus medius hypertonic.</p>	T1 T8 Left ilium
Visit 9 — 05/10/2011		
Subjective Findings:	Physical Findings:	Levels Adjusted:
Hips feeling slightly unbalanced, noticed slight clunking again.	<p><b>C1</b> – Decreased static palpation on left rotation at left transverse process in relation to left mastoid when combined with extension on end range, decreased motion palpation of left lateral mass on left lateral flexion combined with extension, left levator scapular musculature hypertonic, contralateral sub-occipital musculature hypotonic.</p> <p><b>T8</b> – Decreased static palpation, decreased motion palpation on extension and right rotation, right paraspinal musculature hypertonic.</p> <p><b>Left ilium</b> – Decreased static palpation when prone, decreased motion palpation on extension and flexion, edema at superior left PSIS.</p>	Left C1 T8 Left ilium
Visit 10 — 02/11/2011		
Subjective Findings:	Physical Findings:	Levels Adjusted:
Hips have no pain, increased motion, no pain at endrange, no clunking.	<p><b>C1</b> – Decreased static palpation on left rotation at left transverse process in relation to left mastoid when combined with extension on end range, decreased motion palpation of left lateral mass on left lateral flexion combined with extension, left levator scapular musculature hypertonic and contralateral sub-occipital musculature hypotonic.</p> <p><b>T8</b> – Decreased static palpation, decreased motion palpation on extension and right rotation, right paraspinal musculature hypertonic.</p> <p><b>Left sacrum</b> – Decreased static palpation while prone, decreased extension while prone comparatively to contralateral sacroiliac articulation, decreased motion palpation on bilateral lateral flexion, left sacral edema along left lateral sacral border, point tenderness at S2 tubercle and laterally to the left.</p> <p><b>Left calcaneus</b> – Decreased lateral to medial motion palpation, Archilles tendon thickening bilaterally, callusing if superficial plantar surface at posterior medial surface, positive Helbing's sign on left.</p> <p><b>Right talus</b> – Decreased motion palpation on dorsiflexion and plantar flexion of foot as well as abduction and adduction, increased edematous tissue overlying.</p>	Left C1 (Toggle) T8 (Drop Assist) <i>Extremity Adjusted:</i> Left calcaneus Right talus
NOTE: Physical findings and levels adjusted were addressed under full spine Gonstead protocol and extremity adjustments under x-drop assist. Any alternative to this has been noted in parenthesis.		

Table 2: Chiropractic Management Notes (continued)

to relevant subluxation findings; either hypertonic or hypotonic relative to normal resting state contractility ability and increase or decrease of heat of overlying tissue of the articulation.

*Table 2* outlines the subjective and physical findings with subsequent adjustments throughout the course of care over 10 visits.

### Outcome

Throughout the course of 10 visits, there was rapid and enduring improvement as care progressed. There was eventual cessation of bilateral hip pain and restriction and bilateral knee pain resulting in success for the patient's care objectives. She was able to return to peak performance without pain or restriction after 10 visits. The functional deficits found on the initial examination improved and noticeably the left foot flare reduced as well as the subluxation indicators that were seen at the initial presentation at C1, T8, L1 and left ilium as described in *Table 2*. Postural examination revealed marked improvement of the anterior head carriage and progress towards regaining the cervical lordosis. Gait had somewhat normalized with slightly less bilateral overpronation. Standing Kemps and Pace orthopedic tests were performed and resulted negatively bilaterally. There was no pain on endrange of flexion of the hip.

The patient also stated her secondary complaints had predominantly alleviated and stated she felt less stiffness in her low back.

No adverse events were reported throughout the case management.

### Method

An online literature search was conducted, using scientific journal databases Google Scholar, Index to Chiropractic Literature, PubMed, ChiroACCESS and Elsevier. Search key words and phrases included 'bilateral hip pain+chiropractic', 'bilateral hip restriction+chiropractic', 'bilateral knee pain+chiropractic', 'bilateral hip pain restriction+manipulation', 'bilateral hip pain restriction+adjustment', 'bilateral hip pain restriction+adolescent', 'ballet dancer+chiropractic', 'overuse injury adolescent+chiropractic', 'sport/recreation adolescent+chiropractic'. Other internet searches using the above terms were also conducted. The outcome of the literature search revealed no other case studies with parallel variables and factors. However other case studies have reported varying success as well as complete resolution of bilateral hip

pain through non-surgical, conservative measures, despite the bilateral pain being from other pathologies, not altered biomechanics congruent with this report.

### Discussion

Repetitive physical activity can overload an athlete's musculoskeletal system and continuously result in musculature imbalances and postural distortions. Repeatedly, injuries are a result of biomechanical deficits removed from the specific site of injury. Chiropractic management evaluates the kinetic chain and considers factors which may be involved to remedy any functional deficits. This is the basis for successful results, demonstrated in this case report.

Bilateral overpronation, as evident in the initial presentation, can have a global affect on the body and be causative for the postural alterations that were noted, also influencing the pelvic and hip functionality causing the pain and restriction. Correction of the bilateral overpronation in conjunction with lower extremity functional deficits are important in being able to release the tension of the various muscles involved. These were addressed through adjusting spinal and extremity subluxations, namely bilateral lateral calcaneus with potentially compensatory right talus and ilium subluxations throughout the care plan evident in *Table 2*. Bilateral overpronation is a complex that lends itself to continual adaptations up the body's entire kinetic chain.

No adverse events were reported throughout the plan and the patient also was under no other forms of intervention or care. Orthotics were discussed with the patient due to her lower kinetic chain imbalances but with her mother's guidance, it was decided not to utilize them at this point. This decision was also based on the grounds of being a potential external factor that could regress or progress the results and not be a true indicator of the chiropractic care.

After 8 visits, the care frequency was dropped to one visit per month as seen in *Table 2* for maintenance and wellness. The patient and her mother had noted the success in care and wanted to continue with improved function and overall enhanced posture, after the presenting symptoms ceased under this care plan.

There are anatomical differences between the male and female, and this is highlighted at adolescents while puberty is progressing. Anatomical hormonal and functional differences should be understood when treating female patients. Females have a greater Q angle than males which means

there can be different biomechanical stresses placed on their hips when engaging in sport, especially high frequency and level at a young age. Despite this, exercise and sports participation should be promoted in girls and adolescents for health benefits and enjoyment. The results of this case report reveal improvement but these differences need to be taken into consideration if this case report is used for comparison to the presentation of a male patient or a girl of a pre-adolescent age.

There were originally some musculature findings present, including the hypertonic piriformis, psoas and hypotonic vastus medialis. Although these muscles originate and insert directly onto the appendicular and axial skeleton which is the contact points for chiropractic specific adjustments, there was also home advice for muscle stretching and soft tissue work done to the patient on visit 2, 4 and 7. This is a point of contention whether these ancillary physical therapy methods being incorporated in this chiropractic management can be the source of resolution, as opposed to strictly adjustments. The argument presents that it could be attributed to the 'muscle stretching' physical therapy modalities that the patient's presentation cleared up. Conversely however it is noted that improvement of symptoms begins before the soft tissue work was introduced (noted by the patient as increased range of motion or "freedom" after the first adjustment). The author also did not find any supporting literature that muscle stretching or any physical therapy technique results in cessation of pain and restriction in bilateral hips of an adolescent athlete, despite it being a narrow and unlikely topic.

## Conclusion

Specific adjustments delivered to the 14-year-old's spinal segments was able to reduce her pain and restriction which enabled her to perform at peak level without pain or restriction in either hips. It also aided in correcting her postural imbalances.

Restoring a young athlete to full participation has a significant influence on both their mental and physical health. It is prudent to exhaust all conservative measures before considering more invasive measures. No reports were found in medical literature documenting such rapid

and dramatic improvement in the status of a patient with corresponding clinical features. Therefore additional studies and clinical trials should be conducted to establish the role and mechanism of chiropractic in helping adolescents with this presentation. Evidence based research is a pivotal step for the chiropractic profession and larger sample sizes and eventually randomised controlled trials can provide the path for this. This is a founding case report, with room for many to follow with increased sample sizes, controlled variables and optimal validity.

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# The Benefits of Chiropractic Care on the Infant with Idiopathic Central Sleep Apnea: A Case Report

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## ABSTRACT

**Objective:** The purpose of this case report is to describe the chiropractic management of an infant with the clinical presentation of Central Sleep Apnea.

**Clinical Features:** A five-month-old male with a history of respiratory distress following sleeping intervals which began at 10 weeks of age. The diagnosis of central sleep apnea was given at approximately 3 months of age based on the readings of an apnea monitor. The patient was managed with 50 mg QD caffeine citrate and 15mg QD Prevacid. After five months of chiropractic care, the patient's parents noted the bradycardia alarm sounded every night at the same time. The neurologist, working under the suspicion of a mitochondrial disorder, planned to schedule a muscle biopsy and genetic testing. After discussion with the pharmacist, the mother hypothesized that the bradycardia events were due to the caffeine. As the baby matured, his metabolism was utilizing the caffeine more rapidly, causing the drop in heart rate. Once the child was weaned off the caffeine citrate, but still on the Prevacid, the bradycardia events subsided. The apnea events did not resolve, but diminished and rarely set off the alarm.

**Intervention and Outcome:** Chiropractic treatment plan consisted of gentle upper cervical adjustments and craniosacral therapy administered 12 times over a 6 month period. The results demonstrated a decrease or complete elimination of the total amount of apneic and bradycardic events recorded on the monitor. This case report is designed to explore whether chiropractic care might benefit an infant with idiopathic central sleep apnea and demonstrates a multidisciplinary approach to care which may prevent errors in diagnosis and treatment as a patient heals.

**Conclusion:** This case report suggests that chiropractic care including craniosacral therapy may provide a complement to traditional treatment options. It is difficult to objectively assess the contribution of chiropractic care based on the number of interventions performed that prepared the child for healing to the point of no longer needing a caffeine citrate prescription. But this case suggests that further study into the benefits of chiropractic care on central sleep apnea disorders is warranted.

**Key words:** chiropractic, sleep apnea, idiopathic central sleep apnea, central sleep apnea, adjustment, manipulation, craniosacral, cranial nerve x, caffeine, medulla oblongata

## Introduction

Central sleep apnea is a term including a group of sleep-related breathing disorders where respiration is diminished or absent during the sleep cycle. Typically seen with other underlying medical conditions, primary central sleep apnea is rare with a poorly understood etiology. A central apneic event is defined as a cessation of airflow for 10 seconds or longer without respiratory effort.<sup>1</sup> Primary sleep apnea, as defined in this case report, affects primarily premature newborns.<sup>1</sup> Central Hypoventilation Syndrome is defined as a very severe condition of abnormally low breathing during sleep is rare and is an inborn condition that involves a specific gene, PHOX2B.<sup>1</sup> Obstructive Sleep apnea involves a physical blockage of the airways.<sup>1</sup> These do not represent the patient in this report. Idiopathic Central Sleep Apnea

(ICSA) is defined as an uncommon type of central sleep apnea which cause is unknown but results in repeated pauses in breathing effort and airflow.<sup>1</sup> This definition will be used in this report as all medical testing produced no explanation to the patient's condition.<sup>1</sup>

Central Sleep Apnea accounts for only 5% of all apnea cases and in the United States this is less than 1%.<sup>2</sup> It is typically reported in heart failure or stroke patients.<sup>2</sup> The general population prevalence of ICSA is not known, it is more commonly reported in the older patient population. Within a sleep center population pervasiveness was reported to be 4%-7% and 17% within the apneic population.<sup>3</sup> Mortality and morbidity associated with idiopathic central sleep apnea without an underlying primary diagnosis remains unknown.<sup>4</sup> Nor is there data on racial distribution.<sup>4</sup> To date, there is very little research information available on central sleep apnea and infants.<sup>3</sup>

The financial toll for an infant diagnosed with ISCA is large,<sup>5</sup> but insignificant compared to the emotional stress on the caretakers of these infants. The constant fear that the monitor may fail to rouse the infant combined with

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lack of sleep or down time for the parent's trying to care for other children, work and run a household can lead to a significant strain on the caregiver.

### Case Report

A 5-month-old male presented to a chiropractic physician specializing in treating children, by referral from another chiropractor with a chief complaint of sleep apnea in which the child had a cessation of breathing at night and during daytime naps. The parents noticed this issue 3/20/2011, just shy of the child being 2 ½ months old.

Following a "normal" pregnancy with only some mild pre-term labor at 28 weeks, the patient was born at home by midwife with APGAR scores of 7, 8. At the time of the birth the mother developed a severe upper respiratory infection, which the child contracted from day 6 to day 15 sustaining fevers of 101+ degrees Fahrenheit for 1-2 days. Infant was treated with herbs and homeopathic remedies self-prescribed by the mother and recovered well. At 10 weeks, he woke from an evening nap in respiratory distress and was monitored until Emergency Medical Services was called 6 hours later when the child became unresponsive at which time the child was observed to have a low oxygen saturation of 70 milligrams per litre and a heart rate of 34 beats per minute. He remained unconscious for 45 minutes. He was given 2 breathing treatments of albuterol and diagnosed with viral bronchiolitis. Follow up with the treating pediatrician led to a prescription of albuterol via a nebulizer to be given as needed.

One week later, he awoke at 5:30am in respiratory distress following a 4:30 feeding and breathing treatment. At three months the patient was prescribed an apnea monitor and scheduled to see a pediatric neurologist. It was concluded that his neurology exam was normal. The first download of the apnea monitor registered 68 apneic episodes and the child was referred to University of North Carolina, Chapel Hill Children' Hospital where neurology, cardiology, and pulmonology conferred. See *Table 1*.

Prevacid was increased to 15mg/night. At 5 months of age the infant was released from care by his neurologist as the neurologist had no further neurologic concerns. The pediatric cardiologist prescribed a halter monitor for 48 hours and as a result, concluded heart function normal and released him from care. The pulmonologist referred the patient to a sleep specialist at Duke University where the focus of care was on reflux and vagal nerve issues.

The child's history also included several chiropractic

adjustments at another clinic that resulted in 2/3's reduction in apnea episodes when a second sleep study was performed. The patient's parents believed there could have been a correlation between the chiropractic adjustments and a significant decrease in apnea episodes. The parents chose to delay a gastric emptying study and 3rd sleep study to pursue further chiropractic care with this author.

Chiropractic physical examination on the 5-month-old male patient noted normal vital signs and no abnormalities of the skin, face, head, neck, eyes, ears, mouth, upper or lower extremities or torso. Primitive and deep tendon reflexes were normal. Palpation revealed an extension posteriority at the 2nd sacral spinous and a right posterior arch of atlas due to rotation. A gentle adjustment with fingertip touch was given at the listings of L occiput, R atlas, L axis, Posterior-T5, Posterior-T8 and Posterior-S2. Home tractioning of the cervical spine was taught to the parents to be done at home 3 times daily. *Table 2* shows care plan and results.

*Figure 1* demonstrates the decrease of apnea after each adjustment. When the monitor's computer memory is full, the data gathered is converted in a download of information to scale apneas by duration and frequency. Note that the dates of download get further apart as treatment continues.

Tests performed	Results
Sleep study	143 apneas, 3 obstructive, 140 central
EEG	Normal
Chest X-ray	Normal
EKG	Normal
3D Heart Echocardiogram	Normal
Genetic Screening	Normal
Prescriptions given	<ul style="list-style-type: none"> <li>• <b>Caffeine Citrate</b> (125mg) [patient had negative reactions with tachycardia, screaming, dilated pupils and semi-responsiveness] Dosage was dropped to 50mg.</li> <li>• <b>Prevacid</b> (7.5mg)</li> </ul>

**Table 1: Summary of tests and prescriptions given to child**

Date	Care Rendered	Observations at time of Care
6/24/11	Adjustment, home cervical traction recommended	Constipation improved and no apnea alarms
6/28/11	Adjustment, tenderness noted R atlas,	Constipation returns, but no alarms
7/5/11	Adjustment, atlas still tender, parents did not traction	Good bowel movements, one alarm
7/12/11	Adjustment, occipital traction	Apneas began 2 ½ weeks after last adjustment, no more constipation issue
8/3/11	Adjustment	Noted alarms following mother's gluten intake with cervical lymph swelling
8/17/11	Adjustment, dietary changes eliminating gluten	Apneas have improved, fluid in left ear; pt has stopped gaining weight and height.
8/26/11	Adjustment; medication discussion	Still apneas, but now more bradycardia attacks. Scheduled sleep study
9/14/11	Adjustment; request consult with pharmacist	Apneas still better but bradycardia alarms increasing
9/19/11	Adjustment; cranials	Parents begin weaning off caffeine, growth has started, mother stops casein
10/26/11	Adjustment; cranials	Increased bradycardias with infection and fever, still coming off caffeine
11/9/11	Adjustment	Pt has up and downs with bradycardias and apneas as caffeine dumps, increased reflux
12/5/11	Adjustment	Refer back to referring DC for convenience of parents

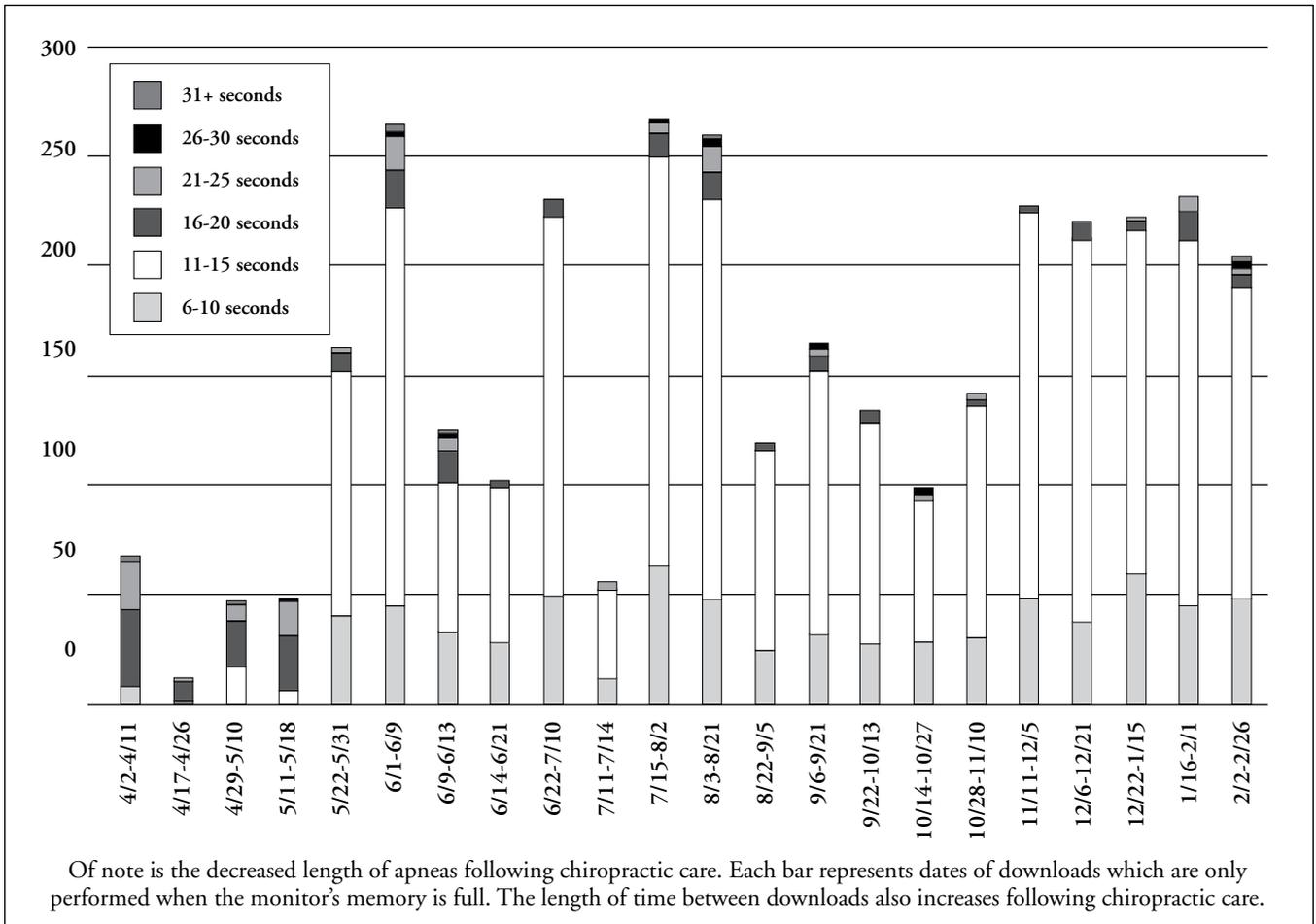
**Table 2: Summary of chiropractic care received**

Of significance on the chart was the discussion to decrease the amount of caffeine the child had been receiving. The mother noted to the chiropractor that the bradycardia events occurred 1 ½ hours after receiving his dosage consistently. After discussion with the compounding pharmacist, the mother hypothesized that the dosage half-life was the cause of the bradycardia events. The changing needs of the child may be reflected in the increased metabolism of caffeine as the child matures. At 1 to 2 ½ months the metabolism or “half-life” of an infant is 26 hours; 14 hours at 3 to 4 ½ months of age; and by 5 to 6 months it is 2 ½ hours.<sup>6</sup> The mother reported that the prescribing neurologist did not wish to stop the caffeine, fearing the child's apnea would spike, on the one hand but at the same time it was unsafe to increase the dose of caffeine citrate enough to make it last 14 hours again, nor was there a time-release version of caffeine citrate available. Increasing the dosage or frequency of caffeine was not safe for the child because

the height and weight of the patient had not changed in over three months, manifesting the side effect of stunted growth. The mother reported that the neurologist did not have an alternative treatment plan and did not approve of the mother's instinct to take the child off the caffeine citrate. The parents educated themselves and weaned the child off of the caffeine citrate. At the end of care, the patient was very stable, improving, weaned off caffeine, and still taking the Prevacid 15mg QD. At the request of the parents, the child was returned to the care of the original family chiropractor.

**Discussion**

The Dentate Ligament Hypothesis proposed by Dr. John Grostic suggests the upper cervical spine has a unique relationship with the spinal cord through the dentate ligament.<sup>7</sup> Building upon the idea of this theory, it is possible that chiropractic care may have a direct influence on the



**Figure 1: Chart of apnea compilations**

vagus nerve through adjustments to the cervical spine. Misalignments or subluxations of the upper cervical spine may compress or distort the dentate ligament leading to stress on the cord or a direct mechanical irritation resulting in venous occlusion and anoxia of areas of the upper cord.<sup>8</sup> Furthermore, building further upon this theory, the influence of the atlas is worthy of consideration. The authors also wonder if torsioning of C1 may have a direct impact on the spinal cerebellar tracts possibly causing a sustained sympathetic reaction through high gate facilitation. The sympathetic nervous system is known mostly as “fight or flight” but it also serves as part of the “ergothrophic function”, adjusting circulatory, metabolic and visceral activity based on musculoskeletal demands.<sup>13</sup> It must also be pointed out, as the parasympathetics work as an antagonist to the sympathetics, their depression would inhibit digestion and respiration, creating a disruption and pathological reaction in tissue and organ response. As the brainstem has a more inferior setting in the foramen magnum in infants, anoxia could theoretically have more of an impact on the brainstem

and its corresponding cranial nerves in infants.<sup>8</sup>

Normal ventilation is achieved by a feedback loop involving the central and peripheral chemoreceptors, intrapulmonary vagal receptors, brain stem respiratory centers, and respiratory musculature.<sup>9</sup> During sleep cycles, behavioral control is diminished and chemical control takes over, most often seen in the non-rapid eye movement (NREM) sleep.<sup>10</sup> Traditionally caused by either ventilatory instability or a depression of brain stem function, infantile primary sleep apnea cannot be determined in most cases. The central respiratory drive is absent resulting in the brain not responding to differentiation of blood gases.<sup>11</sup>

Respiratory neurons are concentrated in three medullary regions: pneumotaxis center, ventrolateral nucleus tractus solitaries, and ventral respiratory group.<sup>12</sup> Each work together to generate and control breathing, rapidly adapting to body requirements. Alterations or malfunctions in any of these centers can result in sudden death, seizures, poor growth patterns, and with long term apnea,

metabolic acidosis may result.

It is conceivable that adjusting the upper cervical spine may improve vagal function, sympathetic reaction, parasympathetic stimulation; respiration, heart rate, and GI operation. Furthermore, the hypothesis of resolution of vagal function with chiropractic care may explain the improvement in respiration (ICSA), heart rate (bradycardia), and GI operation (reflux) experienced by the patient. This needs further investigation.

It is important to note that this case included efforts, coordinated by the parents, of the treating chiropractor, the neurologist, the pulmonologist, and cardiologist for the care of this infant. It is unclear why the child no longer needed the caffeine citrate and the hesitation on the part of the neurologist is understandable given the life threatening nature of idiopathic central sleep apnea in infants. It is possible that chiropractic care had a positive effect upon the patient's symptoms decreasing his need for medication. It is also possible that the change was due simply to maturation of the patient's nervous system. In either case, the caffeine citrate, while helpful and useful upon initial management of the case, may have been no longer needed as the child grew older, and perhaps, could have been causing harm.

If the parent's hypothesis of no longer needing the caffeine citrate had been incorrect, in fact, placing the child's life in danger or if the child continued to suffer from ICSA, the consequences of their actions could have been dire. This did not prove to be the case. But these consequences are ones that all physicians weaning patients off of medications should consider, discuss with parents and remain vigilant for any change or exacerbation in symptoms initiating referral immediately.

It is encouraging to see the potential for teamwork of this nature in the care of a child. If the physicians had more direct contact with each other, as in an interdisciplinary healthcare setting, this may have been less frustrating for the parents.

### Conclusion

The benefits of improving nervous function at the brain stem and peripheral nerves may help the respiratory centers fire appropriately. Also, monitoring prescription medications and reactions can lead to an increased ability to adapt to changing needs of the patient. A healthcare

provider with an alternative perspective can sometimes offer to be a sounding board for patients to think through their options and gain understanding of current procedures for a more positive prognosis. Chiropractors often offer more time and/or increased frequency of visits with patients compared to their medical colleagues. These authors suggest this increased face to face time can lead to more complete gathering of current information and sharing of ideas, which could result in a superior collaborative care plan. Although further studies need to be performed demonstrating the benefits of chiropractic care and Idiopathic Central Sleep Apnea, this case demonstrates the value of chiropractic care in conjunction with medical care for these cases.

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# Abstracts of Interest

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**Pepino VC, Ribeiro JD, Ribeiro MA, de Noronha M, Mezzacappa MA, Schivinski CI. Manual therapy for childhood respiratory disease: a systematic review. *J Manipulative Physiol Ther.* 2013 Jan;36(1):57-65. doi: 10.1016/j.jmpt.2012.12.004.**

**OBJECTIVE:** This study reviewed the scientific evidence available on the effects of manipulative techniques on children with respiratory diseases. **METHOD:** Three databases (scielo, pedro, and medline) were searched for clinical trials on the effects of manual therapy techniques on children and adolescents with respiratory diseases. The relevant studies were chosen by 2 independent researchers who assessed their abstracts and selected the studies that met the criteria for a complete and structured review. **RESULTS:** Of the 1,147 relevant titles, 103 titles were selected for abstract assessment, and of these, 24 were selected for a full-text review. After critical analysis, 8 studies were included in the review and 16 were excluded for the following reasons: 1 covered only conventional therapy, 7 were not about the studied theme, and 8 included adults. Of the 8 studies included in the present review, 5 consisted of asthmatic children and the others of children with the following conditions: cystic fibrosis, bronchiolitis, recurrent respiratory infections, among others. Only 2 studies did not identify positive results with the use of manual therapy. The other 6 studies found some benefit, specifically in spirometric parameters, immunologic tests, anxiety questionnaire, or level of salivary cortisol. **CONCLUSION:** The use of manual techniques on children with respiratory diseases seems to be beneficial. Chiropractic, osteopathic medicine, and massage are the most common interventions. The lack of standardized procedures and limited variety of methods used evidenced the need for more studies on the subject.

Source: State University, São Paulo, Brazil

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**Miller JE, Newell D, Bolton JE. Efficacy of chiropractic manual therapy on infant colic: a pragmatic single-blind, randomized controlled trial. *J Manipulative Physiol Ther.* 2012 Oct;35(8):600-7. doi: 10.1016/j.jmpt.2012.09.010.**

**OBJECTIVE:** The purpose of this study was to determine the efficacy of chiropractic manual therapy for infants with unexplained crying behavior and if there was any effect of parental reporting bias. **METHODS:** Infants with unexplained persistent crying (infant colic) were recruited between October 2007 and November 2009 at a chiroprac-

tic teaching clinic in the united kingdom. Infants younger than 8 weeks were randomized to 1 of 3 groups: (i) infant treated, parent aware; (ii) infant treated, parent unaware; and (iii) infant not treated, parent unaware. The primary outcome was a daily crying diary completed by parents over a period of 10 days. Treatments were pragmatic, individualized to examination findings, and consisted of chiropractic manual therapy of the spine. Analysis of covariance was used to investigate differences between groups. **RESULTS:** One hundred four patients were randomized. In parents blinded to treatment allocation, using 2 or less hours of crying per day to determine a clinically significant improvement in crying time, the increased odds of improvement in treated infants compared with those not receiving treatment were statistically significant at day 8 (adjusted odds ratio [or], 8.1; 95% confidence interval [ci], 1.4-45.0) and at day 10 (adjusted or, 11.8; 95% ci, 2.1-68.3). The number needed to treat was 3. In contrast, the odds of improvement in treated infants were not significantly different in blinded compared with nonblinded parents (adjusted ors, 0.7 [95% ci, 0.2-2.0] and 0.5 [95% ci, 0.1-1.6] at days 8 and 10, respectively). **CONCLUSIONS:** In this study, chiropractic manual therapy improved crying behavior in infants with colic. The findings showed that knowledge of treatment by the parent did not appear to contribute to the observed treatment effects in this study. Thus, it is unlikely that observed treatment effect is due to bias on the part of the reporting parent.

Source: Anglo-European College of Chiropractic, Bournemouth, UK. Contact: [jmiller@aecc.ac.uk](mailto:jmiller@aecc.ac.uk)

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**Price BB, Amini SB, Kappeler K. Exercise in pregnancy: effect on fitness and obstetric outcomes — a randomized trial. *Med Sci Sports Exerc.* 2012, July 26.**

**OBJECTIVE:** A prospective randomized controlled trial was designed to assess the benefits and possible risks of aerobic exercise during pregnancy, using a fitness regimen based on the 2002 American College of Obstetricians and Gynecologists' guidelines for exercise during pregnancy. **METHODS:** Inactive women were randomized at 12-14 wk gestation to a group that remained sedentary or to a group that performed moderate aerobic exercise 45-60 min, 4 d-wk, through 36 wk gestation. Thirty-one subjects in each group completed the study. **RESULTS:** Compared with women who remained sedentary, active women improved aerobic fitness ( $p < 0.05$ ) and muscular strength ( $p < 0.01$ ), delivered comparable size infants with significantly fewer cesarean deliveries ( $p < 0.01$ ), and

recovered faster postpartum ( $p < 0.05$ ), at least related to the lower incidence of cesarean section. Active women developed no gestational hypertension ( $p = 0.16$  compared with controls) and reported no injuries related to the exercise regimen. In the active group, there was one premature birth at 33 wk by a woman with a history of premature delivery of twins at 34 wk. There were no differences between groups in the incidence of gestational diabetes, musculoskeletal pains during pregnancy, flexibility on sit-and-reach test, mean length of pregnancy, neonatal apgar scores, placenta weights, overall length of labor, weight gain during pregnancy, or weight retention postpartum. **CONCLUSION:** Previously sedentary women who began exercising at 12-14 wk improved fitness and delivery outcomes.

Source: Professional Association, Austin, TX, USA. Contact: [beeprice@grandecom.net](mailto:beeprice@grandecom.net)

**Stuge B, Sætre K, Ingeborg Hoff B. The automatic pelvic floor muscle response to the active straight leg raise in cases with pelvic girdle pain and matched controls. *Man Ther.* 2013 Jan 10. pii: S1356-689X(12)00270-6. doi: 10.1016/j.math.2012.12.004. [Epub ahead of print]**

**ABSTRACT:** The active straight leg raise (ASLR) test has been proposed as a clinical test for the assessment of pelvic girdle pain (PGP). Little is known about the activation of the pelvic floor muscles (PFM) during ASLR. The main aim of this study was to examine the automatic PFM contraction during ASLR. Specific aims were to compare automatic contraction to rest and to voluntary contraction, to compare PFM contraction during ASLR with and without compression and to examine whether there were any differences in PFM contraction between women with and without clinically diagnosed PGP during ASLR. Forty-nine pairs of women participated in a cross-sectional study with individual, one-to-one matched cases and controls. PFM was assessed by reliable and valid 3D ultrasound at rest, during voluntary and automatic contraction. Test-retest data for the levator hiatus during ASLR showed good repeatability. Significantly automatic PFM contractions occurred when ASLR tests were performed. There was a strong positive correlation between voluntary and automatic PFM contractions. Manual compression reduced the automatic PFM contraction during ASLR by 62-66%. There were no significant differences between cases and controls in reduction of levator hiatus or muscle length from rest to automatic contractions during ASLR. Interestingly, a significantly smaller levator hiatus was found in women with PGP than in controls, at rest, during an automatic contraction with ASLR and during voluntary

contraction. In conclusion, a significant automatic PFM contraction occurred during ASLR, both in cases and in controls. Women with PGP had a significantly smaller levator hiatus than controls.

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**Elton HA. Soy: The Detrimental Effects of a “Perfect Food”. Nutritional Perspectives: *Journal of the Council on Nutrition*; Oct 2012, Vol. 35 Issue 4, p 33.**

This report is an overview of the facts and research behind soybeans and their products. Soy has evolved from being an industrial product in the early 1900's to a “Perfect Food” in the 1990's and is now finding itself in the limelight of adverse reactions and negative publicity. The current research behind soy describes its detrimental effects on our bodies, our children's bodies and generations to come. Soy is not what it once was. It has been modified to a food product that is not safe to eat. Unfortunately, an overwhelming percentage of our population still considers soy a health food and is marketed as such. The continued consumption of modified soy and its products will likely have a lasting, negative effect on our health that may take generations to reverse.

**Danno K, Colas A, Masson JL, Bordet MF. Homeopathic treatment of migraine in children: results of a prospective, multicenter, observational study. *J Altern Complement Med.* 2013 Feb;19(2):119-23. doi: 10.1089/acm.2011.0821. Epub 2012 Sep 14.**

**OBJECTIVES:** The study objective was to evaluate the effectiveness of homeopathic medicines for the prevention and treatment of migraine in children. Design: this was an observational, prospective, open, nonrandomized, noncomparative, multicenter study. **SETTING/LOCATION:** The study was conducted in 12 countries worldwide. **SUBJECTS:** Fifty-nine (59) physicians trained in the prescription of homeopathic medicines and 168 children, aged 5-15 years, with definite or probable migraine diagnosed using international headache society 2004 criteria were the subjects in this study. **INTERVENTIONS:** Physicians were given complete freedom in terms of treatment prescription; thus, prescriptions were individualized for each patient. **OUTCOME MEASURES:** The frequency, intensity, and duration of migraine attacks in the 3 months prior to inclusion were compared with those during the 3-month follow-up period. Pertinent data were collected using questionnaires completed by the doctor and the patient or his/her parent/guardian. The secondary outcome

measure was the impact of homeopathic medicines on education, measured as absence from school. **RESULTS:** The frequency, severity, and duration of migraine attacks decreased significantly during the 3-month follow-up period (all  $p < 0.001$ ). Preventive treatment during this time consisted of homeopathic medicines in 98% of cases (mean=2.6 medicines/patient). Children spent significantly less time off school during follow-up than before inclusion (2.0 versus 5.5 days, respectively;  $p < 0.001$ ). The most common preventive medicines used were Ignatia amara (25%; mainly 9C), Lycopodium clavatum (22%), Natrum muriaticum (21%), Gelsemium (20%), and Pulsatilla (12%; mainly 15C). Homeopathy alone was used for the treatment of migraine attacks in 38% of cases. The most commonly used medicines were Belladonna (32%; mainly 9C), Ignatia amara (11%; mainly 15C), Iris versicolor (10%; mainly 9C), Kalium phosphoricum (10%; mainly 9C), and Gelsemium (9%; mainly 15C and 30C). **CONCLUSIONS:** The results of this study demonstrate the interest of homeopathic medicines for the prevention and treatment of migraine attacks in children. A significant decrease in the frequency, severity, and duration of migraine attacks was observed and, consequently, reduced absenteeism from school.

Source: Laboratoires Boiron, Sainte-Foy-lès-Lyon, France. Contact: [karine.danno@boiron.fr](mailto:karine.danno@boiron.fr)

**Fernández-Pérez AM, Peralta-Ramírez MI, Pilat A, Moreno-Lorenzo C, Villaverde-Gutiérrez C, Arroyo-Morales M. Can myofascial techniques modify immunological parameters? *J Altern Complement Med.* 2013 Jan;19(1):24-8. doi: 10.1089/acm.2011.0589. Epub 2012 Nov 23.**

**OBJECTIVES:** The objective was to determine the effect of myofascial techniques on the modulation of immunological variables. **DESIGN:** Thirty-nine healthy male volunteers were randomly assigned to an experimental or control group. **INTERVENTIONS:** The experimental group underwent three manual therapy modalities: suboccipital muscle release, so-called fourth intracranial ventricle compression, and deep cervical fascia release. The control group remained in a resting position for the same time period under the same environmental conditions. **OUTCOME MEASURES:** Changes in counts of cd3, cd4, cd8, cd19, and natural killer (nk) cells (as immunological markers) between baseline and 20 minutes post-intervention. **RESULTS:** Repeated-measures anova revealed a significant time  $\times$  groups interaction ( $f(1,35)=9.33$ ;  $p=0.004$ ) for cd19. There were no significant time  $\times$  group interaction effects on cd3, cd4, cd8, or nk cell counts. Intrasubject

analyses showed a higher cd19 count in the experimental group post-intervention versus baseline ( $t=-4.02$ ;  $p=0.001$ ), with no changes in the control group ( $t=0.526$ ;  $p=0.608$ ). **CONCLUSION:** A major immunological modulation, with an increased b lymphocyte count, was observed at 20 minutes after the application of craniocervical myofascial induction techniques.

Source: Department of Physiotherapy, School of Health Sciences, University of Granada, Spain. Contact: [fernandez@ugr.es](mailto:fernandez@ugr.es)

**Mugambi MN, Musekiwa A, Lombard M, Young T, Blaauw R. Synbiotics, probiotics or prebiotics in infant formula for full term infants: a systematic review. *Nutr J.* 2012 Oct 4;11:81. doi: 10.1186/1475-2891-11-81.**

**BACKGROUND:** Synbiotics, probiotics or prebiotics are being added to infant formula to promote growth and development in infants. Previous reviews (2007 to 2011) on term infants given probiotics or prebiotics focused on prevention of allergic disease and food hypersensitivity. This review focused on growth and clinical outcomes in term infants fed only infant formula containing synbiotics, probiotics or prebiotics. **METHODS:** Cochrane methodology was followed using randomized controlled trials (rcts) which compared term infant formula containing probiotics, prebiotics or synbiotics to conventional infant formula with/without placebo among healthy full term infants. The mean difference (md) and corresponding 95% confidence intervals (ci) were reported for continuous outcomes, risk ratio (rr) and corresponding 95% ci for dichotomous outcomes. Where appropriate, meta-analysis was performed; heterogeneity was explored using subgroup and sensitivity analyses. If studies were too diverse a narrative synthesis was provided. **RESULTS:** three synbiotic studies ( $n = 475$ ), 10 probiotics studies ( $n = 933$ ) and 12 prebiotics studies ( $n = 1,563$ ) were included. Synbiotics failed to significantly increase growth in boys and girls. Use of synbiotics increased stool frequency, had no impact on stool consistency, colic, spitting up / regurgitation, crying, restlessness or vomiting. Probiotics in formula also failed to have any significant effect on growth, stool frequency or consistency. Probiotics did not lower the incidence of diarrhoea, colic, spitting up / regurgitation, crying, restlessness or vomiting. Prebiotics in formula did increase weight gain but had no impact on length or head circumference gain. Prebiotics increased stool frequency but had no impact on stool consistency, the incidence of colic, spitting up / regurgitation, crying, restlessness or vomiting. There was no impact of prebiotics on the volume of formula tolerated, infections and gastrointestinal microflora. The quality of

evidence was compromised by imprecision, inconsistency of results, use of different study preparations and publication bias. **AUTHORS' CONCLUSIONS:** There is not enough evidence to state that supplementation of term infant formula with synbiotics, probiotics or prebiotics does result in improved growth or clinical outcomes in term infants. There is no data available to establish if synbiotics are superior to probiotics or prebiotics.

Source: Division of Human Nutrition, Faculty of Medicine and Health Sciences, Stellenbosch University, Stellenbosch, Western Cape, South Africa. Contact: [nkmugambi@hotmail.com](mailto:nkmugambi@hotmail.com)

**Ballard O, Morrow AL. Human milk composition: nutrients and bioactive factors. *Pediatr Clin North Am.* 2013 Feb;60(1):49-74. doi: 10.1016/j.pcl.2012.10.002.**

**ABSTRACT:** This article provides an overview of the composition of human milk, its variation, and its clinical relevance. The composition of human milk is the biological norm for infant nutrition. Human milk also contains many hundreds to thousands of distinct bioactive molecules that protect against infection and inflammation and contribute to immune maturation, organ development, and healthy microbial colonization. Some of these molecules (eg, lactoferrin) are being investigated as novel therapeutic agents. Human milk changes in composition from colostrum to late lactation, within feeds, by gestational age, diurnally, and between mothers. Feeding infants with expressed human milk is increasing.

Source: Division of Immunobiology, Center for Interdisciplinary Research in Human Milk and Lactation, Cincinnati Children's Hospital Medical Center, Cincinnati, OH 45229, USA. Contact: [Olivia.Ballard@cchmc.org](mailto:Olivia.Ballard@cchmc.org)

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**Zerfu TA, Ayele HT. Micronutrients and pregnancy; effect of supplementation on pregnancy and pregnancy outcomes: a systematic review. *Nutr J.* 2013 Jan 31;12:20. doi: 10.1186/1475-2891-12-20.**

**INTRODUCTION:** Every year more than 20 million infants are born with low birth weight worldwide. About 3.6 million infants die during the neonatal period. More than one third of child deaths are thought to be attributable to maternal and child under nutrition. **OBJECTIVES:** to systematically review the effect of supplementing various combinations and types of micronutrients on the course and outcomes of pregnancy. **METHODS:** electronic search of medline, pub med, health internet access to research initiative, and google scholar databases was conducted. Outcomes of interest were birth weight, low

birth weight, small size for gestational age, prenatal mortality and neonatal mortality. After exclusion of irrelevant/incomplete ones, 17 out of 115 articles were considered for the final analysis. **FINDINGS:** majority of the articles reviewed favored the supplementation of micronutrients to pregnant mother. Some studies suggested calcium supplementation is associated with a significant protective benefit in the prevention of pre-eclampsia. The remaining articles reviewed, showed significant benefit of multiple micronutrients supplementation during pregnancy in reducing low birth weight, small for gestational age births as compared to the usual iron-folate supplements. **CONCLUSIONS:** supplying micronutrients, mainly multiple micronutrients have beneficial effect in reducing the risk of low birth weight and other complications. Further studies at various combination and doses of micronutrient supplements are recommended.

Source: College of Health Sciences and Referral Hospital, Dilla University, Dilla, Ethiopia. Contact: [tadal2006@yahoo.com](mailto:tadal2006@yahoo.com)

**Surén P, Roth C, Bresnahan M, Haugen M, Hornig M, Hirtz D, Lie KK, Lipkin WI, Magnus P, Reichborn-Kjennerud T, Schjølberg S, Davey Smith G, Øyen AS, Susser E, Stoltenberg C. Association between maternal use of folic acid supplements and risk of autism spectrum disorders in children. *JAMA* 2013 Feb 13;309(6):570-7. doi: 10.1001/jama.2012.155925.**

**IMPORTANCE:** Prenatal folic acid supplements reduce the risk of neural tube defects in children, but it has not been determined whether they protect against other neurodevelopmental disorders. **OBJECTIVE:** to examine the association between maternal use of prenatal folic acid supplements and subsequent risk of autism spectrum disorders (asds) (autistic disorder, asperger syndrome, pervasive developmental disorder-not otherwise specified [pdd-nos]) in children. **DESIGN, SETTING, AND PATIENTS:** The study sample of 85,176 children was derived from the population-based, prospective norwegian mother and child cohort study (moba). The children were born in 2002-2008; by the end of follow-up on march 31, 2012, the age range was 3.3 through 10.2 years (mean, 6.4 years). The exposure of primary interest was use of folic acid from 4 weeks before to 8 weeks after the start of pregnancy, defined as the first day of the last menstrual period before conception. Relative risks of asds were estimated by odds ratios (ors) with 95% cis in a logistic regression analysis. Analyses were adjusted for maternal education level, year of birth, and parity. **MAIN OUTCOME MEASURE:** Specialist-confirmed diagnosis of asds. **RESULTS:** At the

end of follow-up, 270 children in the study sample had been diagnosed with asds: 114 with autistic disorder, 56 with asperger syndrome, and 100 with pdd-nos. In children whose mothers took folic acid, 0.10% (64/61,042) had autistic disorder, compared with 0.21% (50/24,134) in those unexposed to folic acid. The adjusted or for autistic disorder in children of folic acid users was 0.61 (95% ci, 0.41-0.90). No association was found with asperger syndrome or pdd-nos, but power was limited. Similar analyses for prenatal fish oil supplements showed no such association with autistic disorder, even though fish oil use was associated with the same maternal characteristics as folic acid use. **CONCLUSIONS AND RELEVANCE:** Use of prenatal folic acid supplements around the time of conception was associated with a lower risk of autistic disorder in the moba cohort. Although these findings cannot establish causality, they do support prenatal folic acid supplementation.

Comment in *Periconceptional folic acid and risk of autism spectrum disorders*. [JAMA. 2013]

Source: Norwegian Institute of Public Health, PO Box 4404, Nydalen, N-0403 Oslo, Norway. Contact: [pal.suren@fhi.no](mailto:pal.suren@fhi.no)

**Segal NA, Boyer ER, Teran-Yengle P, Glass NA, Hillstrom HJ, Yack HJ. Pregnancy leads to lasting changes in foot structure. Am J Phys Med Rehabil. 2013 Mar;92(3):232-40. doi: 10.1097/PHM.0b013e31827443a9.**

**OBJECTIVE:** Women are disproportionately affected by musculoskeletal disorders. Parous women seem to be at a particularly elevated risk for structural and functional changes in the lower limbs. The combination of increased weight on the joints with potentially greater laxity during pregnancy could lead to permanent structural changes in the feet. Although arches may become lax during pregnancy, it is unknown whether the changes persist. The objective of this study was to determine whether arch height loss persists postpartum. **DESIGN:** forty-nine women completed this longitudinal study. Static and dynamic arch measurements were collected in the first trimester and at 19 wks postpartum. Linear mixed models were used to determine whether outcome measures significantly changed overall or by parity. **RESULTS:** Arch height and rigidity indices significantly decreased, with concomitant increases in foot length and arch drop. The first pregnancy accounted for the reduction in arch rigidity and the increases in foot length and arch drop. No changes were detected in the center of pressure excursion index. **CONCLUSIONS:** pregnancy seems to be associated with a permanent loss of arch height, and the first pregnancy may be the most significant. These

changes in the feet could contribute to the increased risk for musculoskeletal disorders in women. Further research should assess the efficacy of rehabilitative interventions for prevention of pregnancy-related arch drop.

Source: Department of Orthopaedics & Rehabilitation, The University of Iowa, Iowa City, IA 52242-1088, USA.

**Vas J, Aranda-Regules JM, Modesto M, Ramos-Monserrat M, Barón M, Aguilar I, Benítez-Parejo N, Ramírez-Carmona C, Rivas-Ruiz F. Using moxibustion in primary healthcare to correct non-vertex presentation: a multicentre randomised controlled trial. Acupunct Med. 2013 Mar;31(1):31-8. doi: 10.1136/acupmed-2012-010261. Epub 2012 Dec 18.**

**OBJECTIVE:** To compare the effectiveness of additional moxibustion at point bl67 with moxibustion at a non-specific acupuncture point and with usual care alone to correct non-vertex presentation. **METHODS:** this was a multicentre randomised controlled trial in which 406 low-risk pregnant women with a fetus in ultrasound breech presentation, with a gestational age of 33-35 weeks, were assigned to (1) true moxibustion at point bl67 plus usual care; (2) moxibustion at sp1, a non-specific acupuncture point (sham moxibustion) plus usual care; or (3) usual care alone. The primary outcome was cephalic presentation at birth. Women were recruited at health centres in primary healthcare. **RESULTS:** In the true moxibustion group, 58.1% of the full-term presentations were cephalic compared with 43.4% in the sham moxibustion group (RR 1.34, 95% CI 1.05 to 1.70) and 44.8% of those in the usual care group (RR 1.29, 95% CI 1.02 to 1.64). The reduction in RR of the primary outcome in women allocated to the true moxibustion group compared with the usual care group was 29.7% (95% CI 3.1% to 55.2%) and the number needed to treat was 8 (95% CI 4 to 72). There were no severe adverse effects during the treatment. **CONCLUSIONS:** Moxibustion at acupuncture point BL67 is effective and safe to correct non-vertex presentation when used between 33 and 35 weeks of gestation. We believe that moxibustion represents a treatment option that should be considered to achieve version of the non-vertex fetus. **TRIAL REGISTRATION:** Current controlled trials isrctn10634508.

Comment in: *Moxibustion for breech presentation: significant new evidence*. [Acupunct Med. 2013]

Source: Pain Treatment Unit, Doña Mercedes Primary Health Care Centre, Andalusian Public Health System, Dos Hermanas, Sevilla 41700, Spain. Contact: [jorgef.vas.sspa@juntadeandalucia.es](mailto:jorgef.vas.sspa@juntadeandalucia.es)



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