ORIGINAL RESEARCH

An Impairment Rating Analysis Of Asthmatic Children Under Chiropractic Care

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Abstract — A self-reported asthma-related impairment study was conducted on 81 children under chiropractic care. The intent of this study was to quantify self-reported changes in impairment experienced by the pediatric asthmatic subjects, before and after a two month period under chiropractic care. Practitioners, representing a general range of six different approaches to vertebral subluxation correction, administered a specifically designed asthma impairment questionnaire at the appropriate intervals. Subjects were categorized into two groups; 1–10 years and 11–17 years. Parents/guardians completed questionnaires for the younger group, while the older subjects self-reported their perceptions of impairment. Significantly lower impairment rating scores (improvement) were reported for 90.1% of subjects 60 days after chiropractic care when compared to the pre-chiropractic scores ($p < 0.05$) with an effect size of 0.96. As well, there were no significant differences across the age groups based on parent/guardian versus self rated scores. Girls reported higher (less improvement) before and after care compared to boys, although significant decreases in impairment ratings were reported for each gender. This suggested a greater clinical effect for boys which was supported by effect sizes ranging from 1.2 for boys compared to 0.75 for girls. Additionally, 25 of 81 subjects (30.9%) chose to voluntarily decrease their dosage of medication by an average of 66.5% while under chiropractic care. Moreover, information collected from patients revealed that among 24 patients reporting asthma "attacks" in the 30 day period prior to the study, the number of "attacks" decreased significantly by an average of 44.9% ($p <.05$). Based on the data obtained in this study, it was concluded that chiropractic care, for correction of vertebral subluxation, is a safe nonpharmacologic health care approach which may also be associated with significant decreases in asthma related impairment as well as a decreased incidence of asthmatic "attacks." The findings suggest that chiropractic care should be further investigated relative to providing the most efficacious care management regimen for pediatric asthmatics.

Key words: asthma, adjustment, children, chiropractic, impairment rating, pediatric, vertebral subluxation.

Introduction

Bronchial asthma is a disorder of increased tissue responsiveness of the tracheobronchial tree to various stimuli, resulting in paroxysmal contraction of bronchial airways.[1] The airway obstruction in asthma is due to a combination of factors that include spasm and edema of the smooth muscle of the airways, and increased mucus secretion.[2] With more severe asthma, the asthmatic is forced to compensate for bronchoconstriction in order to permit gas exchange to take place. This is done by breathing at high lung volumes, which enlarges the total lung capacity, resulting in a mechanical opening of the airways. Unfortunately, breathing in a hyperinflated state requires a marked increase in the inspiratory muscle forces and results in varying degrees of dyspnea and fatigue, likely due to the patient's use of accessory muscles of ventilation (platysma and S.C.M.[3]). Sternocleidomastoid muscle contractions have been shown positive correlation with the development of severe airflow obstruction, hyperinflation, and a marked reduction in gas exchange.[4]

A positive correlation between chiropractic care administered for the correction of vertebral subluxation and the patient's perception of decreased respiratory effort, and severity of symptomatology, has been noted in several studies of patients ranging from 2 to 63 years of age.[5,6,7,8,9,10] Chiropractic care has been proposed to significantly reduce non-specific bronchial hyperactivity (n-BR) as well as patient rated asthma severity.[7] Non-specific bronchial hyperactivity (n-BR) measures the resistance to breathing of the bronchial airways after histamine dihydrochloride challenge. Although objective evidence is slow emerging in regard to the effect of chiropractic care on respiratory function there have been some reports.[11,12] Of particular interest is a recent report showing improved forced expiratory volume in patients following adjustments for upper cervical subluxation.[13]

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Vertebral subluxation is characterized, in part, by vertebral misalignment (kinesiopathology), neuropathology and myopathology.[14 15 16 17] It has been demonstrated that pressures as little as 10mm Hg can cause significant neural dysfunction, decreasing the number and amplitude of action potentials by up to 60% of initial values.[18 19 20] This mechanical pressure on the nerve and surrounding tissues which may cause tissue ischemia is proposed to result in the release of chemical inflammatory agents such as substance P [21 22], bradykinin, and histamin [22] as a result of the osseous misalignment and subsequent neuromuscular pathophysiology. This neuromuscular pathophysiology can exist with or without associated pain.[23]

Recent study on the neurogenic mechanisms of asthma has focused on the release of neuropeptides by an axon reflex pathway. These peptides, which include substance P, calcitonin-related peptides, and neurokinin A (a bradykinin), have been shown respectively to have vascular permeability and mucus secretagogue activity, bronchial vascular dilation effect, and a bronchoconstrictor activity.[2] These are the same neurotransmitters postulated to be released from tissues in the presence of vertebral subluxation,[21] which may initiate and/or complicate the asthmatic condition.

As the vertebral subluxation is believed to negatively effect neurological function, [21] the neuroanatomy and physiology of structures associated with respiratory effort could be affected by this condition. In this regard, the neuroanatomy and physiology related to the cervical area reveals that the respiratory center consists of neurons located bilaterally and divided into three major collections. These are the dorsal respiratory group located in the dorsal portion of the medulla oblongata which mainly regulates inspiration, the ventral respiratory group which regulates both inspiration and expiration located in the medulla oblongata, and the pneumotaxic center located dorsally in the superior portion of the pons which helps to regulate rate and pattern of breathing.[24] The medulla oblongata passes inferiorly through the foramen magnum and the C1 spinal canal.[25] It has been theorized [26] that misalignment (a component of vertebral subluxation) of C1 can cause stress and subsequent neural dysfunction to the medulla oblongata and spinal cord. Additionally, the phrenic nerve from the cervical plexus, which innervates the diaphragm, receives fibers from the third, fourth and fifth cervical nerves.[27]

Accessory muscles of breathing such as the platysma and sternocleidomastiod muscles also receive innervation from nerves of cervical origin. The platysma muscles are innervated by the cervical branch of the facial nerve, and the sternocleidomastiod muscles are innervated by the spinal branch of the accessory nerve as well as branches from the anterior rami of the second and third cervical nerves. These nerves are intimately associated with the upper cervical area.[25 27]

Misalignment of thoracic vertebra may cause neural dysfunction to the nerves which innervate anterior serrati, scaleni, abdominal recti, and internal and external intercostal muscles which function to raise and lower the rib cage during respiration. Misalignment of thoracic vertebra may also cause costotransverse fixation, which can limit diaphragmatic excursion and increase respiratory effort. Additionally, the lower thoracic nerves also contribute to the innervation of the diaphragm.[27] Consequently, the presence of vertebral subluxation, i.e. kinesiopathology, neuropathology and myopathology, may increase the asthmatic patients perception of respiratory effort. The present study, therefore, was designed as a preliminary assessment of perceived change in the extent of impairment of pediatric asthmatic patient's while under chiropractic care for the correction of vertebral subluxation.

The importance of gathering data relative to the pediatric population is apparent considering current statistics. In the United States, asthma affects an estimated 14-15 million persons, including 4.8 million (6.9%) under 18 years.[28] In 1993, asthma accounted for an estimated 198,000 hospitalizations and 342 deaths among persons less than 25 years of age. Children were more likely than teens and adults to receive asthma care in the outpatient settings; adolescents and young adults were more likely than other age groups to receive emergency care.[28] Although the treatment of asthma by medication is prevalent, and for many life sustaining, the health complications associated with this approach are well known.[29 30 31 32] Since the correction of vertebral subluxation is non-invasive, the documentation of changes in asthma related impairment, which could reduce or eliminate the need for medication, is a necessary step in evolving the most efficacious care for the millions of children challenged by this condition.

Methods

Subjects

Potential subjects for this study were sought through newspaper advertisement. All subjects between the ages of one to seventeen years of age with a previous medical diagnosis of asthma were considered. Informed consent was obtained from the parents, and/or legal guardian, consistent with the Human Subjects Committee protocol of the Michigan Chiropractic Council. Qualifying subjects were required to be studied for a period of 60 days. A total of 81 subjects participated, all of whom completed the study duration of 60 days. The subject population consisted of 37 females and 44 males ranging in age from one to 17, with a mean age of 10 ± 4.13 years.

Practitioners

A total of 33 chiropractors in various locales of the state of Michigan volunteered to participate in this study. All practitioners were members of the Michigan Chiropractic Council. Each practitioner followed the same procedures in obtaining data for the study. Subjects were evaluated over a period of 60 days during which time they were examined for the presence of vertebral subluxation in accordance with the protocols of the techniques employed by each participating chiropractor. These techniques included, Activator Methods, Diversified, Gonstead, Upper Cervical Technique-H.I.O, Network Spinal Analysis, and Thompson Terminal Point Technique, all of which have been described elsewhere.[33] When vertebral subluxation was indicated to be present, subjects were administered chiropractic adjustment(s) followed by an evaluation for the correction of vertebral subluxation according to the procedures of the methods practiced. No recommendations concerning the use of medication in the treatment of bronchial asthma were made to subjects by

any of the chiropractors participating in the study.

Self-Reported outcomes of Asthmatic Impairment

It was necessary to develop an instrument appropriate to survey the population of subjects in the present study. The most suitable format was found in the Oswestry Low Back Pain Disability Questionnaire.[34,35] This questionnaire was chosen because its disability orientation closely related to anecdotal reports from Michigan Chiropractic Council members regarding the level of impairment observed in patients who had been diagnosed with asthma. However, it was necessary to modify the instrument to reflect areas of impairment which would specifically relate to breathing difficulty instead of low back pain. This was accomplished by substituting the phrase "breathing problems" in the place of "low back pain," and changing the content of the ten broad areas (Appendix). In its final form, the instrument was composed of ten questions. For each of the ten questions, participants were asked to choose one of the six replies that best described their impairment. These answers were subsequently scored 0-5, with 5 being the highest level of impairment. As with the Oswestry Questionnaire, the final score was a percent of the highest score which could be reported (5 x 10 = 50). Since some of the questions were not relevant to the age level of participants (such as walking difficulties), these sections were not answered. Therefore, the highest score attainable was adjusted accordingly, with the percentage reflecting the change. This instrument, adapted from the Oswestry format is herein referred to as the Modified Oswestry Impairment Rating Scale (MOIRS).

In each practice, the questionnaires were completed prior to the commencement of care, and again 60 days following the initial visit. Subjects 11 years and older completed the questionnaires, while parents or legal guardians acted for younger patients. Additionally, subjects or parents/ guardians were asked to supply information regarding changes in number of asthma attacks, and medication usage via an informal questionnaire.

Analysis of Data

Pre and post care scores on the MOIRS were evaluated by a two tailed paired sample t-test assuming equal variances,[36,37] and a two tailed independent t-test assuming unequal variances[36,37] for (1) gender effects, (2) age effects, and (3) response scores based on completion by the subject versus parent or guardian. Significance was determined for all analyses at $p < 0.05$. Response scores were not evaluated as a function of the practice from which they were derived since the number of individual subjects per practice was too low to achieve statistical power.

Additionally, utilizing scores from the MOIRS as a measure of change in impairment, effect sizes[38] were determined to assess the clinical significance associated with chiropractic care. Effect size was determined by the following relationship [mean MOIRS pre care score — mean MOIRS post care score / std. dev. of MOIRS pre care scores]. This measurement allowed for expression of the extent to which a post intervention measurement [post MOIRS rating] varied from normal variation around the mean of pre intervention measurements [pre MOIRS rating]. Following the relationship described, a value of 0.2 is taken to mean a small clinical effect, 0.5 is taken to mean a moderate clinical effect, and 0.8 is taken to mean a large clinical effect.[38]

Results

Content and Construct Validity and Internal Consistency of the MOIRS Questionnaire

As presented in the introduction, content validity was initially established by having practitioners participating in the study validate the content of the survey relative to its intended purpose. The content, either adopted from the Oswestry Pain Disability questionnaire or originally developed, was approved unanimously by these practitioners as reflecting the type of disabilities reported by their asthmatic patients. Following the study, practitioners reported that subjects found the questionnaire to be clear and complete, both primary attributes of content validity.[39]

Since construct validity is a process requiring considerable evidence gathered over a period of time through repeated uses of the instrument, no gold standard currently exists with regard to the type of questionnaire administered in this study. However, several initial measures of validity did arise from the present study. First, since the instrument was intended to discriminate "post intervention" effects, its ability to detect statistical differences between pre and post chiropractic care (presented below) attests to its validity in that regard.[40]

Reliability was examined by determining Cronbach's coefficient alpha[41] for the ten questions in the survey instrument before (0.70) and after chiropractic care (0.77). These coefficients reveal a substantial level of internal consistency within the instrument. This level of reliability also contributes to the initial phase of evaluating its construct validity. Further use of this instrument in similar asthmatic populations will be required to continue the validation process.

MOIRS Ratings Before and After Chiropractic Care

Significantly lower MOIRS scores of 20.6 ± 12.1 were reported 60 days after chiropractic care when compared to the pre-chiropractic scores 32.1 ± 12.0 ($p < 0.000$). Within the population of 81 patients, there were 73 (90.1%) reports of decreased impairment. In 4 (4.9%) there was no reported change, and in 4 (4.9%) there were reports of increased impairment (Table 1).

Additional information supplied by patients or parent/guardian revealed that among 24 patients reporting asthma "attacks" in the 30 day period prior to the study, the number of "attacks" decreased from an average of 2.96 ± 3.30 incidents per 30 days prior to study, to 1.3 ± 2.60 incidents per 30 days during the study. This represented a significant decrease of 44.9% ($p < .05$). Additionally 25 of 81 (30.9%) patients chose to voluntarily decrease their dosage of medication by an average of 66.5%, with a range of 20% to 100% per month.

Subject Categories

Self-Reported versus Parent/Guardian-Reported Responses

Subjects were divided into age ranges according to their

Table 1. Impairment Score Changes* in Bronchial Asthma Pediatric Patients Before and After Chiropractic Care.

Patient Categories	*Scores* Pre	Post	*Probability †* (p)	*Effect Size‡*
A. Total Population	32.1 ± 12.0	20.6 ± 12.1	0.000	0.96
B. Age Range/Gender				
1-10 years				
Males	30.4 ± 10.5	15.8 ± 12.1	0.000	1.40
Females	30.8 ± 11.9	21.1 ± 12.0	0.000	0.81
11-15 years				
Males	30.7 ± 11.2	19.4 ± 10.5	0.000	1.00
Females	37.4 ± 14.5	26.7 ± 12.7	0.000	0.73
C. Gender				
Total Population				
Males	30.3 ± 10.3	17.8 ± 11.1–	0.000	1.20
Females	34.2 ± 13.5	24.0 ± 12.5	0.000	0.75

• Impairment rating scores were obtained from the Modified Oswestry Index Rating Scale (MOIRS, see Methods for protocols). Higher Scores represent greater impairment.

† Probability values of less than 0.05 were significant.

‡ Effect size (see Methods) is a measure of clinical effect, where 0.2 is a small effect, a moderate effect, and 0.8 a large effect.

– Compared across (between) groups, post care males scored significantly ($p = 0.02$) lower (improvement) than females. No other comparisons between groups were statistically significant.

apparent ability to complete the questionnaire alone, or requiring a parent or guardian to act for them. The division was made between 1 to 10 years and 11 to 17 years. Although MOIRS scores were lower in the younger age bracket prior to and after care than the higher age group, there was no significant difference between the age categories. This suggested that guardian versus self-reporting elicited the same range of responses. Moreover, in both age groups, MOIRS scores were significantly lower (improvement) following chiropractic care compared to pre chiropractic MOIRS scores ($p < 0.000$).

Gender Differences

Girls showed slightly higher impairment scores (34.2 ± 13.5) before chiropractic care than did boys (30.3 ± 10.3). Although both genders reported significantly decreased impairment after care, scores were significantly higher among girls (24.0 ± 12.5) when compared to boys(17.8 ± 11.1), suggesting a more profound clinical effect for males. This possibility was further explored by investigating effect sizes, separately, for the genders.

Effect size, derived from MOIRS scores before and after chiropractic care, was used as a measure of estimating the extent of clinical change. While, overall, the clinical effect was large for the subject population as a whole (0.96), boys demonstrated a higher effect size (1.20) than did girls (0.75), as can be seen in Table 1, thus supporting a proposed larger clinical effect for males.

Discussion

The Survey Instrument (MOIRS)

Due to lack of previous use of the MOIRS, its internal construct validation is in the initial phase. The instrument is administered easily, lending itself to use by parents/guardians as well as self-rating by young adults. It is anticipated that it will continue to be used by chiropractors and other practitioners interested in assessing health outcomes associated with asthmatics. Since the demonstration of internal and external validity for any questionnaire is a process[42] rather than a singular event, it is important that data be gathered from a number of studies for comparison. As a first step in this process, this paper has introduced data which provides a base for comparison. Consequently, while the statistical differences and effect sizes reported in this investigation are compelling, they must be interpreted with caution while awaiting continued evidence regarding validation of the instrument.

Perceived Changes in Impairment Due to Asthma

The information collected concerning change in the number of asthma "attacks" during this study needs to be viewed in consideration of the timing of the study (May–September), since some atopic (allergic) asthmatic events may be contributed to by seasonal factors such as exposure to higher amounts of pollen. Additionally, influences due to the incidence of non-atopic (nonreagenic) events and atopic asthmatic events incited by exposure to environmental antigens which can not be related to seasonality, such as animal hair, cigarette smoke, and various chemotoxins, were not considered in the present study. To some extent, therefore, the number of asthmatic "attacks" could be related to these factors. However, the significant reduction in asthmatic "attacks" coupled with the high percentage of respondents (or their parent/guardian) voluntarily reducing medication levels, suggests a more permanent effect. This is based on the logical presumption that asthmatic subjects or parents/guardians would be expected, through their personal experience, to recognize "typical" seasonal or occasional environmental influences related to "attack" frequency.

Although demonstrating significant decreases in scores (improvement) pre to post chiropractic care, the 11-17 year old subjects of both sexes demonstrated a trend of self-reporting higher scores than younger subjects (one–ten years). While these differences were not significant, the trend may reflect some level of variation in perception between those self-rating, as opposed to parents/guardians. As pediatric studies will frequently involve this type of design, this issue should remain an important concern as it impacts on validation of the instrument.

While there were no significant differences in age groups within genders, females reported significantly less post improvement than males. The implication that a more pronounced clinical effect was apparent for males than females, while substantiated by statistical significance as well as effect size, currently lacks explanation. However, some evidence exists which suggests that females tend to report their health lower than males even though they may not exhibit other indicators of a lower state of health. Verbrugge [43] proposes that this could be a reflection of the more frequent utilization of helath care by females. As this information is specific to adult populations it may or may not account for the observation regarding gender differences in the present study, especially considering the fact that responses from approximately half of both the male and female subjects were reported by parents/guardians. Certainly, a follow up study investigating more subjects will be needed to attest to the consistency of this finding. Moreover, evaluation of the inference that the significant reduction in impairment was due to chiropractic care will require a controlled clinical research design to focus on gathering evidence related to cause and effect. Relative to this issue, the diversity of techniques employed by different chiropractors participating in the study could be broadly grouped into six general approaches. While it is not possible from the data collected in this study to ascertain if one technique was more effective than another, it is evident that, overall, subjects or parent/guardians responded similarly, regardless of the chiropractic approach used for correction of vertebral subluxation. Further study, among those advocating specific approaches will be necessary to elucidate any distinctions in efficacy. Moreover, it will be of interest to conduct additional study regarding the consistency of segmental locations which are adjusted among the different approaches, concomitant with reported changes in asthma impairment. Such information could offer considerable insight regarding the range of possible approaches effective in the correction of vertebral subluxation.

Conclusions

The authors of this study do not suggest that chiropractic care is to be considered a substitute for prudent, proper medical attention for the asthmatic patient. However, it should be noted, that traditional pharmacological approaches to the management of asthma have been shown to represent a risk to the patient,[29 44 45] with several studies calling into question the efficacy of such treatment in the management of asthmatic conditions.[29 30 31 32] Therefore, when considering pharmaceutical agents in the management of asthma in the pediatric patient, the expected benefit must be weighed against the inherent risks. As shown in the present study, chiropractic care, a safe nonpharmacologic health care approach, may also be associated with self-reported decrease in asthma-related impairment to the patient, including the patient's perception of reduced respiratory effort, as well as a decreased incidence of asthmatic "attacks." In view of these findings it is suggested that chiropractic care be further investigated regarding its role in the overall health care management of pediatric asthmatics.

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Appendix

Asthma Research Program

Quantitative Asthmatic Index

This questionnaire has been designed to give the doctor information as to how breathing difficulty has affected your ability to manage everyday life. Please answer every section and mark in each section the ONE box which applies to you. We realize you may consider that two of the statements in any one section relate to you, but please mark the box which most closely describes your condition

1) Current difficulties
- ☐ I have no breathing problems at this moment.
- ☐ I have mild breathing problems at this moment.
- ☐ I have moderate breathing problems at this moment.
- ☐ My breathing problems are fairly severe at this moment.
- ☐ My breathing problems are severe at this moment.
- ☐ My breathing problems are very severe at this moment.

2) How many times have you ever been hospitalized for Asthma
- ☐ Never.
- ☐ One Time.
- ☐ Two Times .
- ☐ Three Times.
- ☐ Four Times.
- ☐ Five or more times.

3) When was the last time you had a severe flare-up or needed treatment for your asthma?
- ☐ Never.
- ☐ More than twelve months ago.
- ☐ Within the last twelve months.
- ☐ Within the last six months.
- ☐ Within the last month.
- ☐ Within the last week.

4) Mild Activity
- ☐ I can walk any distance with no problems.
- ☐ I can walk any distance with occasional problems.
- ☐ I can walk a lot but have frequent breathing problems.
- ☐ I don't walk much because I have frequent problems breathing .
- ☐ I walk rarely because I have frequent and severe problems breathing .
- ☐ I never walk because of severe breathing problems.

5) Vigorous Activity
- ☐ I participate in vigorous activity with no breathing problems.
- ☐ I participate in vigorous activity with mild breathing problems.
- ☐ I participate in vigorous activity with moderate breathing problems
- ☐ I participate in vigorous activity with severe breathing problems.
- ☐ My activities are rarely vigorous because of severe breathing problems.
- ☐ I am never vigorous because of severe breathing problems.

6) In the past 4 weeks how much time have you missed from work, school, or usual activity because of asthma?
- ☐ None.
- ☐ One to three days.
- ☐ Four days to one week.
- ☐ One to two weeks.
- ☐ Two to three weeks.
- ☐ Three to four weeks.

7) How often do asthma attacks awaken you at night?
- ☐ Never.
- ☐ Less than once a week.
- ☐ Once or twice a week.
- ☐ Three or four times a week.
- ☐ Five or six times a week.
- ☐ Every Night.

8) School / Work
- ☐ My breathing never interferes with work activity.
- ☐ My breathing rarely interferes with work activity.
- ☐ My breathing moderately interferes with work activities.
- ☐ My breathing interferes very much with work activities.
- ☐ My breathing prevents me from doing most jobs.
- ☐ My breathing prevents me from doing any work.

9) How much does your asthma interfere with your social activities (family, friends, neighbors or groups)
- ☐ Never.
- ☐ Rarely.
- ☐ Slightly.
- ☐ Moderately.
- ☐ Frequently.
- ☐ Extremely.

10) Medication
- ☐ I never take medication or inhalants.
- ☐ I very rarely take medication or inhalants.
- ☐ I rarely take medication or inhalants.
- ☐ I sometimes take medication or inhalants.
- ☐ I frequently take medication or inhalants.
- ☐ I use my inhaler most days.

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