

## **A critical review of the effectiveness of non-speech oral motor exercises (NSOMEs) on speech intelligibility in children with articulation difficulties**

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A critical review of research on the use of non-speech oral motor exercises (NSOMEs) to treat children with articulation disorders was performed. Research studies reviewed include two group studies, one survey and three retrospective literature reviews. Overall the consensus from these studies is that there is very limited evidence to support the use of NSOMEs in clinical practice for treatment of articulation difficulties. Further research, using high quality experimental studies, is recommended.

### ***Introduction***

Non-speech oral motor exercises (NSOMEs) are being used by clinicians across North America to treat children with articulation disorders (Lof & Watson, 2008; Hodge, Salonka & Kollias, 2005). These exercises are defined as a therapy technique that is used to help a child improve their articulation abilities, but that does not require them to produce any speech sounds (Lof & Watson, 2008). By using NSOMEs, one is purported to improve the resting posture of the tongue, lip and jaw; increase the strength, muscle tone and range of motion of the articulators; and help to develop overall muscle control (Ruscello, 2008). Research on the topic of NSOMEs has shown that there is little evidence to support the efficacy of using NSOMEs to improve articulation in children; however 85% of clinicians in North America continue to use them in their daily clinical practice (Lof & Watson, 2008; Hodge, Salonka & Kollias, 2005). As a profession, Speech-Language Pathologists (SLPs) need to incorporate evidence-based practice (EBP) in order to maintain the highest, most current standards in their clinical practice (Powell, 2008).

### ***Objectives***

The objective of this paper is to critically evaluate the current research surrounding non-speech oral motor exercises (NSOMEs), so that clinicians can incorporate the evidenced-based results accordingly.

### ***Methods***

#### Search Strategy

To search for articles relating to the research question a number of online databases were used, including PubMed, CINAHL, SCOPUS, PsycINFO and ProQuest

Dissertations and Theses' as well as manual search in the University library. The following search terms were used: Non-speech exercises, Non-speech treatments, Oral Motor Exercises, Oral Motor Treatment, Oral Motor Therapy, Oral Exercises, Oral exercises AND efficacy, Oral Motor Exercises AND efficacy, Oral Motor Exercises and Apraxia, Oral Simulation exercises.

#### Selection Criteria

In order to be included in this literature review, articles were required to focus on the use of Non-speech Oral Motor Exercises (NSOMEs) to treat articulation disorders in children. Papers reviewing previous literature on the subject were also included.

#### Data Collection

Results of the literature search revealed six articles that met the selection criteria: two group studies, one survey, and three literature reviews. All of the articles came from peer-reviewed journals.

### ***Results***

**Group Study #1:** In a descriptive study involving a single subject design, Guisti-Braislin and Cascella (2005) looked at the effects of an oral motor therapy approach, without using traditional articulation practice, on four school-aged children with mild articulation disorders. The authors chose to use the program *Easy Does it for Articulation: An Oral Motor Approach* (Strode & Chaimberlain, 1997) during fifteen half hour treatment sessions over the course of seven weeks. The children (two boys and two girls), with a mean age of 6.5 years, had normal academic and cognitive abilities, passed a hearing screening and had not previously received speech therapy.

Prior to the study, an independent Speech-Language Pathologist (SLP) used the *Kaufman Speech Praxis test for Children* (Kaufman, 1995) to confirm that each child had intact oral structure and function. For therapy, the children were split into two groups of two. Treatment consisted of gross motor activities, body positioning, jaw stability, face wake-ups and direct facilitation. Each exercise was completed by the children in three sets of five seconds each, excluding the gross motor activities in which they only completed one set of five repetitions.

The sounds-in-words subtest of the *Goldman Fristoe Test of Articulation* (GFTA-2) (Goldman & Fristoe, 2000) was administered by an independent SLP pre- and post-therapy to assess the children's articulation. Following the seven weeks of therapy, pre- and post-test comparisons were made to establish whether the oral motor approach had made any changes in the children's articulation. The results of the study indicate that on average, the children made 2.5 less errors following therapy (*pre-test*: range of 4-13 errors, mean=9, SD=4.70; *post-test*: range of 2-10 errors, mean=6.5, SD=3.41). Therefore, there was no significant change in the children's speech following oral motor therapy. Pre- and post-test inter-rater reliability was calculated to range from 0.84 to 0.97.

This study should be rated as having level III evidence as it has a number of weaknesses, the first being the small number of participants and the fact that the treatment duration was a total of only 7.5 hours. The fact that the children did not make any significant changes in their speech could be influenced by these two factors. Also, the statistical analysis done in this study is very brief and the reader is provided with a fairly small amount of data.

The authors also purport a number of reasons why gains were not made in the children's speech. One reason is that all of the children were found to have intact oral motor skills following the *Kaufman Speech Praxis test for Children* (Kaufman, 1995). Oral motor exercises claim to increase oral motor strength, but in order for them to be of any benefit to a client, the client must first be shown to have a lack of strength. A second reason that gains were not made could be because the children's speech errors were related to the placement of their articulators. The authors suggest that treatment of their errors may have been more successful if the treatment approach focused on each child's specific error pattern. A final reason as to why the children did not make any gains is the idea that children may be better off learning how to produce a sound by learning to produce the whole unit rather than learning the sound in discrete parts.

**Group Study #2:** In a non-randomized clinical trial, Hixon and Hardy (1964) looked at training the articulation of children with Cerebral Palsy (CP) by using non-speech activities such as blowing, sucking, swallowing, and chewing. The authors looked at 50 children with CP (27 females and 23 males), 25 of which were diagnosed as being spastic quadriplegics and 25 who were athetoid quadriplegics. Their ages ranged from four years, four months to 16 years, two months (mean=10 years, 6 months).

The inclusion criteria for the study required the children to (1) have their motor problem medically diagnosed as either spasticity or athetosis, (2) the child had to be able to cooperate and complete each experimental task, (3) the child had to pass a hearing test, and (4) the child had to have adequate cognitive abilities, as determined by a clinical psychologist.

Non-speech tasks were performed by the children in both groups, following instructions and a demonstration which were given by the examiner. Tasks included: (1) opening and closing of the lips while the teeth are together, (2) alternating retracting and rounding the lips, (3) raising and lowering the tongue tip to the alveolar ridge (4) lateral movements of the tongue from one corner of the mouth to the other, and (5) raising and lowering of the jaw. Each child was required to perform three repetitions of the task. One repetition involved the child making the non-speech oral motor movement as many times as they could within ten seconds. The mean of the three repetitions was then calculated.

This study should be rated as level IIb, as the authors used a non-randomized clinical trial with no control group. The results of this study support research that suggests that "non-speech movements of the articulators are not strongly related to speech problems" and that performing non-speech oral motor exercises with children who have CP will have little effect on improving their speech intelligibility. The authors recommend using techniques that involve direct speech production by the child in order to facilitate improved speech production.

**Survey:** Lof and Watson (2008) carried out a nationwide survey of the United States in order to see if Speech-Language Pathologists (SLPs) are using non-speech oral motor exercises (NSOMEs) in their clinical practice to help children with articulation disorders. The survey also looked at: (1) what types of NSOMEs are being used, (2) the underlying beliefs behind using these exercises, (3) whether the SLPs have received training for these exercises, (4) which populations clinicians are using NSOMEs with, and (5) the specific tasks/procedures/tools they use to perform these

exercises. SLPs to be mailed the survey were randomly selected from a list of SLPs who work with children from birth to 11 years of age, which was taken from membership records of the American Speech-Language and Hearing Association (ASHA).

Out of the 2000 surveys that were mailed out, only 537 (27.5%) of the surveys were returned and complete enough to be included in the analysis. All of the SLPs have earned a master's degree and the majority of the respondents have over 15 years experience working with children who have articulation disorders. Eighty-five percent of the people who responded indicated that they do in fact use NSOMEs in their clinical practice.

Eighty-seven percent of the SLPs reported that they learned about this type of therapy through continuing education workshops. 92.7% of the SLPs reported that they have found improvements in the non-speech oral motor abilities of their clients, 86.3% reported seeing improved speech production in their clients after using these exercises, and 68% report using the exercises as a technique to fall back on when other techniques do not work.

Sixty percent of the SLPs who responded believe that development of speech is based on a child's early oral motor behaviours; however there is literature that does not support this belief.

Following the return of the survey, the authors were able to rank the exercises in order of which NSOMEs SLPs report using most frequently; (1) blowing, (2) tongue "push-ups," (3) pucker-smile alterations, (4) tongue wags (lateralizations), (5) "big smile," (6) tongue-to-nose-then-to-chin movements, (7) cheek puffing, (8) blowing kisses, (9) tongue curling.

A ranking of SLPs beliefs on the benefits of NSOMEs was compiled following the return of the surveys. The top 10 benefits listed were improved (1) tongue elevation, (2) awareness of articulators, (3) tongue strength, (4) lip strength, (5) lateral tongue movements, (6) jaw stabilization, (7) lip and tongue protrusion, (8) drooling control, (9) velopharyngeal competence, and (10) sucking ability.

68% of the SLPs who responded believe that NSOMEs can be used to "warm-up" the articulators, and following that they work on speech production directly. 25% of the SLPs report that they divide their time evenly between using direct speech production techniques and working on NSOMEs, and only 7% reported that they use NSOMEs as their sole therapy technique.

SLPs were asked to rate which populations they use NSOMEs with to treat speech disorders in children. A list was then formed of the top four; (1) dysarthria, (2) Childhood Apraxia of Speech (CAS), (3) structural anomalies (e.g. cleft palate), and (4) Down syndrome. Some of the less frequent uses that SLPs reported were, using NSOMEs with children (1) in the early intervention stage, regardless of their diagnosis, (2) identified as late talkers, (3) with phonological disorders, (4) with hearing impairments, and (5) with functional misarticulations. Looking at the populations listed above, it is hard to see why the same intervention would be used with all of these disorders, which stem from different etiologies.

Respondents were asked to rate how familiar they were with the current literature on the subject. SLPs reported being "very familiar" with the research, with 61% of the SLPs agreeing with the statement "The literature I have read strongly encourages the use of NSOMEs." When asked to rate their knowledge of the theoretical background related to use of NSOMEs, the responding SLPs believed that they have a sound understanding. It is clear that the SLPs are in fact not familiar with the current research, as it does not support the use of NSOMEs in clinical practice.

This research, as it is a survey would be rated as level III evidence. This study found that a large number of the clinical population of SLPs do in fact support the use of NSOMEs with children suffering from a wide variety of disorders, in their clinical practice. Current research however does not maintain using these exercises to produce changes in a child's speech production (Lass & Pannbacker, 2008; Ruscello, 2008).

**Literature Review #1:** In a retrospective review of the literature, Forrest (2002) discusses the controversy behind using non-speech oral motor exercises (NSOMEs) to treat children with phonological/articulatory disorders (PADs). PADs are disorders or delays in acquiring speech that are not associated with any neurological impairments. There is an underlying belief that motor deficits are central to a PAD, and therefore that NSOMEs will be beneficial in improving a child's speech development.

This review looks at a four hypotheses that support the use of oral-motor exercises in articulation therapy; (1) whether practice on a part of the task increases the rate and accuracy of learning of the whole, (2) children with PADs have limited tone to the speech musculature, (3) oral-motor exercises will provide a linkage between a sensorimotor period where neural pathways relating movement and the resulting percept are developed, by reconstructing the hierarchy of articulator movement

normally experienced during development, and (4) that speech develops from earlier occurring behaviours such as sucking, chewing, or oral-motor reflexes.

The author reviewed three studies that focus on the efficacy of using oral-myofunctional therapy (normally used for correcting tongue thrust) on correction of speech production. In the first study, children were separated into two groups; one receiving treatment for swallowing (by way of NSOMEs) and the other received treatment for both swallowing and speech. Both groups were found to show an improvement, however the evidence in this article is judged to be weak based on the failure to describe the therapy procedures and the high rate of subject attrition that went unaccounted for.

In the second article, the examiners looked at whether oral myofunctional therapy has an effect on improving articulation. All of the children in this study had anterior tongue thrust in addition to a severe frontal lisp. These children were also divided into two groups; one received articulation therapy only for a course of 14 weeks, the other group first received myofunctional therapy for 6 weeks and then articulation therapy for the remaining 8 weeks. The results of this study show that the children in both treatment groups made improvements in their articulation, but there was no difference in the total amount of change in articulation between the two groups. Therefore it can be suggested that tongue thrust treatment alone causes no difference in speech production. These results were similar to the third article reviewed.

In terms of the first hypothesis stated by the author, it has been found that training part of a task can be an effective way to increase learning of a complex task, but only under limited conditions. If the behaviour being learned consists of highly interdependent parts, then part training will not facilitate acquisition of the task. Since speech relies on a number of highly interdependent movements, part training, such as using NSOMEs, is not felt to be an effective way of improving speech production.

The second hypothesis looks at increasing tone and strength of the articulators. In children with PADs, strength is a complicated issue. First of all, a label of 'PAD' implies that the child would not have muscle weakness. A child is only given this label when there is no evidence of an organic basis to the speech problem and so, to treat a child who is labeled as 'PAD' by using exercises aimed at increasing strength would be futile. Secondly, it is not clear how much strength is required to articulate. So it is hard to evaluate whether a child has enough strength to articulate adequately or not.

Therefore, we need to question the use of NSOMEs as a treatment to increase the strength of the articulators for speech.

The third hypothesis deals with the notion that early sensorimotor experiences are what form the basis of our speech development, and that if a child suffers from sensory deficits, this will have an impact on their motor learning. However, upon review of the research, the author states that studies do not reveal a clear connection between a child's articulatory skill and kinesthetic sensitivity. Therefore it is hard to argue a case for using NSOMEs to treat children with PAD.

The fourth and final hypothesis posits that speech acquisition comes from a child's early non-speech behaviours, such as sucking and chewing, and is modified over the course of development to include more diverse behaviours such as speech. If this hypothesis proves to be true, then using NSOMEs to treat children with PADs would in fact be beneficial to acquiring speech. There are few studies that have looked at these patterns, but those that have suggest that speech movements and non-speech movements are very different from each other, even at the earliest stages of speech acquisition. Therefore, using NSOMEs to treat PADs is an inefficient use of time.

Based on the author's review of currently available literature, this author feels that NSOMEs should not be used as a legitimate intervention technique with children who have a PAD.

**Literature Review #2:** In a retrospective review of previous research, Lass and Pannbacker (2008) review the principles of evidence-based practice (EBP) in order to apply them to non-speech oral motor exercises (NSOMEs) to help clinicians make valid, evidence-based conclusions about whether they should be using NSOMEs as a treatment method in their clinical practice. Despite being in use for years, NSOMEs are a controversial issue because there is weak/limited evidence that supports claims of improvement in swallowing and speech. The purpose of this review is to help SLPs make informed, evidence-based conclusions about using NSOMEs, especially as it applies to intervention of phonological disorders.

In order to review the current literature, the authors conducted hand searches as well as a search of electronic databases. They came up with a total of 46 peer- and non-peer-reviewed articles. Eleven studies concerning the application of NSOMEs for phonological disorders were reviewed and classified according to their level of evidence; one class Ib; one class IIa; seven class IIb, and two class III. Out of these

eleven studies, only two were found to suggest that NSOMEs may be beneficial in improving speech outcomes. Of the two studies that found NSOMEs to be beneficial, Lof (2003) points out that the validity of one of these studies may be questionable as there were some methodological and statistical flaws. Also important to note is that only three of the eleven studies have been published in peer-reviewed journals. The rest are either pending publication or were presented at an ASHA annual meeting.

Studies of non-speech outcomes were also evaluated. Eight out of the nine studies were related to muscle control and feeding. Two studies were classified as level I, three were rated at a level II, and four were considered a level III as they were non-experimental studies. These studies provide weak support for using NSOMEs as a way to treat muscle control and feeding.

There were also a few studies that included both speech and non-speech outcomes. None of these reports however contained scientific, controlled data, and as a result they were all rated as class IV evidence. As this is such a weak rating, the evidence is not considered to be credible.

Based on a deficiency of high levels of evidence, NSOMEs should not be used as a method of intervention for speech sound disorders until further research can be done, at a higher level of evidence, to indicate that NSOMEs are an effective therapy tool.

**Literature Review #3:** In another retrospective literature review, Ruscello (2008) discusses three specific topics in his evaluation of non-speech oral motor exercises (NSOMEs); (1) a definition of NSOMEs and a description of specific techniques and their purposes, (2) the theoretical background and intended purposes of the exercises, and (3) a literature review of current research on the topic.

NSOMEs originated from a phonetic and/or a phonemic treatment because the exercises are aimed at the non-speech motor movements and oral postures needed to develop the motor patterns that are required for speech sound production. NSOMEs however, have a history of being controversial in treating communication disorders.

The author defines NSOMEs as activities that are used to manipulate the resting posture and/or movements of the lips, jaw, and tongue. Other research adds to that definition by saying that the exercises are designed to “increase strength and improve muscle tone and range of motion” (Clark, 2005). NSOMEs can be split into three categories; active muscle exercises, passive muscle exercises and sensory stimulation.

Active muscles exercises are the most common type of NSOMEs used. One can use active exercises for strength training and stretching. Passive exercises are considered the movement of a muscle (or muscle group) either through the use of exercise machines or by assistance from the clinician. The purpose of a passive exercise is to maintain joint flexibility, facilitate sensory input to a muscle (or muscle group) or to enhance tone.

Sensory stimulation is a technique used mostly with children who have speech sound disorders of an unknown etiology. This technique includes the use of massage, vibration, temperatures (hot/cold) and electrical stimulation to elicit a response from the motor system.

The author reports that there are currently two theoretical rationales behind the use of NSOMEs; one stems from research in occupational and physical therapy, while the other is from speech literature. The theory stemming from occupational and physical therapy suggests that people have a template for how they make their normal movements. This template is programmed in the central nervous system (CNS) and if there is damage to the CNS, the pre-programmed movement patterns are disrupted by abnormal patterns of tone or reflex behavior. Based on this theory, treatment is aimed at reducing the reflex and tone disorders so that normal movements can emerge.

The second theory, based on speech literature, states that speech functions and vegetative, non-speech functions are coordinated in the same way. Therefore, activities such as a babies chewing or sucking are precursors to the formation of speech skills. However, recent research on this topic does not support this hypothesis.

In a review of the literature, the author looks at ten studies available on the topic of treating speech sound disorders by using NSOMEs. Of the ten studies, five of the articles look at children who have a developmental speech sound disorder in combination with an oral myofunctional problem such as tongue thrusting. One study concluded that there was no improvement in articulation following NSOMEs. Three of the studies used NSOMEs in combination with speech sound treatment, either simultaneously or in SBS format. Both of the studies showed improvement in the articulation of children’s speech sounds when using the two techniques in combination, as well as slight improvement in the groups who were solely given NSOMEs. The final study out of five, showed a slight improvement in articulation of the treated speech sound as a result of NSOMEs, with the examiner claiming that the resting posture of the tongue and lips, as well as articulation

was improved as a result of the child's tongue thrust therapy.

The second set of articles that the author examined used NSOMEs as a treatment for children with articulation disorders. Of these five articles, only one showed positive results of using NSOMEs to treat articulation, and that study used speech therapy in combination with NSOMEs.

Overall the author states that these studies lack "appropriate experimental control" and that they have not been given adequate peer review. The author also supports the view that there is not enough credible evidence to support the use of NSOMEs as a therapy to improve articulation, and that in order to continue to use this therapy in clinical practice, there need to be more evidence-based studies done to help support or reject this as a valid therapy technique.

### ***Discussion***

From the studies gathered and reviewed above, it is evident that more evidence-based research is required on the topic of non-speech oral motor exercises (NSOMEs). Of the five articles reviewed in this paper, all were found to have relatively weak levels of evidence. As well, within the literature reviews, the studies being evaluated were all found to have low levels of evidence, even when they were reported to support the use of NSOMEs,

Tasks involving NSOMEs are hard to critically evaluate as there are many factors involved in the production of these exercises that are difficult to control. First of all, NSOMEs are purported to increase strength, but Lof (2006) states that the actual strength needed to articulate for speech is very low, and does not come close to the maximum strength abilities that the articulators possess or perform, during NSOMEs. In order to help refute or justify the use of NSOMEs, future evidence-based research needs to find a way for researchers to objectively measure whether a client first, has articulatory weakness and second, whether their articulatory strength is increased following NSOMEs (Lof, 2006).

A second factor that needs to be controlled for in future research is the way in which NSOMEs are used. In order to strengthen any other muscle of the body, there is a basic strength training paradigm that needs to be followed; the exercise must be repeated many times, with resistance, until failure, and then this must be done over, and over again (Lof, 2006). Most NSOMEs however, do not use this model of strength training; there is usually no resistance involved in an exercise,

and the exercises are often not repeated enough times to produce any actual increase in strength (Lof, 2006).

As evidenced by Lof & Watson (2008), Forrest (2002) and Ruscello (2008), clinicians and researchers also need to take into account the etiology of a population when considering use of NSOMEs. In their nationwide survey, Lof & Watson (2008) found that this intervention procedure was being used across disorder etiologies that are fundamentally different. As an example, clinicians surveyed were using NSOMEs to treat both motor movement disorders and language-based difficulties, when the philosophy behind using NSOMEs is to improve the resting posture of the tongue, lip and jaw, increase the strength, muscle tone and range of motion of the articulators, and help to develop overall muscle control (Ruscello, 2008). It is doubtful that motor skills learned from the use of NSOMEs would benefit a child with language-based difficulties (Lof, 2006; Lof & Watson, 2008; Forrest, 2002).

### ***Clinical Implications***

Currently, the available evidence suggests that non-speech oral motor exercises (NSOMEs) are not an effective technique for the treatment of children with articulation difficulties. Clinicians need to critically evaluate the evidence in order to make a decision as to whether they will continue to use these exercises in their clinical practice.

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