Immediate effects of chiropractic thoracic manipulations on the autonomic nervous system

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Research Paper

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Abstract

Introduction: The aim of this study is to investigate the immediate effects of chiropractic thoracic manipulations on the autonomic nervous system through heart rate variability data. The study includes 30 healthy individuals and thoracic spine physical examinations were performed before the application of the chiropractic thoracic manipulations. The 30 participants were randomly divided into two groups: an experimental group and a placebo group. Thoracic manipulations were applied after 5 minute Heart Rate Variability (HRV) measurement of each 15 individuals in the experimental group via the eMotion Faros device. The 15 participants in the placebo group were also subjected to the same measurements and analyses before sham manipulations. The measurements were then repeated after the manipulations for the two groups. Consequently, the data obtained by these measurements was evaluated by the Kubios HRV analysis software.

Result: As a result of the measurements and analyses, significant decreases were found in the parasympathetic nervous system activity (RMSSD, HF power, PNS index, pNN50 values decreased) for participants in the experimental group, while there were significant increases in the sympathetic nervous system activity (LF power, SNS index, stress index values increased) ($p<0,05$). In placebo group there was no change for all the parameters ($p>0,05$).

Conclusion: In conclusion, it is observed that thoracic chiropractic manipulation has an immediate effect on the autonomic nervous system activity.

Keywords: chiropractic, thoracic manipulation, autonomic nervous system, sympathetic nervous system, parasympathetic nervous system

Abbreviations: HRV: Heart Rate Variability; SMT: Spinal Manipulative Therapy; HVLA: High Velocity Low Amplitude; RMSSD: Root Mean Square of the Successive Differences; HF: High Frequency; LF: Low Frequency;

INTRODUCTION

Back pain is commonplace in the general population and may cause serious individual and socio-economic problems. The annual prevalence of back pain is approximately 35% in the Danish population. Complementary medicine modalities are commonly used by patients who suffer from back pain. 75% of patients worldwide apply for chiropractic therapy, physiotherapy or osteopathy treatment. Spinal Manipulative Therapy (SMT) and spinal mobilization are treatment options that clinicians commonly offer to patients with back pain [1].

Chronic thoracic pain is less common than chronic low back or neck pain. However, impairments caused by chronic thoracic pain are similar to the other regions. Additionally, a variety of invasive techniques like epidural or facet joint injections are used more rarely in the thoracic spine than in the lumbar or cervical spine. Thoracic facet joints arthritis, intervertebral disc herniation, ligament tears or radiculitis may be responsible for chronic thoracic pain [2].

Chiropractors are healthcare professionals who offer services in diagnosis, treatment, prevention of neuromuscular skeletal system disorders and their effect on public health, focus on dysfunctions, and use manual therapies such as joint adjustment and manipulation. [3-5]. The building blocks of chiropracty consist of the interaction between the structure composed of the spine and the musculoskeletal system and functions of the nervous system. And the fundamental philosophy of chiropracty is to protect health and resolve health problems [3].

Spinal manipulative therapies are often used in treating back pain. High-Velocity Low Amplitude (HVLA) Manipulation is performed by applying high-velocity and low-amplitude thrust after passively reaching the end of a joint movement. Manipulation creates mechanical effects by causing instantaneous or immediate changes in the spine and surrounding soft tissue. It has been demonstrated that the amount of movement of the facet joint capsule and the vertebral rotation during spinal manipulations are the same as the changes that occur during physiological movements. Clinical studies involving sham manipulations take into account the types of sensory inputs that try to be mimicked or excluded. Studies have shown that sham manipulations, which provide pre-load but do not include a driving force, have the potential to activate Paraspinal muscle afferents [6,7].

Although the physiological mechanisms underlying spinal manipulative techniques are still unknown, several hypotheses have been proposed that offer mechanical, neurophysiological and psychological justifications for these techniques. The mechanical force used during manipulation has a direct effect on the central nervous system, which generates positive neurophysiological responses that cause a general central sensitivity. The effects of manipulation are beyond just biomechanical changes. It also has effects on both the somatic nervous system and the autonomic nervous system. Somatic nociceptive and autonomic regulatory regions in the central nervous system usually respond to the same somatic or visceral afferent inputs [8-10].

In the sympathetic nervous system, preganglionic neurons take root from the T1-T5 lateral gray columns for the heart. Sympathetic nerve endings reaching the heart ultimately lead to an increased chronotropic and inotropic effect on the heart and slight vasodilation of the coronary arteries. Due to this anatomic relation, certain chiropractors have stated that manipulation of the thoracic spine affects the sympathetic nervous system [11].

A sympathetic response is expected when chiropractic manipulation is applied to a thoracic segment since the sympathetic fibers include the stellate ganglion that stimulates the sympathetic chain ganglia in L2-3 interval and particularly C7-T1 junctions in the upper thoracic region. In addition, the parasympathetic nerve fibers connected to the brainstem are associated with the C1 and C2 vertebrae. In line with this information, the upper cervical segment is expected to give a parasympathetic response while the thoracic segments are expected to give a sympathetic response [12].

Heart Rate Variability (HRV) is the inter-beat variability in heart rate and is moderated by the balance of sympathetic and parasympathetic divisions of the autonomic nervous system which reflects the changes in it. Many research studies are based on the paradigm that increased sympathetic tone is associated with decreased parasympathetic tone and vice versa. In this regard, HRV values are more than an indicator of possible disorders in the autonomic system. Certain disorders trigger parallel changes in the sympathetic and parasympathetic nerve activity. HRV is also accepted as a parameter that carries the complex interaction between the brain and the cardiovascular system. Vertebral manipulations can affect the autonomic nervous system activity and cause a change in HRV parameters [13,14]. Painful disorders of the vertebral column are strongly related to the activity of the autonomic nervous system. By the way, the neurophysiologic effects of the manipulations might differ between healthy volunteers and pain patients [15,16]. So, understanding the effects of the spinal manipulations more precisely on this system is needed.

The aim of this study is to determine the immediate effect of chiropractic thoracic manipulation on the autonomic nervous system via heart rate variability.

DATA AND METHODOLOGY

This study included 30 healthy participants who applied to Acibadem Beylikduzu Surgical Medical Center between April-May 2019 and were diagnosed with mechanical limitations in the thoracic region, after physical examination by a physiotherapist with 2 years' experience in chiropracty. In the physical exam, the thoracic range of motion was tested and soft tissue movements were investigated by palpation. The participants were evaluated and tested to determine if the individuals met the study criteria. Following this stage, the study procedures were explained to the patients who then read and signed the voluntary consent form.

Ethics committee approval and work permit number 2019-7/27 were obtained on 04.04.2019 for the study.

SELECTION OF CASES

Criteria for inclusion in the study:

1. Age between 18-50 years
2. Literacy in the Turkish language
3. Willing to participate in the study voluntarily
4. Limitation of movement in the thoracic region in physical examination

Criteria for exclusion from the study:

1. History of traumatic disability in the thoracic spine
2. Tumoral, infectious, psychiatric, systemic disease or bleeding diathesis
3. Having any treatment due to severe kyphosis, cervical, thoracic or lumbar dysfunction
4. Contraindications to HVLA manipulation like severe osteoporosis, nerve compression, also participants with positive Forestier's sign, Beevor's sign, Naffziger's test, Schepelmann's sign

METHODOLOGY

Demographic information was obtained from the individuals who had fulfilled the study criteria prior to application. Mechanical limitations in the thoracic region were checked by a range of motion tests and palpation was performed to evaluate soft tissue movements.

Examinations, manipulations, and measurements were carried out by a 5-years experienced physiotherapist under supervision of a physiatrist. Originally, 31 individuals were considered for the trial. 1 individual was found to have no limitation after examination and the remaining 30 individuals were found to have mechanical limitations in the mid-thoracic region. Therefore the individual with no limitations was excluded from the study. Individuals who had mechanical limitations were randomly divided into 2 equally sized groups, respectively (first participant to experimental group, next participant to placebo group), therefore 15 participants were assigned to the experimental group and the other 15 were assigned to the placebo group. The group of the participant was already determined before examination. If he or she was excluded from the study, the next one's group didn't change. A sampling of this study is shown in Fig. 1.

Thoracic chiropractic manipulations HVLA were applied to the experimental group and sham manipulations were applied to the placebo group. The individual was asked to cross his arms in front of his chest in the supine position. The hand of the practitioner was placed in the form of a half-fist on the back of the individual below the limited thoracic region. In this position, the transverse processes lie under the fingertips and thinner area of the hand. The other hand supported the neck from posteriorly under the neck of the individual. Posterior-anterior stimulation was given by pushing the individual from front to back and facet joint shifts were noticed. Thus, high-speed low amplitude thrust force was applied. In sham manipulation, only positioning was performed. The application of the manipulations lasted 15 minutes in total for each individual. 5-minute HRV measurements were performed using the eMotion Faros device before and after the application and the results were analyzed in detail using Kubios (HRV) Heart Rate Variability analysis software.

The measurements were done in a comfortable sitting position. Normal breathing is advised during measurement and the temperature was stabilized 20-25°C. The participants were instructed not to eat and smoke for two hours before measurement and they were asked to go toilet if there was a need. They were said to sleep well, drink no alcohol for the previous day. Also, participants were asked not to engage in heavy sports for the measurement day and the previous day.

Root Mean Square of the Successive Differences (RMSSD), High Frequency power (HF power), the percentage of successive R-R intervals (the time interval between successive electrocardiogram R-waves) that differ by more than 50 milliseconds (pNN50) and Parasympathetic Nervous System index (PNS index) were the components of the HRV that were used to evaluate the activity of the PNS. For the sympathetic activity, Low-Frequency power (LF power), Sympathetic Nervous System index (SNS index) and stress index were the parameters. The LF (and HF) powers in normalized units (n.u.) provide a more direct link to sympathetic (and parasympathetic) nervous activities. In addition, Baevsky's stress index is strongly linked to sympathetic nervous activity. Thus, the PNS index computed in Kubios HRV is based on Mean RR, RMSSD and HF power (n.u.); and SNS index is based on the mean Heart Rate (HR), Baevsky's stress index and LF power (n.u.). PNS and SNS indexes are computed as mean deviation from normal values. Therefore, PNS and SNS index values of zero mean that the parameters are on average equal to their normal values. In summary, PNS and SNS indexes provide reliable estimates of autonomic nervous system activities as compared to normal resting values.

Since the number of individuals in each group was less than 30 (n<30), no normality distribution was required, and non-parametric tests were used [17]. A Wilcoxon Signed-Rank Test was used to determine whether there was a significant difference in pre and post-application values, and a Mann Whitney U test was used to determine whether there was a significant difference between the experimental and control groups in terms of measurements [18]. IBM SPSS 22.0 statistics software was used for analysis and p<0.05 significance level was taken as a basis.

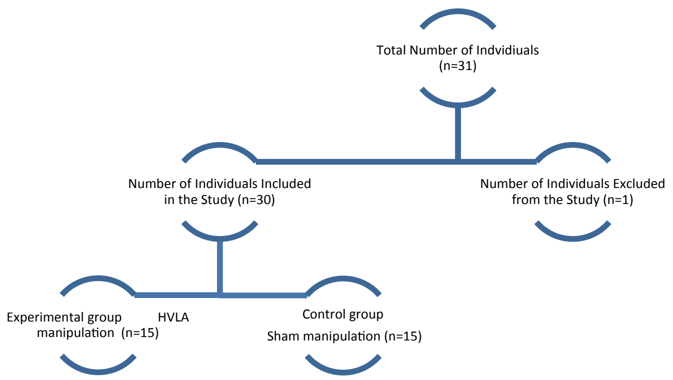

Fig. 1. Sampling of the study

FINDINGS

The study included 10 females (33.3%) and 20 males (66.6%) and in each group, there were 10 males and 5 females. The average age of the patients was 28.33 ± 9.35 years in the sham group and 29.13 ± 6.71 in the HVLA group, making a total of 28.73 ± 8.00. The mean height was 177.47 ± 7.58 (meters) in the sham group and 175.4 ± 7.58 in the HVLA group, therefore, the grand total was 176.93 ± 14.27. As a result of the Mann Whitney U test applied to determine the distribution between the groups, it was found that age, (p=0.48), height (p=0.57) distributions between the groups were not statistically significant.

A Mann Whitney U test was used to compare the Mean R-R measurement values (millisecond) before and after the applications for both the HVLA and sham groups, while Wilcoxon Signed-Rank Test was used to compare the effects of the HVLA and sham manipulation groups on Mean R-R measurement values. Mean R-R reflects the overall HRV. Elevation of the PNS activity increases HRV and Mean R-R values but the latter is less specific according to RMSSD.

In short, it was found that the effects of HVLA (Z=-0.48, p>0.05) and sham (Z=-398, p>0.05) manipulations on the mean RR values were not statistically significant.

Mann Whitney U test was also used to compare the RMSSD results of the HVLA and sham groups before and after application and the results are shown in Table 1. In addition, Table 2 shows the comparison between HVLA and sham manipulation groups in terms of their effect on RMSSD results determined via a Wilcoxon Signed-Rank Test.

From Table 1, it can be observed that RMSSD measurement results were statistically significant in the placebo and experimental groups before application (U:55 and p<0.05), while there was no statistically significant difference between the placebo and experimental groups after application (U:96.5 and p>0.05).

Analyzing Table 2, it can be observed that the sham manipulations

Table 1. Comparison of Root Mean Square of the Successive Differences (RMSSD) measurement results before and after applications in both the placebo and experimental groups

RMSSD	**Placebo group (N=15)**		**Experimental group (N=15)**			
Millisecond (ms)	Mean rank	Rank sum	Mean rank	Rank sum	U	p
Before application	11.67	175	19.33	290	55	0.017
After application	16.57	248.5	14.43	216.5	96.5	0.507
U and p: Statistically significant differences in the placebo and experimental groups in RMSSD measurement results p>0.05: Differences were considered significant; p<0.05: Differences were considered non-significant						

had a negative effect (decrease in the RMSSD values) on 6 people and a positive effect on 9 people (increase in the RMSSD values). However, HVLA manipulations had a negative effect on all 15 individuals. Overall, the effect of Sham manipulation (Z=-1.08, p>0.05) on RMSSD values were not statistically significant, while the effect of HVLA manipulation (Z=-3.41, p<0.05) on RMSDD values were statistically significant in a negative direction.

HF power measurement values (n.u.) of the HVLA and sham groups before and after applications were compared and contrasted via Mann Whitney U test. Table 3 shows the comparison between HVLA and sham manipulation groups in terms of their effect on HF POWER measurement results obtained by the Wilcoxon Signed-Rank Test. Analyzing Table 3, it can be observed that sham manipulations had a negative effect on 7 people and a positive effect on 8 people. However, HVLA manipulations showed a negative effect on 12 people and a positive effect on 3 people. Thus, the effect of sham Manipulation (Z=-0.09, p>0.05) on HF power value was not statistically significant, while the effect of HVLA manipulation (Z=-2.05, p<0.05) on HF power value was statistically significant in a negative direction (decrease in value).

Table 4 shows that sham manipulations had a negative effect on 5 people and a positive effect on 10 people. However, HVLA manipulations had a negative effect on 14 people and a positive effect on 1 person. In summary, the effect of sham manipulations (Z=-0.97, p>0.05) on PNS index value was not statistically significant, while the effect of HVLA manipulation (Z=-0.97, p>0.05) on PNS index value was statistically significant in a negative direction.

Table 5 demonstrates that sham manipulations had a negative effect on 7 people and a positive effect on 8 people, while the HVLA manipulation had positive effect on all 15 people. The effect of Sham manipulation (Z=-0.31, p>0.05) on Stress index (Square root of Baevsky's stress index) value was not statistically significant, while the effect of HVLA manipulation (Z=-3.41, p<0.05) on Stress index value was statistically significant in a positive direction.

Table 6 demonstrates that sham manipulations had a negative effect on 8 people and a positive effect on 7 people, while the HVLA manipulations had a negative effect on 3 people and a positive effect on 12 people. In summary, the effect of Sham manipulation (Z=-0.11,

Table 2. Effects of Experimental and placebo group manipulations of the Root Mean Square of the Successive Differences (RMSSD) values

RMSSD	Placebo group (N=15)					Experimental group (N=15)				
Final measurement- first measurement	N	Mean rank	Rank sum	Z	p	N	Mean rank	Rank sum	Z	p
Negative rank	6	6.83	41.00	-1.08	0.28	15	8.00	120.00	-3.41	0.002
Positive rank	9	8.78	79.00			0	0.00	0.00		
Z and p: Effect of Sham manipulation on RMSSD values										

Table 3. Effects of HVLA and sham manipulations on High Frequency (HF) Power values

HF POWER	Placebo group (N=15)					Experimental group (N=15)				
Final measurement-first measurement	N	Mean rank	Rank sum	Z	p	N	Mean rank	Rank sum	Z	P
Negative rank	7	8.79	61.50	-0.09	0.93	12	8.00	96.00	-2.05	**0.04**
Positive rank	8	7.31	58.50			3	8.00	24.00		
Equal	0					0				

Table 4. Effects of HVLA and sham manipulations on Parasympathetic Nervous System (PNS) index value

PNS INDEX	Placebo group (N=15)					Experimental group (N=15)				
Final measurement- first measurement	N	Mean rank	Rank sum	Z	p	N	Mean rank	Rank sum	Z	p
Negative rank	5	8.60	43.00	-0.97	0.33	14	8.14	114.00	-3.07	0.00
Positive rank	10	7.70	77.00			1	6.00	6.00		
Equal	0					0				

Table 5. Effects of HVLA and sham manipulations on Stress index value

STRESS INDEX	Placebo group (N=15)					Experimental group (N=15)				
Final measurement- first measurement	N	Mean rank	Rank sum	Z	p	N	Mean rank	Rank sum	Z	p
Negative rank	7	9.36	65.50	-0.31	0.75	0	0.00	0.00	-3.41	0.00
Positive rank	8	6.81	54.50			15	8.00	120.00		
Equal						0				

Table 6. Effects of HVLA and sham manipulations on Low Frequency (LF) power value

LF POWER (n.u.)	Placebo group (N=15)					Experimental group (N=15)				
Final measurement-first measurement	N	Mean rank	Rank sum	Z	p	N	Mean rank	Rank sum	Z	p
Negative rank	8	7.25	58.00	-0.11	0.91	3	8.17	24.50	-2.02	0.04
Positive rank	7	8.86	62.00			12	7.96	95.50		
Equal	0					0				

Table 7. Effects of HVLA and sham manipulations on Sympathetic Nervous System (SNS) index value

SNS INDEX	Placebo group (N=15)					Experimental group (N=15)				
Final measurement- first measurement	N	Mean rank	Rank sum	Z	p	N	Mean rank	Rank sum	Z	p
Negative rank	8	6.81	54.50	-0.31	0.75	1	7.00	7.00	-3.01	0.00
Positive rank	7	9.36	65.50			14	8.07	113.00		
Equal						0				

Table 8. Effects of HVLA and sham manipulations on PNN50 value

PNN50	Placebo group (N=15)					Experimental group (N=15)				
Final measurement-first measurement	N	Mean rank	Rank sum	Z	p	N	Mean rank	Rank sum	Z	p
Negative rank	8	9.63	77.00	-0.97	0.33	10	9.50	95.00	-1.99	0.047
Positive rank	7	6.14	43.00			5	5.00	25.00		
Equal						0				

p>0.05) on LF power value was not statistically significant, while the effect of HVLA manipulation (Z=-2.02, p<0.05) on LF power value was statistically significant in a positive direction.

Table 7 demonstrates that sham manipulations had a negative effect on 8 people and a positive effect on 7 people, while the HVLA manipulation showed a negative effect on 1 person and a positive effect on 14 people. In summary, the effect of Sham manipulation (Z=-0.31, p>0.05) on SNS index value was not statistically significant, while the effect of HVLA manipulation (Z=-3.01, p<0.05) on SNS index value was statistically significant in a positive direction.

Table 8 shows the comparison between the HVLA and sham groups in terms of pNN50 measurement values before and after applications obtained by Mann Whitney U-test.

Analyzing Table 8, it can be observed that sham manipulations had a negative effect on 8 people and a positive effect on 7 people, while HVLA manipulations had a negative effect on 10 people and a positive effect on 5 people. In this regard, the effect of Sham manipulation (Z=-0.97, p>0.05) on PNN50 value was not statistically significant, while the effect of HVLA manipulation (Z=-1.99, p<0.05) on PNN50 value was found to be statistically significant in a negative direction.

DISCUSSION

The aim of this study was to measure the immediate effect of chiropractic thoracic manipulation on the autonomic nervous system by the HRV. The study was conducted in a controlled manner on 30 individuals aged between 18-50 years. HVLA manipulation used in the study is generally used in the treatment of pain, limitation of movement, posture disorders, and joint dysfunctions. It is observed that studies on the chiropractic method give information on the autonomic nervous system, however, this interaction is usually neglected.

RMSSD, pNN50, and HF power are values that are related to the parasympathetic nervous system activity, while LF power and stress index are values that are related to the sympathetic nervous system activity [19]. Additionally, the PNS index and SNS index are associated with parasympathetic and sympathetic activities stated in Kubios software based on data from 21000 people, obtained by Nunan et al. [20]. While there was an evident decrease in parasympathetic nervous system values such as RMSSD, pNN50, HF power, and PNS index as a result of the study, sympathetic nervous system values such as LF power, Stress index and SNS index showed an evident increase. It was observed that there was no statistically significant change in specific values of Mean RR and Mean HR.

Literature reviews indicate that there is a very limited number of published studies that have undertaken similar investigations, largely because chiropractic manipulations are used more for their effect on joint dysfunctions. The effect of thoracic HVLA manipulation on HRV in healthy adults was examined in a study conducted by Budgell and Polus [21] with 28 participants aged between 18-45 years. This study also demonstrated that thoracic HVLA manipulation creates short-term changes in HRV indicating that it may partially affect the autonomic nervous system, although there is no statistically significant effect.

In their study, Welch and Boone [22] analyzed the effect of chiropractic manipulation on cervical and thoracic joint dysfunctions and the autonomic nervous system in 40 individuals aged between 25-55 years. Blood pressure and heart rate were measured in all individuals, while HRV was measured in only 7 individuals. As a result of these analyses, cervical manipulation was found to be statistically effective on blood pressure, while thoracic manipulation was not statistically effective. At the same time, there was no statistical significance in HRV measurements of the 7 individuals. Measurement with a wider sample group is suggested since the number of individuals in this study is low.

With the exception of one specific study, many research studies including the compilation conducted by Kingston et al. [23] on the effects of spinal mobilization on the sympathetic nervous system, are carried out with asymptomatic individuals. These studies concluded that spinal mobilizations are effective on the sympathetic nervous system. Yet, spinal segments are not evaluated in these studies. Welch and Boone [22] reported that the cervical region showed parasympathetic stimulation while the thoracic region showed sympathetic stimulation, and HVLA manipulation was not performed in this study.

Silva et al. [24] analyzed the influence of thoracic spinal manipulation on autonomic modulation and heart rate in patients with rotator cuff tendinopathy. There were asymptomatic group taking true manipulation, tendinitis groups with true and placebo manipulative treatments. They found no differences among the true manipulation and placebo groups. All the three groups showed the same autonomic behavior after the intervention, suggesting stimulation of the parasympathetic activity. It was recommended that autonomic nervous system activity can be influenced by body position, upper thoracic compression and manual contact, baroreceptor reflex, breathing, and the presence of pain.

Win et al. [25] investigated the effects of upper (C1-C2) and lower (C6-C7) cervical spinal manipulation on blood pressure and heart rate variability in individuals with neck pain. This study was conducted with 20 people aged between 19-23 years. It was concluded that manipulation to the upper cervical region increased parasympathetic activity while manipulation to the lower cervical region increased sympathetic activity. In addition, it was stated that the parasympathetic system was active in patients with neck pain.

Sillevis et al. [26] examined the immediate effects of thoracic spine manipulation on the autonomic nervous system by measurement of pupillary diameter. Comparing the effects of placebo and HVLA, the study included 101 individuals aged between 18-65 years with dysfunction at T3-T4 levels. As a result of this study, it was stated that manipulation did not change the pupillary diameter and therefore, did not produce any sympathetic or parasympathetic response. In our study, it was determined that HVLA manipulation resulted in an increase in the sympathetic nervous system data according to HRV measurements, while there was a decrease in the parasympathetic nervous system data. In this regard, the possible cause of the discrepancy in the study of Sillevis et al. [26] may be the measurement methods.

Zhang et al. [27], examined the effects of chiropractic therapy on HRV and pain. In this study, 96 chiropractic practitioners were given HRV measurement devices and 10 patients were asked to record their before-and-after application data for 4 weeks. The study resulted in data from 539 people when one-off measurements are omitted. Significant improvement was observed in HRV after chiropractic therapy at the end of the first and fourth weeks. However, this study did not share any information on the autonomic nervous system.

Sampath et al. [28] suggested in their study that spinal manipulation of the thoracic spine is associated with a neuro-endocrinal response. As a result, they reported changes in biomechanical structures as well as in Autonomic Nervous System (ANS) after spinal manipulation. They further stated that these changes in ANS, as a result of spinal manipulation, may be associated with the changes in the supraspinal mechanisms that control pain. Moreover, they mentioned that manipulations in different ways (mobilization, manipulation, massage) in different parts of the body (cervical, lumbar, pelvic, sacral) can produce different results since different receptors are affected by different methods of manipulation. Our study is consistent with this view. Indeed, HVLA manipulation to the thoracic region had an effect on the autonomic nervous system by decreasing parasympathetic nervous system activity and increasing sympathetic nervous system activity.

Picchiottino et al. [29] investigated the immediate effect of joint manipulative therapies on the autonomic nervous system and found that mobilizations were effective on the skin sympathetic activity, whereas HRV was ineffective (moderately positive evidence). In addition, they suggested that HVLA manipulations may have an acute effect on the cardiovascular autonomic activity, while the autonomic activity may also have an acute effect on various parameters (very low level of positive evidence).

From our study, it is suggested that the reason for the increase in the sympathetic nervous system data is that thoracic manipulation affects the sympathetic chain in the thoracic region segmentally, however, as Coote [30] suggested in his study, this increase may result in another increase in parasympathetic activity in a period of frequent short-term sympathetic activity increases.

There are no studies using the same parameters as ours in the literature review. Our study was limited to 30 individuals, applications were made to the thoracic region and instant measurements were taken. Therefore, results in different regions may vary in long-term analyses. The fact that thoracic manipulation produced an immediate increase in sympathetic activity in our study may be due to the technique that was used in the thoracic region where sympathetic fibers emerge. As yet, there are no studies in the literature evaluating the long-term effect of thoracic manipulations on the autonomic nervous system.

Consequently, it is important to explain the relationship between chiropractic manipulations and the autonomic nervous system by means of further studies involving more participants and evaluating long-term effects of cervical and lumbar chiropractic manipulations using different techniques.

CONCLUSION

In this study, we aimed to observe the immediate effects of chiropractic thoracic manipulation on the autonomic nervous system. As a result, there was a decrease in the parasympathetic nervous system data and an increase in the sympathetic nervous system data after HVLA manipulation. However, there was no variability observed in the autonomic nervous system of individuals who received sham manipulation therapy. In conclusion, it is observed that thoracic chiropractic manipulation has an immediate effect on the autonomic nervous system activity.

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