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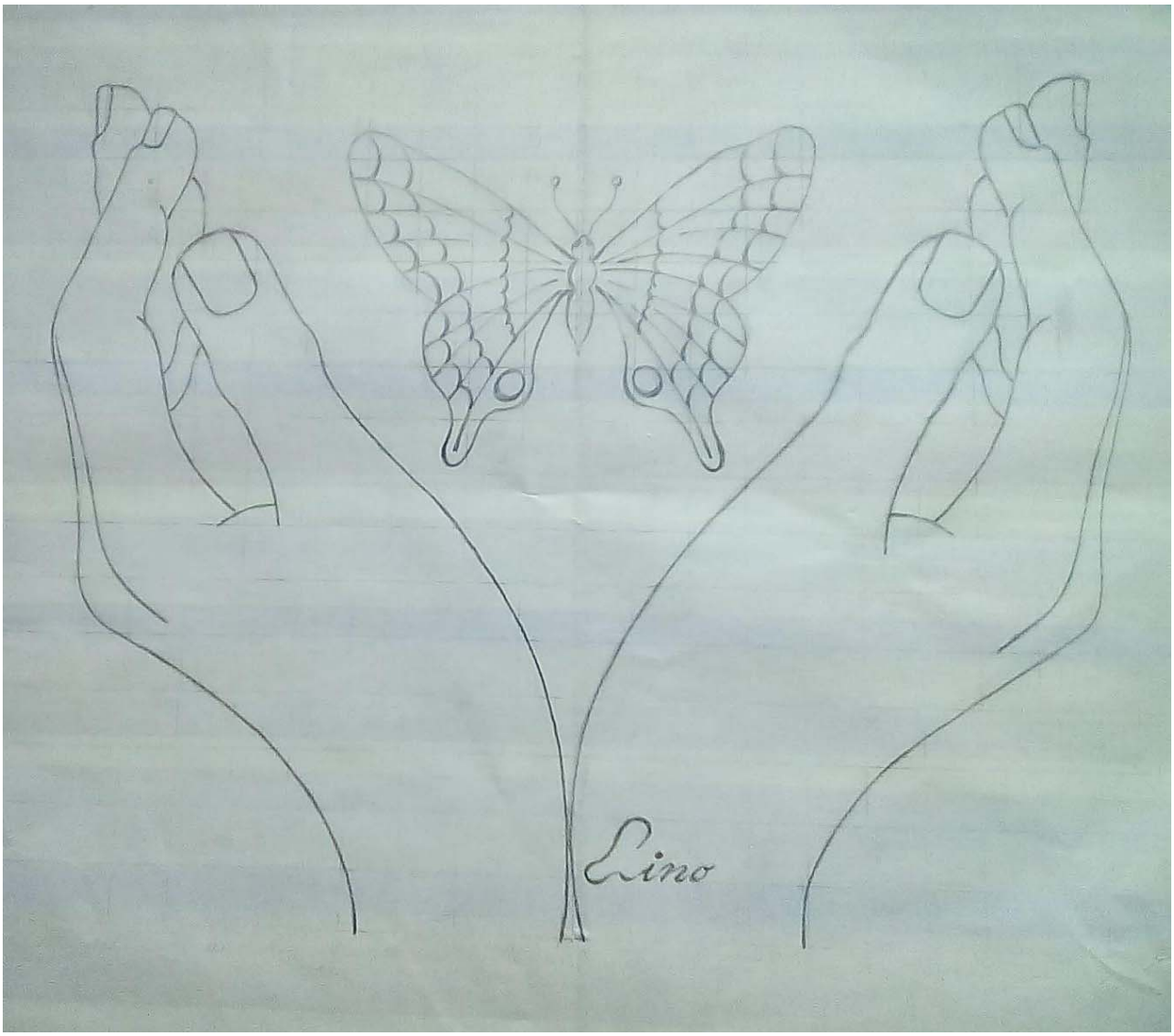

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Sympathovagal neuroautonomic assessment by studying heart rate variability (HRV) in athletes undergoing cervical-lumbar osteopathic manipulation.

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Key words: neuroautonomic assessment, heart rate variability (HRV), osteopathic manipulation.

ABSTRACT

Background: Many subjects suffer from cervical and lumbar pain caused by compression of the nerve root, due to the presence of protrusions or hernias along the course of the spine, especially in the cervical or lumbar tract. This condition is often found in young athletes. **Aim of the study:** the aim of the scientific work is to investigate, by studying the variability of the heart rate, the effect on the neurovegetative tone of osteopathic manipulation in young athletes in good health and without cardiovascular risk factors, affected by cervicalgia and lumbago from compression**. Materials and Methods:** In our study, 20 subjects were enrolled, with an average age of 37.8 years, who provided informed consent for privacy and for non-invasive recording of the parameters used for research purposes. All enrolled subjects underwent continuous digital electrocardiographic examination lasting 3 minutes or at least 250 heart beats to evaluate the orthosympathetic and parasympathetic tone. All enrolled subjects underwent baseline electrocardiographic recording before osteopathic treatment, at time

0 or (T0), and after osteopathic manipulation treatment, for the recording of post-treatment control at time 1 or (T1). In order to study any differences in the orthosympathetic and parasympathetic neurovegetative tone, the group of enrolled subjects was divided into subgroups on the basis of the area of the spine subjected to treatment. No subject performed cervical and lumbar manipulation simultaneously in the same session in order to avoid confounding factors in the data analysis. **Results:** From the data analysis using the software for the study of heart rate variability Kubios, an increase in orthosympathetic tone emerged (LF (T0) 834.0 msec vs LF(T1) 893.0 msec) and the parallel modulation of parasympathetic tone (HF(T0) 348.0 msec vs HF(T1) 372.1 msec). This trend of sympathovagal neuromodulation is confirmed by the analysis of the orthosympathetic/parasympathetic ratio (LF/HF(T0) = 1.8 vs LF/HF(T1) = 1.9). **Discussion:** the data obtained from the study we carried out on subjects treated by osteopathic manipulation suggest a direct influence of osteopathic treatment on neurovegetative tone, more precisely, data gathered by the analysis of the frequency domain show an increase post-treatment in orthosympathetic tone and a remodulation of parasympathetic tone despite the clinical improvement of pain and functional limitation reported by the subject undergoing cervical or lumbar osteopathic manipulation. **Conclusions:** the study we carried out allows us to confirm the presence of a neurovegetative modulation in healthy subjects without cardiovascular risk factors subjected to osteopathic manipulation of the cervical and/or lumbar spine. This aspect has been further confirmed by the analysis of the orthosympathetic/parasympathetic ratio in terms of LF/HF. At the moment, given the number of subjects enrolled and the division into study subgroups for the stratification of neurovegetative changes in relation to the tract of the spine subjected to osteopathic manipulation, we believe it is necessary to consider the study as a pilot study carried out on small subgroups of enrolled subjects. Only the expansion of the study sample will be able to provide confirmation of the data analysis that emerged from the pilot study of the two subgroups.

Background: Many subjects suffer from cervical and lumbar pain caused by compression of the nerve root, due to the presence of protrusions or hernias along the course of the

spine, especially in the cervical or lumbar tract. This condition is often found in young athletes. In similar cases the possible solution is either osteopathic and rehabilitative treatment or invasive surgical treatment. Osteopathic treatment of the vagus nerve through manipulations can lead to numerous benefits, including (1) the reduction of stress, since targeted manipulations can reduce the activity of the sympathetic nervous system, decreasing the levels of stress and anxiety, (2) the improvement of digestion since the vagus nerve plays a key role in gastrointestinal motility. Improved vagal function can lead to more efficient digestion and reduced gastrointestinal symptoms, 3) regulation of Heart Rate as osteopathic techniques can help modulate heart rate, influencing cardiovascular health, 4) improvement of Respiratory Function as by intervening on the activity of the diaphragm muscle it can improve breathing and increase lung capacity, 5) modulation of Immune System activity as improved regulation of the vagus nerve can have positive effects on the immune system, improving the body's response to infections and finally, 6) reduction of Chronic Pain as visceral osteopathic manipulations can reduce muscle tension and relieve chronic pain, especially in areas related to the vagus nerve.

Aim of the study: Evidence of the efficacy of osteopathic manipulation associated with rehabilitation treatment is increasingly present in the scientific literature and thus we decided to investigate the effect of osteopathic manipulation in young athletes in good health and without cardiovascular risk factors, affected by cervicalgia and lumbago from compression. **Materials and methods:** In our study, 20 subjects over 18 years of age were enrolled (minimum age 23 years, maximum age 47 years and mean age 37.8 years) who provided informed consent for privacy and for non-invasive recording of the parameters used for research purposes. All enrolled subjects underwent continuous digital electrocardiographic examination lasting 3 minutes or at least 250 heart beats for the evaluation of orthosympathetic and parasympathetic tone using mathematical formulas for the analysis of heart rate variability in terms of the length of the RR interval (expressed in milliseconds or msec.). All enrolled subjects underwent baseline

electrocardiographic recording at time 0 or (T0) before osteopathic treatment. After performing the electrocardiographic recording, the subjects underwent osteopathic manipulation of the cervical and/or lumbar tract based on the symptoms reported to the specialist. Finally, following the osteopathic manipulation treatment, all patients were again subjected to a similar digital electrocardiographic recording lasting 3 minutes or 250 heart beats for post-treatment control at time 1 or (T1). In order to study any differences in orthosympathetic and parasympathetic neurovegetative tone, the group of subjects enrolled was divided into subgroups based on the area of the spine subjected to treatment. The first group included the subjects undergoing manipulation on the cervical segment. The second group included the subjects treated with manipulation on the lumbar segment. No subject underwent the manipulation of the cervical and lumbar segments simultaneously in the one session, in order to avoid confounding factors in the data analysis.

Results: From the data analysis using the software for the study of heart rate variability Kubios, an increase in orthosympathetic tone emerged (LF (T0) 834.0 msec vs LF(T1) 893.0 msec) and a remodulation of parasympathetic tone (HF(T0) 348.0 msec vs HF(T1) 372.0 msec). This trend of sympathovagal neuromodulation is confirmed by the analysis of the orthosympathetic/parasympathetic ratio (LF/HF(T0) = 1.869 vs LF/HF(T1) = 1.995). The variations of the three variables taken into consideration represent the indirect expression of the variations in adrenergic and cholinergic tone studied by digital electrocardiography analysis. This method is based on the use of mathematical formulas such as the fast Fourier transform and the regression analysis for the study of the frequency domain of heart rate variability. In order to differentiate any discrepancies between osteopathic treatment of the cervical district compared to the lumbar district, the analysis of heart rate variability was repeated by stratifying the subjects of the study based on the segment of the spinal column subjected to treatment. In the study group that included patients subjected to treatment of the cervical segment, an increase in orthosympathetic tone was found (LF(T0) = 165.9 msec vs LF(T1) = 222.8 msec) and the remodulation of parasympathetic tone (HF(T0) =

147.1 msec vs HF(T1) = 102.4 msec) with a reduction in the LF/HF ratio, i.e. (LF/HF(T0) = 1.1 vs LF/HF(T1) = 1.2). In the study group that included subjects undergoing treatment of the lumbar segment, an increase in orthosympathetic tone (LF(T0) 925.6 msec vs LF(T1) 1027.5 msec) and a reduction in parasympathetic tone (HF(T0) 780.6 msec vs HF(T1) 677.2 msec) was found and this trend was confirmed by the analysis of the LF/HF ratio, i.e. (LF/HF(T0) = 1.0 vs LF/HF(T1) = 1.6).

Discussion: Osteopathy uses a manual approach to improve the mobility and function of tissues, correcting and eliminating somatic dysfunctions. Correcting vagus nerve dysfunctions is a crucial part of osteopathic practices, because this nerve plays a central role in many bodily functions. This is evident when analyzing 5 main practices such as: (1) Craniosacral Mobilization Techniques, that aim to improve the mobility of the cranial bones and sacrum, indirectly influencing the vagus nerve that travels through the jugular foramen in the skull. Mobilization of the cranial structures can reduce tension around the vagus nerve, improving its function. (2) Sub Occipital Release Manipulation, as the vagus nerve enters the skull through the foramen lacerum, this area can be subject to dysfunction, between the temporal bone and the occipital bone. Manipulations in this area can facilitate proper nerve function and reduce symptoms associated with vagal dysfunction. (3) Diaphragm Manipulation, as the area is innervated by the phrenic nerve, which has connections with the vagus nerve. Osteopathic techniques that improve the mobility of the diaphragm can positively influence the function of the vagus nerve, promoting better breathing and reducing stress. The vagus nerve travels through the thoracic outlet, an area that can be subject to compression or tension. Osteopathic treatment at this point can relieve nerve compression, improving vagal function. (4) Cervical Spine Treatment, since the vagus nerve travels through the neck, and tension or dysfunction in the cervical spine can affect its function. Osteopaths use cervical manipulations with both high-velocity direct techniques (HVLA) and indirect techniques (fascial and/or aggravation techniques), to relieve these tensions, improving nerve conduction. (5) The Visceral Approach, since osteopathic techniques

aim to improve the mobility of internal organs. The vagus nerve innervates many visceral organs and therefore, improving visceral mobility can help optimize nerve function. The data obtained from the study we carried out on subjects treated with osteopathic manipulation suggest a direct influence of osteopathic treatment on neurovegetative tone, although not statistically significant. More precisely, data gathered by the analysis of the frequency domain show the increase in orthosympathetic tone and the reduction in parasympathetic tone after lumbar manipulation and both cervical-lumbar treatment. A reduction in neurovegetative modulation was instead highlighted in the group receiving cervical manipulation. In all three study conditions, a clinical improvement in pain and functional limitation was reported by subjects undergoing cervical or lumbar osteopathic manipulation. From the analysis of the data using the software for the study of heart rate variability Kubios, an increase in orthosympathetic tone emerged (LF (T0) = 834.0 msec vs LF(T1) = 893.0 msec) and a remodulation of parasympathetic tone (HF(T0) = 348.0 msec vs HF(T1) = 372.0 msec). This trend of sympathovagal neuromodulation is confirmed by the analysis of the orthosympathetic/parasympathetic ratio (LF/HF(T0) = 1.869 vs LF/HF(T1) = 1.995). The variations of the three variables taken into consideration represent the indirect expression of the variations in adrenergic and cholinergic tone studied by electrocardiographic analysis. This method is based on the use of mathematical formulas such as the fast Fourier transform and the regression analysis for the study in the frequency domain and on the use of non-linear analysis systems for the study of the entropy of the variability of the heart rate. In order to differentiate any discrepancies between the osteopathic treatment of the cervical district compared to the lumbar district, the analysis of the variability of the heart rate was repeated by stratifying the subjects of the study based on the segment of the spinal column subjected to treatment. In the study group that included subjects undergoing treatment of the cervical segment, an increase in orthosympathetic tone was found (LF(T0) = 165.9 msec vs LF(T1) = 222.8 msec) and a remodulation of parasympathetic tone (HF(T0) = 147.1 msec vs

HF(T1) = 102.4 msec) with a reduction in the LF/HF ratio, i.e. (LF/HF(T0) = 1.1 vs LF/HF(T1) = 1.2). In the study group that included subjects undergoing treatment of the lumbar segment, an increase in orthosympathetic tone (LF(T0) = 925.6 msec vs LF(T1) = 1027.5 msec) and a reduction in parasympathetic tone (HF(T0) = 780.6 msec vs HF(T1) = 677.2 msec) was found and this trend was confirmed by the analysis of the LF/HF ratio, i.e. (LF/HF(T0) = 1.0 vs LF/HF(T1) = 1.6).

Conclusions: the study we conducted allows us to confirm the presence of a neurovegetative modulation in healthy subjects without cardiovascular risk factors subjected to osteopathic manipulation of the cervical and/or lumbar spine. In all three study conditions, i.e. both in the entire study group and in the two study subgroups created by stratifying the subjects based on the segment of the spine subjected to osteopathic manipulation, variations were found, although not statistically significant, in the orthosympathetic and parasympathetic tone.

This aspect was further confirmed by the analysis of the orthosympathetic/ parasympathetic ratio in terms of LF/HF and also by studying the variability of the heart rate based on study algorithms in the frequency domain. At the moment, given the number of subjects enrolled and the subdivision into study subgroups for the stratification of neurovegetative changes in relation to the tract of the spine subjected to osteopathic manipulation, we believe it is necessary to consider the study as a pilot study carried out on small subgroups of enrolled subjects. Only the expansion of the study sample will be able to provide confirmation of the data analysis that emerged from the pilot study of the two subgroups.

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Conflicts of interests: none declared

Valutazione neuro-autonomica simpato-vagale mediante studio della variabilità della frequenza cardiaca (HRV) in atleti sottoposti a manipolazione osteopatica cervico-lombare.

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Key words: neuroautonomic assessment, heart rate variability (HRV), osteopathic manipulation.

ABSTRACT

Introduzione: Molti soggetti soffrono di dolore cervicale e lombare dovuto a compressione della radice nervosa da protrusioni o ernie presenti lungo il decorso della colonna, soprattutto nel tratto cervicale o lombare. Tale aspetto viene spesso riscontrato anche in giovani atleti. **Scopo dello studio:** lo scopo del lavoro scientifico è quello di indagare, mediante studio della variabilità della frequenza cardiaca, l'effetto sul tono neurovegetativo della manipolazione osteopatica in giovani atleti in buone condizioni di salute e senza fattori di rischio cardiovascolari, affetti da cervicalgia e lombalgia da compressione. **Materiali e Metodi**: Nello studio da noi effettuato sono stati arruolati 20 soggetti, di età media 37,8 anni, che hanno fornito il consenso informato per la privacy e per la registrazione non invasiva dei parametri utilizzati per finalità di ricerca. Tutti i soggetti arruolati sono stati sottoposti ad esame elettrocardiografico digitale continuativo della durata di 3 minuti o almeno 250 battiti cardiaci per la valutazione del tono ortosimpatico e parasimpatico. Tutti i soggetti arruolati sono stati sottoposti a registrazione elettrocardiografica basale al tempo 0 o (T0) prima del trattamento osteopatico e, successivamente, dopo

il trattamento di manipolazione osteopatica al sono stati nuovamente sottoposti ad analoga registrazione elettrocardiografica digitale per controllo post trattamento al tempo 1 o (T1). Al fine di studiare eventuali differenza del tono neuro-vegetativo ortosimpatico e parasimpatico, il gruppo di soggetti arruolati è stato suddiviso in sottogruppi in base alla zona della colonna vertebrale sottoposta a trattamento. Nessun soggetto ha effettuato contemporaneamente la manipolazione del tratto cervicale e lombare nella stessa seduta al fine di evitare fattori di confondimento nell'analisi dei dati. **Risultati:** dall'analisi dei dati mediante software per lo studio della variabilità della frequenza cardiaca Kubios, è emerso l'incremento del tono ortosimpatico (LF (T0) 834,0 msec vs LF(T1) 893,0 msec) e la parallela modulazione del tono parasimpatico (HF(T0) 348.0 msec vs HF(T1) 372,1 msec). Tale andamento della neuro-modulazione simpato-vagale è confermata dall'analisi del rapporto ortosimpatico/parasimpatico (LF/HF(T0) = 1.8 vs LF/HF(T1) = 1.9). **Discussione**: i dati ottenuti dal nostro studio effettuato su soggetti trattati mediante manipolazione osteopatica , suggeriscono una diretta influenza del trattamento osteopatico sul tono neuro-vegetativo ovvero è stato evidenziato dall'analisi dei dati mediante analisi nel dominio della frequenza che dopo il trattamento si verifica l'incremento del tono ortosimpatico e la rimodulazione del tono parasimpatico seppur in presenza di una condizioni di miglioramento clinico del dolore e della limitazione funzionale riferita dal soggetto sottoposto a manipolazione osteopatica cervicale o lombare. **Conclusioni**: lo studio da noi effettuato ci consente di affermare la presenza di una modulazione neuro-vegetativa nei soggetti sani e senza fattori di rischio cardiovascolari sottoposti a manipolazione osteopatica della colonna vertebrale sul cervicale e/o lombare. Tale aspetto è stato ulteriormente confermato dall'analisi del rapporto ortosimpatico/parasimpatico in termini di LF/HF. Al momento, dato il numero dei soggetti arruolati e la suddivisone in sottogruppi di studio per la stratificazione delle variazioni neuro-vegetative in relazione al tratto della colonna vertebrale sottoposto a manipolazione osteopatica, riteniamo doveroso considerare lo studio come uno studio pilota effettuato su piccoli sottogruppi di soggetti arruolati. Solo l'ampliamento del campione in studio potrà fornire la conferma dell'analisi dei dati emersa dallo studio pilota dei due sottogruppi.

Introduzione: Molti soggetti soffrono di dolore cervicale e lombare dovuto a compressione della radice nervosa da protrusioni o ernie presenti lungo il decorso della colonna, soprattutto nel tratto cervicale o lombare. Tale aspetto viene spesso riscontrato anche in giovani atleti. In tali casi le possibili soluzioni sono il trattamento osteopatico e riabilitativo oppure il trattamento invasivo chirurgico. Il trattamento osteopatico del nervo vago tramite manipolazioni può portare a numerosi benefici, tra cui 1) la riduzione dello Stress poiché le manipolazioni mirate possono ridurre l'attività del sistema nervoso simpatico, diminuendo i livelli di stress e ansia, 2) il miglioramento della Digestione poiché il nervo vago gioca un ruolo chiave nella motilità gastrointestinale. Una migliore funzione vagale può portare a una digestione più efficiente e alla riduzione dei sintomi gastrointestinali, 3) la regolazione della Frequenza Cardiaca poiché le tecniche osteopatiche possono aiutare a modulare la frequenza cardiaca, influendo sulla salute cardiovascolare, 4) il miglioramento della Funzione Respiratoria poiché intervenendo sull'attività del muscolo diaframma può migliorare la respirazione e aumentare la capacità polmonare, 5) la modulazione dell'attività del Sistema Immunitario poiché una migliore regolazione del nervo vago può avere effetti positivi sul sistema immunitario, migliorando la risposta dell'organismo alle infezioni ed infine, 6) la riduzione del Dolore Cronico poiché le manipolazioni osteopatiche viscerali possono ridurre le tensioni muscolari e alleviare il dolore cronico, specialmente in aree correlate al nervo vago.

Scopo dello studio: E' sempre più presente nella letteratura scientifica l'evidenza dell'efficacia della manipolazione osteopatica associata al trattamento riabilitativo e per tale motivo abbiamo deciso di indagare l'effetto della manipolazione osteopatica in giovani atleti in buone condizioni di salute e senza fattori di rischio cardiovascolari, affetti da cervicalgia e lombalgia da compressione.

Materiali e metodi: Nello studio da noi effettuato sono stati arruolati 20 soggetti di età superiore a 18 anni (età minima 23 anni, età massima 47 anni ed età media 37,8 anni) che hanno fornito il consenso informato per la privacy e per la registrazione non invasiva dei

parametri utilizzati per finalità di ricerca. Tutti i soggetti arruolati sono stati sottoposti ad esame elettrocardiografico digitale continuativo della durata di 3 minuti o almeno 250 battiti cardiaci per la valutazione del tono ortosimpatico e parasimpatico mediante formule matematiche di analisi della variabilità della frequenza cardiaca in termini di lunghezza dell'intervallo RR (espresso in millisecondi o msec.). Tutti i soggetti arruolati sono stati sottoposti a registrazione elettrocardiografica basale al tempo 0 o (T0) prima del trattamento osteopatico. Successivamente all'esecuzione della registrazione elettrocardiografica I soggetti arruolati sono stati sottoposti a manipolazione osteopatica del tratto cervicale e/o lombare in base alla sintomatologia riferita allo specialista. Infine , dopo il trattamento di manipolazione osteopatica, i soggetti arruolati nello studio, sono stati nuovamente sottoposti ad analoga registrazione elettrocardiografica digitale della durata di 3 minuti o 250 battiti cardiaci per controllo post trattamento al tempo 1 o (T1). Al fine di studiare eventuali differenza del tono neuro-vegetativo ortosimpatico e parasimpatico, il gruppo di soggetti arruolati è stato suddiviso in sottogruppi in base alla zona della colonna vertebrale sottoposta a trattamento. Il primo gruppo includeva i soggetti trattati sul segmento cervicale. Il secondo gruppo includeva I soggetti trattati sul segmento lombare. Nessun soggetto ha effettuato contemporaneamente la manipolazione del tratto cervicale e lombare nella stessa seduta al fine di evitare fattori di confondimento nell'analisi dei dati.

Risultati: dall'analisi dei dati mediante software per lo studio della variabilità della frequenza cardiaca Kubios, è emerso l'incremento del tono ortosimpatico (LF (T0) 834,0 msec vs LF(T1) 893,0 msec) e la rimodulazione del tono parasimpatico (HF(T0) 348.0 msec vs HF(T1) 372,0 msec). Tale andamento della neuro-modulazione simpato-vagale è confermata dall'analisi del rapporto ortosimpatico/parasimpatico (LF/HF(T0) = 1.869 vs LF/HF(T1) = 1.995). Le variazioni delle tre variabili prese in considerazione rappresentano l'espressione indiretta delle variazioni del tono adrenergico e colinergico studiate mediante analisi elettrocardiografia digitale. Tale metodica è basata sull'utilizzo di formule matematica come la trasformata veloce di Fourier e l'analisi

regressiva per lo studio nel dominio della frequenza della variabilità della frequenza cardiaca. Al fine di differenziare eventuali discrepanze tra il trattamento osteopatico del distretto cervicale rispetto al distretto lombare è stata ripetuta l'analisi della variabilità della frequenza cardiaca stratificando i soggetti dello studio in base al segmento della colonna vertebrale sottoposto a trattamento. Nel gruppo di studio che includeva soggetti sottoposti a trattamento del segmento cervicale è stato riscontrato l'incremento del tono ortosimpatico (LF(T0) = 165.9 msec vs LF(T1) = 222.8 msec) e la rimodulazione del tono parasimpatico (HF(T0) = 147.1 msec vs HF(T1) = 102.4 msec) con riduzione del rapporto LF/HF ovvero (LF/HF(T0) = 1.1 vs LF/HF(T1) = 1.2). Nel gruppo di studio che includeva soggetti sottoposti a trattamento del segmento lombare è stato riscontrato l'incremento del tono ortosimpatico (LF(T0) 925.6 msec vs LF(T1) 1027.5 msec) e la riduzione del tono parasimpatico (HF(T0) 780.6 msec vs HF(T1) 677.2 msec) e tale andamento è stato confermato dall'analisi del rapporto LF/HF ovvero (LF/HF(T0) = 1.0 vs LF/HF(T1) = 1.6).

Discussione: L’osteopatia utilizza un approccio manuale per migliorare la mobilità e la funzione dei tessuti, correggendo ed eliminando le disfunzioni somatiche. Correggere le disfunzionalità del nervo vago, è un focus importante nelle pratiche osteopatiche, perché questo nervo ha un ruolo centrale in molte funzioni corporee. Tale aspetto è evidente analizzando: 1) le Tecniche di Mobilizzazione Cranio-sacrale che mirano a migliorare la mobilità delle ossa craniche e del sacro, influenzando indirettamente il nervo vago che passa attraverso il forame giugulare nel cranio. La mobilizzazione delle strutture craniali può ridurre le tensioni intorno al nervo vago, migliorando la sua funzione, 2) Il nervo vago entra nel cranio attraverso il foro lacero, un punto che può essere soggetto a disfunzioni, tra osso temporale ed osso occipitale. Manipolazioni delicate in questa area possono facilitare il corretto funzionamento del nervo e ridurre i sintomi associati alle disfunzioni vagali, 3) la Manipolazione del Diaframma poiché è innervato dal nervo frenico, che ha connessioni con il nervo vago. Tecniche osteopatiche che migliorano la mobilità del diaframma possono

influenzare positivamente la funzione del nervo vago, promuovendo una migliore respirazione e riducendo lo stress. Il nervo vago passa attraverso lo stretto toracico, un'area che può essere soggetta a compressioni o tensioni. Il trattamento osteopatico in questo punto possono alleviare le compressioni nervose, migliorando la funzionalità vagale, 4) il Trattamento della Colonna Cervicale poiché il nervo vago attraversa il collo, e tensioni o disfunzioni nella colonna cervicale possono influenzarne la funzione. Gli osteopati utilizzano manipolazioni cervicali con tecniche sia dirette ad alta velocità (HVLA) ,che indirette (tecniche fasciali e/o di aggravamento), per alleviare queste tensioni, migliorando la conduzione nervosa, ed infine, 5) l'Approccio Viscerale poichè le tecniche osteopatiche mirano a migliorare la mobilità degli organi interni. Il nervo vago innerva molti organi viscerali e quindi, migliorare la mobilità viscerale può aiutare a ottimizzare la funzione del nervo.

I dati ottenuti dal nostro studio effettuato su soggetti trattati mediante manipolazione ostepoatica , suggeriscono una diretta influenza del trattamento osteopatico sul tono neuro-vegetativo, seppur non statisticamente significativa, ovvero è stato evidenziato dall'analisi dei dati mediante analisi nel dominio della frequenza l'incremento del tono ortosimpatico e la riduzione del tono parasimpatico dopo trattamento cervico-lombare o del solo distretto lombare. E' stata invece evidenziata una riduzione della modulazione neurovegetativa nel gruppo di trattamento del segmento cervicale. In tutte e tre le condizioni di studio è stato riferito un miglioramento clinico del dolore e della limitazione funzionale da parte dei soggetto sottoposti a manipolazione osteopatica cervicale o lombare. Dall'analisi dei dati mediante software per lo studio della variabilità della frequenza cardiaca Kubios, è emerso l'incremento del tono ortosimpatico (LF (T0) = 834,0 msec vs LF(T1) = 893,0 msec) e la rimodulazione del tono parasimpatico (HF(T0) = 348.0 msec vs HF(T1) = 372,0 msec). Tale andamento della neuro-modulazione simpato-vagale è confermata dall'analisi del rapporto ortosimpatico/parasimpatico (LF/HF(T0) = 1.869 vs LF/HF(T1) = 1.995). Le variazioni delle tre variabili prese in considerazione rappresentano l'espressione indiretta delle variazioni del tono

adrenergico e colinergico studiante mediante analisi elettrocardiografica. Tale metodica è basata sull'utilizzo di formule matematica come la trasformata veloce di Fourier e l'analisi regressiva per lo studio nel dominio della frequenza e sull'utilizzo di sistemi di analisi non lineare per lo studio dell'entropia della variabilità della frequenza cardiaca. Al fine di differenziare eventuali discrepanza tra il trattamento osteopatico del distretto cervicale rispetto al distretto lombare è stata ripetuta l'analisi della variabilità della frequenza cardiaca stratificando i soggetti dello studio in base al segmento della colonna vertebrale sottoposto a trattamento. Nel gruppo di studio che includeva soggetti sottoposti a trattamento del segmento cervicale è stato riscontrato l'incremento del tono ortosimpatico (LF(T0) = 165.9 msec vs LF(T1) = 222.8 msec) e la rimodulazione del tono parasimpatico (HF(T0) = 147.1 msec vs HF(T1) = 102.4 msec) con riduzione del rapporto LF/HF ovvero (LF/HF(T0) = 1.1 vs LF/HF(T1) = 1.2). Nel gruppo di studio che includeva soggetti sottoposti a trattamento del segmento lombare è stato riscontrato l'incremento del tono ortosimpatico (LF(T0) = 925.6 msec vs LF(T1) = 1027.5 msec) e la riduzione del tono parasimpatico (HF(T0) = 780.6 msec vs HF(T1) = 677.2 msec) e tale andamento è stato confermato dall'analisi del rapporto LF/HF ovvero (LF/HF(T0) = 1.0 vs LF/HF(T1) = 1.6).

Conclusioni: lo studio da noi effettuato ci consente di affermare la presenza di una modulazione neuro-vegetativa nei soggetti sani e senza fattori di rischio cardiovascolari sottoposti a manipolazione osteopatica della colonna vertebrale sul cervicale e/o lombare. In tutte e tre le condizioni di studio ovvero sia nell'intero gruppo di studio che nei due sottogruppi di studio creati stratificando i soggetti in base al segmento della colonna vertebrale sottoposto a manipolazione osteopatica, sono state riscontrate variazioni, seppur non statisticamente significative, del tono ortosimpatico e del tono parasimpatico.

Tale aspetto è stato ulteriormente confermato dall'analisi del rapporto ortosimpatico/parasimpatico in termini di LF/HF ed anche mediante studio della variabilità della frequenza cardiaca basate su algoritmi di studio nel dominio della frequenza. Al momento, dato il numero dei soggetti arruolati e la suddivisone in

sottogruppi di studio per la stratificazione delle variazioni neuro-vegetative in relazione al tratto della colonna vertebrale sottoposto a manipolazione osteopatica, riteniamo doveroso considerare lo studio come uno studio pilota effettuato su piccoli sottogruppi di soggetti arruolati. Solo l'ampliamento del campione in studio potrà fornire la conferma dell'analisi dei dati emersa dallo studio pilota dei due sottogruppi.

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Conflitti di interesse: nulla da dichiarare.

TABLES

All enrolled subjects	BASE ± DS	CONTROL ± DS	Probability (P)
LF	834,000 ± 362,250	893,000 ± 347,750	0,914
HF	348,000 ± 130,250	372,000 ± 155,750	0,746
LF/HF	1,869 ± 1,112	1,995 ± 1,195	0,650
Subgroup "Cervical"	**BASE ± DS**	**CONTROL ± DS**	**Probability (P)**
LF	165,900 ± 132,000	222,800± 136,725	0,625
HF	147,100 ± 110,100	102,400 ± 69,525	0,438
LF/HF	1,100 ± 0,900	1,200 ± 1,050	0,313
Subgroup "Lumbar"	**BASE ± DS**	**CONTROL ± DS**	**Probability (P)**
LF	925,460 ± 460,200	1027,500 ± 822,300	0,844
HF	780,600 ± 587,900	677,250 ± 371,300	1,000
LF/HF	1,000 ± 0,980	1,650 ± 0,900	0,135

Table 1: Descriptive statistical analysis of the changes in neurovegetative tone pre and post osteopathic manipulation. The three different tables show the data of the entire study group and the stratified analysis dividing the subjects according to the segment of the spinal column subjected to osteopathic manipulation. The data are expressed as mean value + standard deviation (SD).

Table 1: Analisi statistica descrittiva delle variazioni del tono neurovegetativo prima e dopo manipolazione osteopatica. Le tre differenti tabelle mostrano i dati dell'intero gruppo di studio e la stratificazione dei soggetti in base al segmento della colonna vertebrale sottoposta a manipolazione osteopatia. I dati sono espressi come media ± deviazione standard (DS).

Figures

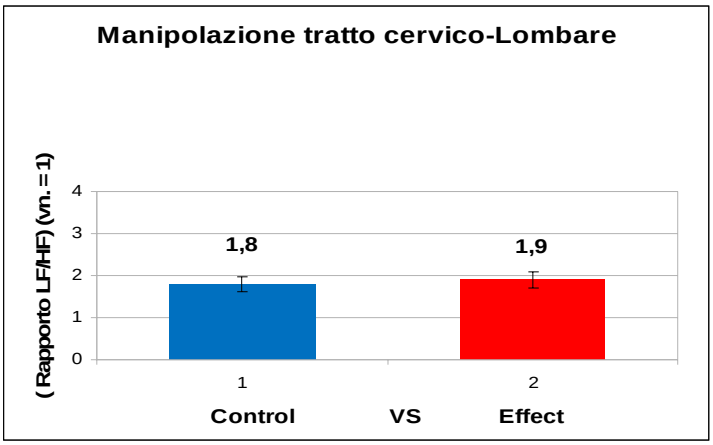

Fig. 1: Graphic representation of the effect of osteopathic treatment on the cervico-lumbar region.

Fig. 1: Rappresentazione grafica dell'effetto del trattamento osteopatico in zona cervico-lombare.

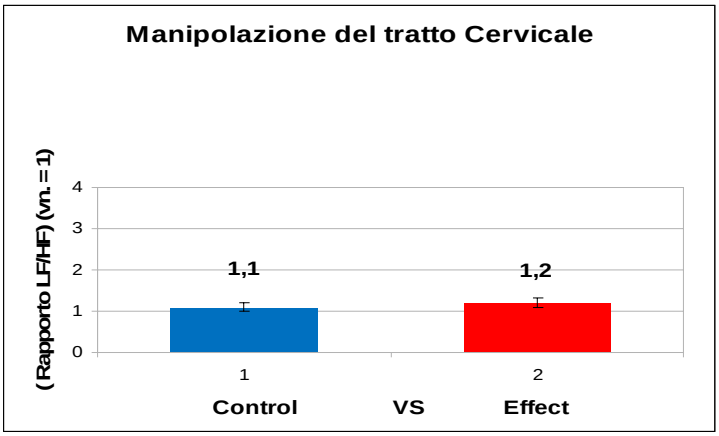

Fig. 2: Graphic representation of the effect of osteopathic treatment on the cervical region.

Fig. 2: Rappresentazione grafica dell'effetto del trattamento osteopatico in zona cervicale.

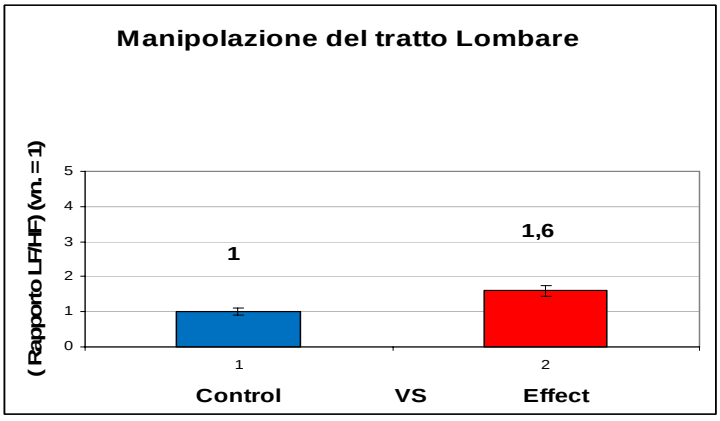

Fig. 3: Graphic representation of the effect of osteopathic treatment on the lumbar region.

Fig. 3: Rappresentazione grafica dell'effetto del trattamento osteopatico in zona lombare.

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