

## Immediate Effect of Cold and Neutral Spinal Spray on Autonomic Functions In Healthy Volunteers – A Comparative Study

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**Abstract : Background and Objectives :** Hydro therapy is a system of Naturopathic medicine where treatment is given using various forms of water. Spinal spray is one of the treatment used in hydro therapy for the management of various disorders. Hence present study aims to evaluate the physiological effects of cold and neutral spinal spray and measure the difference among them. **Materials and Methodology:** 90 male healthy volunteers were recruited for the study. Subjects were randomly allocated into three groups, cold spinal spray (Group 1), neutral spinal spray (Group 2), and control (Group 3). Intervention was given for the duration of 20 minutes. Assessments were done 5 minutes before and 5 minutes immediately after the intervention. **Results:** Results of individually groups are shown some changes, but there is significance in the form of ( $p < 0.05$ ) when compared between the inter group that is cold spinal spray and neutral spinal spray. **Conclusions:** Application of cold spinal spray on the body enhances the sympathetic activity and has could have a role in maintaining the cardiac tone and preventing various cardiovascular ailments, whereas a neutral spinal spray enhances parasympathetic activity.

**Keywords:** Hydro therapy, Spinal spray, Heart rate variability, Autonomic Nervous System, Naturopathy.

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### I. Introduction

Hydrotherapy, formerly called hydropath and also called water cure, is a part of medicine and alternative medicine, in particular of naturopathy, occupational therapy and physiotherapy. Almost all the ancient civilization has practiced and explored the therapeutic use of water.<sup>1</sup> The first definitive treatise on hydrotherapy explaining its techniques and effects was written by John Harvey Kellogg in 1900 entitled "Rational Hydrotherapy".<sup>2</sup>

Spinal spray is a local, slightly pressurized (1 pressure per square inch (PSI)) hydratic measure in which the spinal area is exposed to water of certain temperature for a specific duration to get desired effects. This procedure controls all the organs of the body, since most of the nerve roots start from the spinal cord. They are the sensory centers, temperature controlling centers, vasomotor centers and sympathetic and parasympathetic centers in the brain and spinal cord. The small and large blood vessels of the heart, lungs, digestive system and brain contract or dilate depending on the temperature of water used in the spray. It improves oxygen supply to the lungs and heart by increasing blood circulation.<sup>3</sup>

Though spinal spray treatment has been used extensively in Clinical Naturopathy both for rejuvenation as well as therapy for so many various disorders. In this present scenario it is essential to understand the underlying mechanisms of spinal spray before using it as a treatment. Currently there are no scientific studies reporting physiological effects of spinal spray. Hence, the present study is aimed to evaluate the physiological effects of cold spinal spray and neutral spinal spray among healthy individuals.<sup>3</sup>

### II. Methodology

#### 2.1. Subjects

Ninety normal healthy volunteers of both males and females ages ranging between 18 to 28 years were recruited.

##### 2.1.1. Study Group

Male Students from Sri Dharmasthala Manjunatheshwara (SDM) College of Naturopathy and Yogic Sciences, Ujire, Dakshina Kannada were recruited for the study.

##### 2.1.2. Inclusion criteria

The following inclusion criteria will be on the basis for selecting subjects

1. Age: 18 to 28 years.
2. Who won't consume alcohol or tobacco products since 24 hours before the intervention.
3. Genders: Both Males and Females.
4. BMI: 20-23 kg/m<sup>2</sup>.

### 2.1.3. Exclusion criteria

Participants will be excluded if they have

1. History of mental illnesses.
2. History of alcohol/ substance abuse.
3. Menstruation.
4. Those who are under any medications during the study.<sup>4</sup>

### 2.1.4. Consent form

The subjects were instructed about the study and all subjects who are willing to take part in the study were considered. A signed informed consent was obtained from each individual. Institutional Ethical Committee approved the study.

## 2.2. Study setting

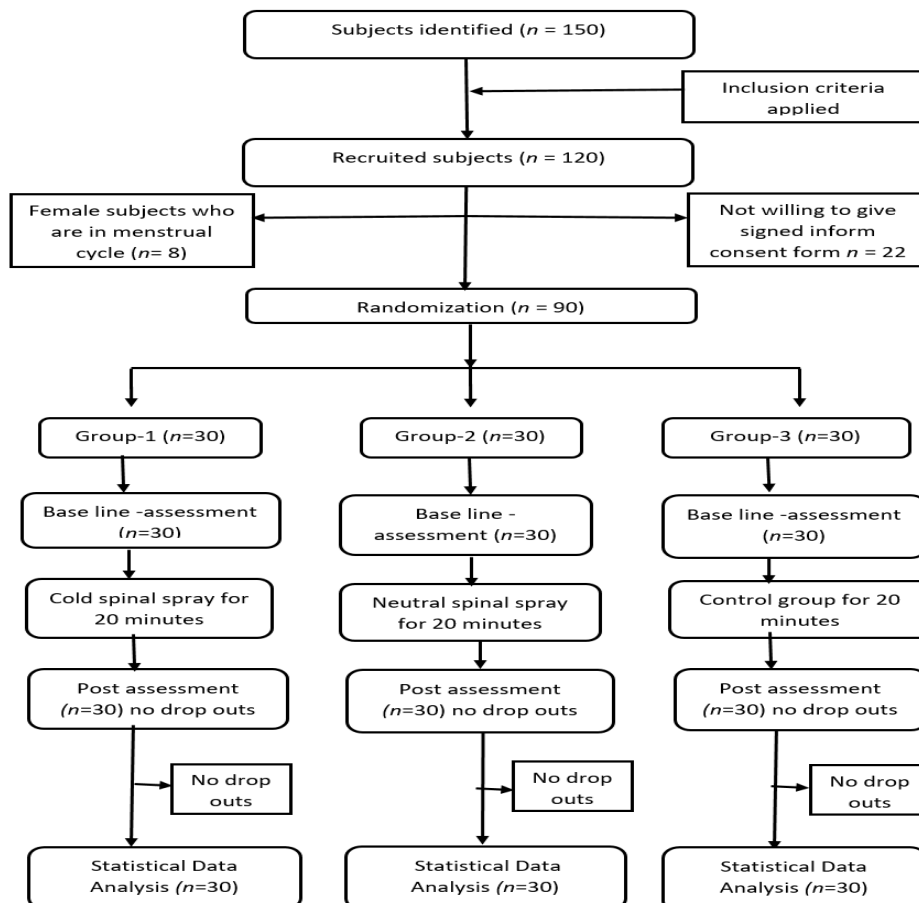
### 2.2.1. Setting for assessments and Interventions

Subjects were randomly allocated into two groups using computerized generated random number table. For (group 1) cold spinal spray was given for 20 minutes, for (group 2) neutral spinal spray was given for 20 minutes, for (group 3) lying down on the spinal spray tub for 20 minutes without water flow. Assessments were done 5 minutes before and 5 minutes immediately after the intervention.

## 2.3. Design

The study adopts was three arm Randomized Control Trial. 90 healthy volunteers were divided in to two groups. Group 1 received cold spinal spray, group 2 neutral spinal spray, group 3 control group. All the subjects were assessed before and after the treatment.

**Figure 1: Illustration of Study Plan**



## **2.4. Assessments**

Condition of recordings: The subjects were seated on a chair recording leads were connected to the four-channel polygraph equipment (BIOPAC, Montana, USA; model No: BSL 4.0 MP 36) and monitored on a closed circuit TV. Instructions were given to the subjects to remain relatively undisturbed during the session.

### **2.4.1. Variables Studied**

The word variable has been used to denote 'measurement or attribute on which observations are made'.<sup>5</sup> Hence in the present thesis the assessments measures have been described as variables.

- Heart rate
- Heart rate variability
- Respiratory rate
- Digit pulse volume (DPV)
- Blood pressure
- Body temperature

## **2.5. Intervention**

### **2.5.1. Experimental groups: (Group 1 & 2)**

General description about spinal spray therapy

- Subject is made to be with minimum dress and asked to lie on the spinal spray tub.
- A spinal spray tub consists of a fiber perforated tube at the center of the tub, this tube is connected with a pipe to a 0.5 H.P. motor adjusted below the tub which is connected to water supply.
- The subject is asked to be in minimum dress and made to lie down in the supine position on the tub and start the machine. There will be constant spray from perforated tube ascending to surface of the body directly to the spinal cord region for a span of 20 minutes.
- Temperature of the water of cold spinal spray and neutral spinal spray will be measured by hydratic thermometer (water thermometer)<sup>2</sup>.

### **TEMPERATURE**

- Cold spinal spray: 12.7°C to 18.3°C (Group 1)
- Neutral spinal spray: 33.3°C to 35.0°C (Group 2)

**PRESSURE:** 1 Pressure per inch (PSI).

**Control group:**

The control group subjects will be made lie down on the spinal spray tub for 20 minutes without intervention.

### **2.5.2. Materials Used**

- Channel Polygraph.
- Sphygmomanometer.
- Thermometer.
- Spinal spray tub.

## **2.6. Data analysis**

The raw data obtained from each subject in each recorded session were tabulated separately. The group's mean, standard deviation and p- values were calculated for all the variables by using one-way ANOVA for intra group comparison. Independent t test is applied for inter group comparison between the group1 and group2, group 1 and group3, group 2 and group 3. Whereas to compare the three groups post score by ANOVA. Statistical analysis was done using Statistical Package for Social Sciences (SPSS 21.0).

## **III. Results**

In the present study on comparing the outcome measures of the three groups, corrected for baseline, a significant reduction in HR, RMSSD, LF HF, LF/HF MEAN RR, were more observed and when compared the three groups cold shows a significantly stimulates the sympathetic nervous system and whereas neutral spinal spray stimulates the para sympathetic nervous system.

Comparison among two groups that is group 1 and group 2, cold spinal spray group shown increase in SBP, DBP, HR VLF, LF, LF/HF after the treatment. Whereas MEAN RR, SDNN, PNN50, RMSSD, NN50, HF BT reduced slightly, PR, RR remains unchanged. Suggest arousal of sympathetic activity following cold spinal spray when compared with neutral spinal spray. There is significant change ( $p=0.05$ ) in SBP, DBP, BT when compared the group 1 and group 2.

In comparison of group 1 and group 3 that is cold spinal spray group with control group there is a slight raise in the SBP, DBP, RR, PR, RMSSD, NN50, PNN50, HF, LF/HF whereas BT, MEAN RR, SDNN, VLF,

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LF, reduced slightly, it is suggesting that there is a sympathetic activity following cold spinal spray when compared with control group. There is a significant change ( $p < 0.05$ ) in SBP, DBP when compare the group 1 and group 3.

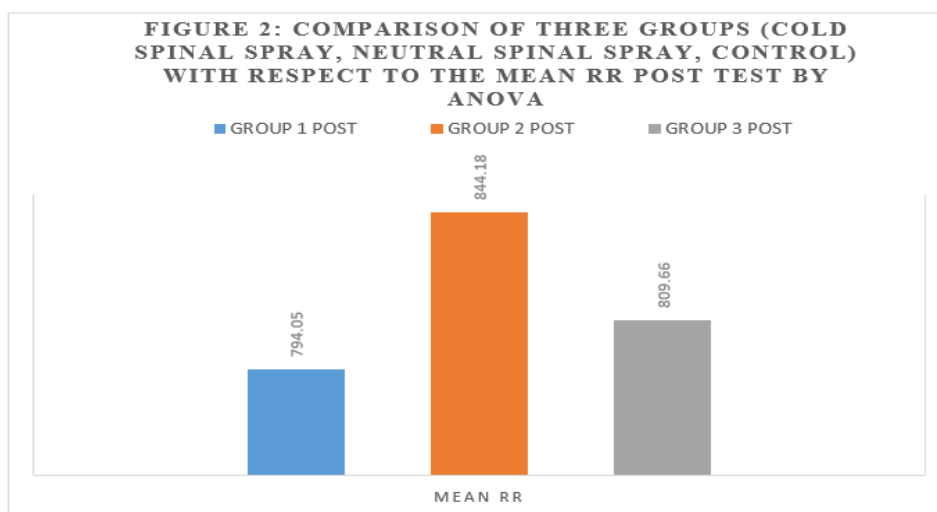
In comparison of group 2 and group 3 that is neutral spinal spray group with control group there is a slight raise in the RR, PR, MEAN RR, RMSSD, NN50, PNN50, HF, SDNN, BT whereas SBP, DBP, HR, VLF, LF, LF/HF reduced slightly, it is suggesting that there is a parasympathetic activity following neutral spinal spray when compared with control group. There is a significant change ( $p < 0.05$ ) in SBP, DBP, BT, NN50, PNN50 when compare the group 1 and group 3.

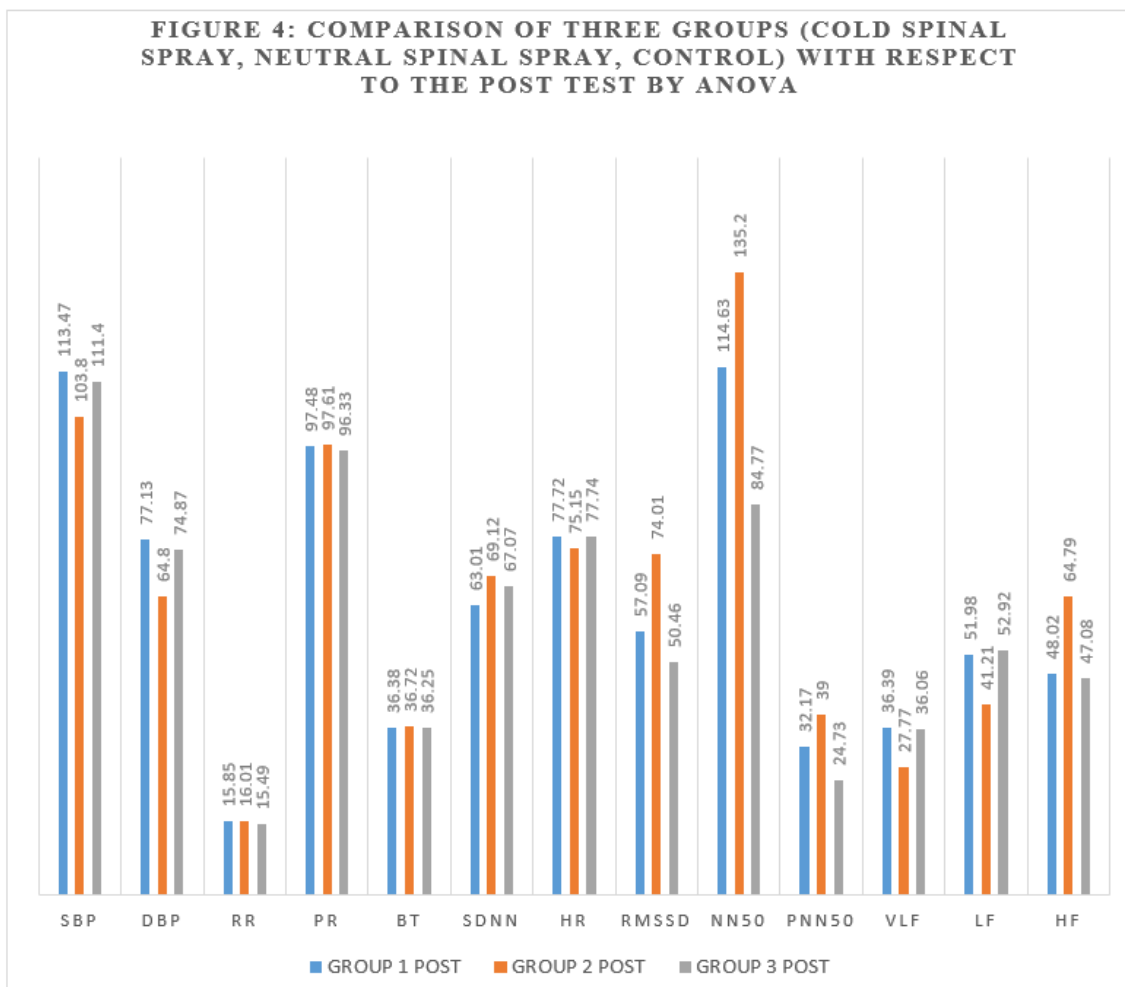
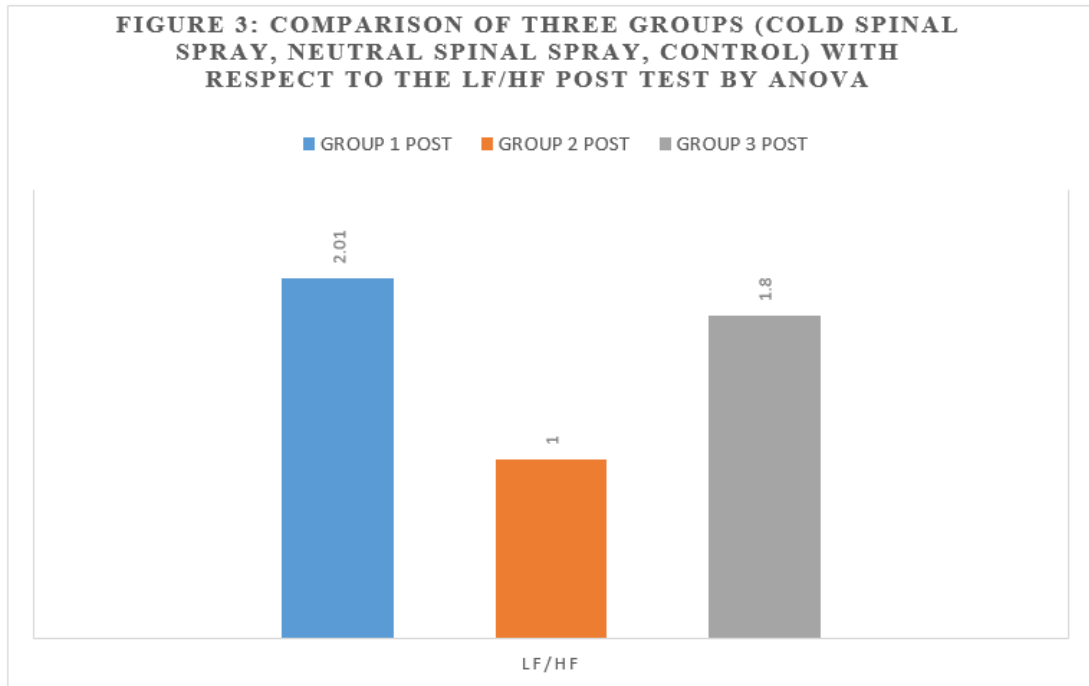
Although results of individually groups are shown some changes, but there is significance in the form of ( $p < 0.05$ ) SBP, DBP, BT, MEAN RR, HR, LF, HF, LF/HF in cold spinal spray group, SBP, DBP, BT, MEAN RR, HR in neutral spinal spray group, whereas, in control group there is significant change ( $p < 0.05$ ) in the SBP, DBP, BT, MEAN RR, SDNN, HR when compared with in the groups (intra group comparisons).

**Table1:** Comparison of three groups (cold spinal spray, neutral spinal spray, control) with respect to the posttest by ANOVA

Variables	Group 1 Post mean (SD)	Group 2 post mean (SD)	Group 3 post mean (SD)	P VALVE
SBP	113.47 ± 7.79	103.80 ± 7.85	111.40 ± 8.70	0.0001*
DBP	77.13 ± 7.35	64.80 ± 6.78	74.87 ± 5.84	0.0001*
RR	15.85 ± 1.33	16.01 ± 1.22	15.49 ± 1.360	0.5606
PR	97.48 ± 2.35	97.61 ± 2.21	96.33 ± 3.46	0.3214
BT	36.38 ± 0.66	36.72 ± 0.37	36.25 ± 0.61	0.0001*
MEAN RR	794.05 ± 119.06	844.18 ± 134.29	809.66 ± 134.78	0.0162*
SDNN	63.01 ± 22.20	69.12 ± 33.32	67.07 ± 33.96	0.7413
HR	77.72 ± 10.38	75.15 ± 10.11	77.74 ± 13.05	0.0005*
RMSSD	57.09 ± 25.19	74.01 ± 53.36	50.46 ± 34.12	0.0500*
NN50	114.63 ± 68.89	135.20 ± 68.29	84.77 ± 61.09	0.0229
PNN50	32.17 ± 20.71	39.00 ± 21.55	24.73 ± 19.43	0.1748
VLF	36.39 ± 15.48	27.77 ± 15.46	36.06 ± 20.71	0.4362
LF	51.98 ± 20.39	41.21 ± 18.80	52.92 ± 15.00	0.0352*
HF	48.02 ± 20.59	64.79 ± 18.80	47.08 ± 15.00	0.0376*
LF/HF	2.01 ± 1.09	1.00 ± 0.81s	1.80 ± 0.97	0.0487*

\*=  $p \leq 0.05$  MEANS significant SD=Standard deviation, HR=Heart rate, RR=Respiratory rate, PR=Pulse rate, MEANRR= Mean of R-R interval, RMSSD=The square root of the mean squared difference between adjacent N-N intervals, NN50=Consecutive normal sinus (NN) intervals exceeds 50 ms, pNN50=The fraction of consecutive NN intervals that differ by more than 50 ms, VLF=Very low frequency power, LF=Low frequency Power, HF=High frequency power, LF/HF=Low frequency/High frequency ratio, SBP=Systolic blood pressure, DBP=Diastolic blood pressure and BT=Temperature.





#### **IV. Discussion**

The main aim of the study was to evaluate and compare the physiological effect of cold spinal spray, neutral spinal spray and evaluate their respective changes on various autonomic functions viz. Heart rate, Heart Rate Variability, Respiratory rate, Pulse rate, Body temperature and Blood pressure in normal healthy volunteers. All the 90 subjects underwent the intervention for the duration of 20 minutes over the spinal spray tub in supine position with legs folding. There were no adverse effects reported during or after the intervention.

Results of the individuals who underwent cold spinal spray group showed slight increase in SBP, DBP, RR, MEAN RR, RMSSD, NN50, PNN50, HF and decrease in SDNN, HR, VLF, LF, LF/HF, whereas PR, BT remains unchanged. But there is significance in the form of ( $p < 0.05$ ) SBP, DBP, BT, MEAN RR, HR, LF, HF, LF/HF in cold spinal spray group and it indicates the increase sympathetic activity. This results is correlating with the Mika P et, al., done on Kubios- HRV study.<sup>6</sup>

Individuals who underwent neutral spinal spray group showed slight increase in MEAN RR, PNN50, NN50, HF, decrease in SBP, DBP, SDNN, HR, RMSSD, VLF, LF, LF/HF, and RR, PR, BT remains unchanged. But there is significance in the form of ( $p < 0.05$ ) SBP, DBP, BT, MEAN RR, HR in neutral spinal spray group and it indicates parasympathetic activity. This results are correlating with the Mika P et, al., done on Kubios- HRV study.<sup>6</sup>

Comparison among two groups that is group 1 and group 2, cold spinal spray group shown increase in SBP, DBP, HR after the treatment. Whereas VLF, LF, RMSSD, NN50, HF BT reduced slightly, PR, RR remains unchanged. Suggest arousal of sympathetic activity following cold spinal spray when compared with neutral spinal spray. There is significant change ( $p = 0.05$ ) in SBP, DBP, BT when compare the group 1 and group 2.

In comparison of group 1 and group 3 that is cold spinal spray group with control group there is a slight raise in the SBP, DBP, RR, PR, MEAN RR, RMSSD, NN50, PNN50, HF whereas BT, SDNN, VLF, LF, LF/HF reduced slightly, it is suggesting that there is a sympathetic activity following cold spinal spray when compared with control group. There is a significant change ( $p = 0.05$ ) in SBP, DBP when compare the group 1 and group 3. This results is correlating with the Mika P et, al., done on Kubios- HRV study.<sup>6</sup>

In comparison of group 2 and group 3 that is neutral spinal spray group with control group there is a slight raise in the SBP, DBP, RR, PR, MEAN RR, RMSSD, NN50, PNN50, HF, SDNN, BT whereas SBP, DBP, HR, VLF, LF, LF/HF reduced slightly, it is suggesting that there is a parasympathetic activity following neutral spinal spray when compared with control group. There is a significant change ( $p = 0.05$ ) in SBP, DBP, BT, NN50, PNN50 when compare the group 1 and group 3.

There may be a transient cutaneous vasoconstriction following cold spinal spray suggesting a shift of the sympatho-vagal tone towards the sympathetic side. From the results it could be concluded that a cold spinal spray could possibly enhance cardiac health, whereas a neutral spinal spray which has shown to improve the parasympathetic activity could well be used in anxiety, Insomnia etc.<sup>7</sup>

The probable mechanism of action indicating a sympathetic dominance might be due to peripheral vasoconstriction following an exposure to cold temperature. Although individual results of cold spinal spray indicate a sympathetic dominance, and that of a neutral spinal spray indicating parasympathetic dominance, there is strong evidence in the form of significant ( $p < 0.05$ ) when either groups are compared which could be used for clinical relevance.

##### **4.1 Limitations of the Study**

- The main limitation of the study is that, there was lack of control over the variation in atmospheric temperature.

##### **4.2 Directions for future research**

- Observation duration can be increased to 15 to 30 minutes.
- Conducting study with a larger sample size.
- Skin conductance in the form of GSR can be included.
- Study can be conducted on general population.

#### **V. Conclusion**

In comparison with the cold spinal spray, neutral spinal spray stimulates the parasympathetic nervous system. Application of cold spinal spray on the body enhances the sympathetic activity and has a role in maintaining the cardiac tone and preventing various cardiovascular ailments. Whereas a neutral spinal spray enhances parasympathetic activity and can be applied effectively to treat stress, insomnia and anxiety. Though there were significant changes observed in the form of p value but there was a considerable change in the autonomic nervous system.

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