

# Effects of Wearing a Compression Undershirt during a Deep Breath on the Autonomic Nervous System \*

Toshimitsu EBISU\*<sup>1</sup>, Tatsuki MORI\*<sup>2</sup>, Rikako KATAOKA \*<sup>3</sup>, Tomohisa YOKOYA\*<sup>1</sup>,  
Takahiko SAKAZAKI\*<sup>1</sup>, and Takanori NOGUCHI\*<sup>1</sup>

\*<sup>1</sup> Faculty of Sports and Health Sciences, Department of Sports and Health Sciences,

The purpose of this study is to clarify the effects of wearing a compression undershirt during a deep breath on the autonomic nervous system. Ten male students at Fukui University of Technology volunteered to be subjects in this study. The fatigue stress measuring system (the Fatigue Science Laboratory, VM302) was used to determine the reaction of the autonomic nervous system. The control experiment was done by determining the effect of wearing a compression undershirt on autonomic nervous system at rest. The subjects wore the compression undershirt and took a deep breath as the actual experiment. As results of this study, it was found that the parasympathetic nerve is tense by taking a deep breath although wearing a compression undershirt stimulates the sympathetic nerve. It may be thought that the deep breathing stimulates the parasympathetic nerve regardless of the clothes worn.

*Key Words*: Wearing Compression Undershirt, Deep Breath, Autonomic Nervous System

## 1. Introduction

Deep breathing is often suggested to show health effects such as relaxation. The deep breath controls the function of the sympathetic nerve and includes work with parasympathetic nerve as predominance<sup>1)</sup>. It was reported that deep breathing elicited a stress relaxation effect from a value of saliva amylase<sup>2)</sup>.

In contrast to the statement, it can be thought that wearing a compression undershirt might act to excite the sympathetic nerve. If the parasympathetic nerve is tense by taking a deep breath although wearing a compression undershirt stimulates the sympathetic nerve, it can be thought that a relaxation effect of the deep breathing is large.

In the present stress-filled society, there are many studies on stress relaxation. The study to clarify a relaxation effect of the deep breathing by making a stress-induced state is not seen. It is revealed that the stress relaxation effect of the deep breathing is remarkable if a relaxation effect of the deep breathing is produced in a stress-induced state. A relaxation effect of the deep breathing becomes clear in greater detail. The parasympathetic nerve can be activated anytime consciously<sup>3)</sup>. Taking a deep breath slowly can improve the parasympathetic nerve if it is done conscious in daily life<sup>3)</sup>.

Although a large number of compression undershirts have been produced on a commercial basis and these have been reported to have healthy effects, compression undershirts showed no beneficial effect on body composition<sup>4)</sup>. Another study<sup>5)</sup> reported that the wearing compression tights could help alleviate constipation because the compression tights pressed the abdomen. Some research<sup>6)</sup> on applying pressure to a muscle as

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\*<sup>1</sup> Faculty of Sports and Health Sciences, Department of Sports and Health Sciences

\*<sup>2</sup> Students, Faculty of Sports and Health Sciences, Department of Sports and Health Sciences

\*<sup>3</sup> Eastern Garment & Tetile Co., Ltd. Students, F

E-mail: tebisu@fukui-ut.ac.jp

pressurizing training indicated that it usually leads to muscle hypertrophy and muscle strengthening. Such training is to provide muscle strength training while suppressing the muscles.

A study has not yet accomplished about the parasympathetic nerve effect of the deep breathing while wearing a compression undershirt that it is thought for the sympathetic nerve to be stimulated. Such a research study, however, has not been proved scientifically although it can be thought that deep breathing is effective in bringing a relaxation effect under any circumstances.

The purpose of this study is, therefore, to clarify the effects of wearing a compression undershirt during a deep breath on the autonomic nervous system.

## 2. Methods

Ten male students at Fukui University of Technology volunteered to be subjects in this study. All of the experiments in this study were done in August, 2019. At first the subjects sat down on a chair and took a deep breath without wearing a compression undershirt and measured their autonomic nervous systems. Afterwards, they sat down on a chair and took a deep breath by wearing a compression undershirt and measured their autonomic nervous systems again. The control experiment was done by determining the effect of wearing a compression undershirt on the autonomic nervous system at rest to confirm that wearing a compression undershirt stimulates the sympathetic nerve. The actual experiment was done by determining the effects of wearing a compression undershirt after confirming stimulation of the sympathetic nerve. In the actual experiment the subjects wore the compression undershirt and took a deep breath. After that, the autonomic nervous system was measured equally. Although there were many methods about the breathing method, the 4-7-8 breathing method was used in this study.

The 4-7-8 method is the series of numbers to count in the head at the time of breathing, but it is not the number of seconds. The method is as follows: (1) Close the mouth and breathe from the nose. Count from 1 to 4 mentally and inhale breath calmly and deeply to take in oxygen to fill the chest. (2) Count from 1 to 7 mentally while maintaining the breath. Do not stop the breath then and mentally envision that oxygen is filling the entire body. (3) Breathe out slowly from the mouth while counting from 1 to 8 mentally. At this phase, some exhalation from the nose is also acceptable. After having practiced for the subject to do the breathing techniques exactly, he waited for a while to come back to the rest state and carried out the method more only once.

The point of the deep breath is that more time should be spent to exhale compared with to inhale. At the time of expiration, the function of parasympathetic nerve is promoted<sup>?)</sup>.

The following were carefully considered to clarify the effects of wearing a compression undershirt during breathing: (1) Just the upper torso of a short-sleeved compression undershirt was worn to try to ensure the safety of all subjects since it is possible for the pressure to raise blood pressure or to cause discomfort; (2) Subjects were told to stop wearing the compression undershirt whenever they felt pain; (3) Written informed consent was obtained from all of the subjects; (4) The compression undershirt used in this study presses the abdomen. As the pressure to be applied to the abdomen varied according to personal figures, the undershirt which fitted the figure of each person; and (5) The subjects' safety was, furthermore, enhanced by this study's having been approved by the Official Standards Committee for Research Conducted with Human Subjects of Fukui University of Technology (入-2019-04).

The variables determined in all of the experiment in this study were the following: Mean HR, Max HR, Mini HR, LF, HF, LF/HF, TP, ccvTP, and a deviation value. The fatigue stress measuring system (the Fatigue Science Laboratory, VM302) was used to determine the reaction of the autonomic nervous system.

The compression undershirt, by e-GATE, Inc. used in this study was shown in Figure 1. The undershirt is made of 75% nylon and 25% polyurethane.



( Front side)

(Back side)

Figure 1. The compression undershirt

### 3. Results and Discussion

A change of the autonomic nervous system at the time of the compression undershirt wearing and non-wearing at rest is shown in Table 1. Since this was done as a control experiment before a real experiment, the table was also illustrated in another research paper<sup>8)</sup>. That study and the current study were conducted by using the same subject at a different time of the same day. Mean, standard deviation (SD), and t-ratio values of all variables on the autonomic nervous system at rest between the results of wearing and not wearing the compression undershirts are shown in the table. Subjects in the study sat down on a chair and rested with eyes closed, without wearing a compression undershirt, for 90 seconds. The subject's autonomic nervous system measurements were then taken. Afterwards, the compression undershirt was applied for 90 seconds and measurements were repeated.

Table 1. A change of the autonomic nervous system at the time of the compression undershirt wearing and non-wearing at rest.

Variables	Non-wearing	Wearing	t
Mean HR (bpm)	66.6 ± 10.7	66.7 ± 10.1	0.092
Max HR (bpm)	77.6 ± 10.7	77.8 ± 10.6	0.108
Min HR (bpm)	58.8 ± 10.9	58.5 ± 10.7	0.226
LF	1089.2 ± 1035.5	1159.5 ± 952.9	0.229
HF	1417.9 ± 1370.6	972.6 ± 944.3	2.492*
LF/HF	3.65 ± 4.68	5.66 ± 9.50	1.135
TP	2506.9 ± 1984.3	2132.3 ± 1521.5	0.884
ccvTP	4.90 ± 1.90	4.69 ± 1.81	0.671
Deviation	49.50 ± 10.28	48.7 ± 9.56	0.605

( Mean ± SD, n = 10 )

( \* p<0.05 )

where: Mean HR = Mean Heart Rate

Max HR = Maximum Heart Rate

Min HR = Minimum Heart Rate

LF = Index Reflecting the Sympathetic Nerve

HF = Index Reflecting the Parasympathetic Nerve

LF/HF = Balance of the Sympathetic Nerve and the Parasympathetic Nerve

TP = Work of the Whole Autonomic Nerve Function

ccvTP = the Value that Corrected TP with a Heart Rate

Deviation = Deviation Value

According to the Table 1, it is shown that HF significantly decreases by compression undershirt wearing. It

seems that wearing a compression undershirt decreases parasympathetic nerve at rest. Since the sympathetic nerve and the parasympathetic nerve have opposite work and when sympathetic nerve is tense, a body is in an excited state. Strain of the parasympathetic nerve means that the body is in a state of relaxation. It is therefore found that wearing a compression undershirt creates a state of tension. In this study, the Deviation in the Table 1 indicates the value that made ccvTP the deviation value at age.

A change of the autonomic nervous system when a deep breath was taken without wearing the compression undershirt to when a deep breath was taken with wearing the compression undershirt is shown in Table 2. Mean, SD, and t-ratio values of all variables on the autonomic nervous system when a deep breath was taken without wearing the compression undershirt to when a deep breath was taken with wearing the compression undershirt are shown in the table. As illustrated in Table 2, HF was found to increase trend by wearing the compression undershirts. Since a tendency to increase was seen in a change of Max HR, cardiac function seems to be influenced. A more detailed study will be, however, necessary to clarify this phenomenon for a level of significance although it is low.

**Table 2. A change of the autonomic nervous system when a deep breath was taken without wearing the compression undershirt to when a deep breath was taken with wearing the compression undershirt.**

Variables	Non-wearing	Wearing	t
Mean HR (bpm)	64.3 ± 9.2	65.3 ± 10.8	0.769
Max HR (bpm)	78.1 ± 8.3	80.4 ± 11.4	1.498 <sup>†</sup>
Min HR (bpm)	53.1 ± 6.6	51.1 ± 13.8	0.781
LF	4398.9 ± 2836.4	4924.1 ± 2950.0	0.732
HF	794.8 ± 574.8	1074.2 ± 968.5	1.571 <sup>†</sup>
LF/HF	13.4 ± 11.0	10.6 ± 7.1	0.867
TP	5194.0 ± 3156.0	5998.5 ± 3690.1	1.111
ccvTP	7.03 ± 2.31	7.42 ± 2.64	1.359
Deviation	57.2 ± 13.1	57.9 ± 14.4	0.761

( Mean ± SD, n = 10 ) ( <sup>†</sup> p<0.1 )

According to this study, the parasympathetic nerve is tense by taking a deep breath although wearing a compression undershirt stimulates sympathetic nerve. It may be thought that the deep breathing stimulates parasympathetic nerve regardless of what clothes are worn.

After carrying out training of the breathing for four weeks, a subjective stress reaction in the normal decreased conspicuously<sup>9)</sup>. The highly individual difference was confirmed, however, for the effect again at the same time<sup>9)</sup>. In other words, a relaxation effect by the deep breathing became clear even if there were the some individual differences.

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#### 4. Conclusion

The purpose of this study was to clarify the effects of wearing a compression undershirt during a deep breath on autonomic nervous system. Ten male students at Fukui University of Technology volunteered to be subjects in this study. The variables determined in all of the experiments in this study were the following: Mean HR, Max

HR, Mini HR, LF, HF, LF/HF, TP, ccvTP, and a deviation value.

The control experiment was done by determining the effect of wearing a compression undershirt on the autonomic nervous system at rest. The actual experiment was done by determining the effects of wearing a compression undershirt while doing push-ups, squats, and low-intensity exercise.

As results of this study, it was found that parasympathetic nerve is tense by taking a deep breath although wearing a compression undershirt stimulates sympathetic nerve. It may be thought that the deep breathing stimulates parasympathetic nerve regardless of what clothes are worn.

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