

THE EFFECT OF PHYSIOACOUSTIC RELAXATION TO ALLEVIATE SELF-EXPERIENCED STRESS IN CHRONIC BACK AND NECK PAIN PATIENTS

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Background

- spine rehabilitation is a challenge
- severely disabled chronic patients often show a wide spectrum of symptoms, including pain, physical impairment and disability, self-experienced stress, anxiety, and depression among many other findings (refs).
- Multidisciplinary approach in spine rehab has been recently advocated (refs)
- Finding effective methods for spine rehabilitation to improve the outcomes is a never-ending task.
- We have noticed in our clinical practice that some patients undergoing spine rehabilitation express substantial level of self-experienced stress. We made a hypothesis that this feature would be of significance for the rehabilitation outcome.

- Features involved in the stress responses vary between individuals, however, typical ones include an increase in heart rate, reduction in heart rate variation, palm sweating, subconscious increase in postural and facial muscle tonus, among many other physiological features. Relaxation Rate (RLX) indicates heart rate variation as a numerical value, which is based on the fluctuations of interbeat intervals. Heart rate variability (HRV) of a healthy subject is in general large in resting conditions and during light exercise. Long-term stress is shown to reduce HRV. HRV also gradually disappears when exercise becomes more severe and heart rate increases.

- The physioacoustic therapy system is a method of using low frequencies within the range of 27-113 Hz for therapeutic purposes. It is applied using a reclining chair housing a computer and six audio speakers. The computer creates and controls low frequency sinusoidal sound waves, which are broadcast through the speakers, operated via a handset, using a pre set programme. Patients feel the sound as sympathetic resonance within muscles and other tissues. Albeit the evidence supporting the efficacy of the physioacoustic method is scarce in medical literature, the physioacoustic method is approved by the FDA in the USA and has BSI medical appliance approval in the UK, with three medical claims being allowed: to improve blood circulation, to reduce pain and to relaxes muscles where applied.

- In postulating the present study, we made the following assumptions:
 - 1) A subgroup of patients would show abnormally high levels of perceived stress
 - 2) The physioacoustic treatment would relieve the perceived stress among the patients
 - 3) Changes in RLX would be related to the changes in perceived stress during relaxation

- 4) Reduction of muscle activity in selected muscles would be related to the changes in perceived stress during relaxation
- 5) Reduction in pain and disability would result as reduction of perceived stress during the outpatient rehabilitation programme.

Assessments

- 1) 100-mm visual analogue score (VAS) on perceived stress.
- 2) Relaxation Rate (RLX) was recorded with a heart rate monitor (Polar XXX). The recorded parameter is a modified standard deviation value for the heart rate variation, and the measuring unit used is milliseconds. The RLX values were recorded a) at baseline in resting position (supine) b) before and after an orthostatic test c) before and after the RELAX intervention and d) in deep breathing.
- 3) Amplitude changes in the surface EMG of forehead muscles. The amplitudes were recorded before and after the RELAX intervention
- 4) Amplitude changes in the surface EMG of trapezius muscle. The amplitudes were recorded before and after the RELAX intervention

Subjects

34 patients of which 23 males and 11 females. Further description to be added on subject demographics.

Study design: a pre-post study with two interventions, RELAX and DBC. RELAX (one 20-minute relaxation) was performed both before and after the 12-week DBC Active Spine Care Programme.

Interventions:

- 1) **RELAX:** a 20-minute physioacoustic relaxation, performed twice, i.e., before and after the DBC intervention.
- 2) **DBC:** The DBC Active Spine Care programme for lumbar or cervical spine problems.

Statistical analysis

The results were analysed using a repeated-measures ANOVA (*within-factor time*) with grouping factors (*between; sex, responder*). Since there was no sex difference in the observed responses, both sexes were combined in the later analyses. Since there was major inter-individual variation in the stress responses, the subjects were classified into three groups based on their responses in self-experienced stress. The classification was based on the estimation of the least significant threshold in the terms of calculating the standard error of the mean of the stress VAS score at the baseline (4,0 mm), which was multiplied by two. In other words, the group “Better” received larger a benefit in stress than 8mm (n=11), the group “No change” included those whose stress levels remained in the bracket of +/- 8 mm (n=16) and the group “Worse” experienced larger an increase in self-experienced stress than 8 mm (n=4).

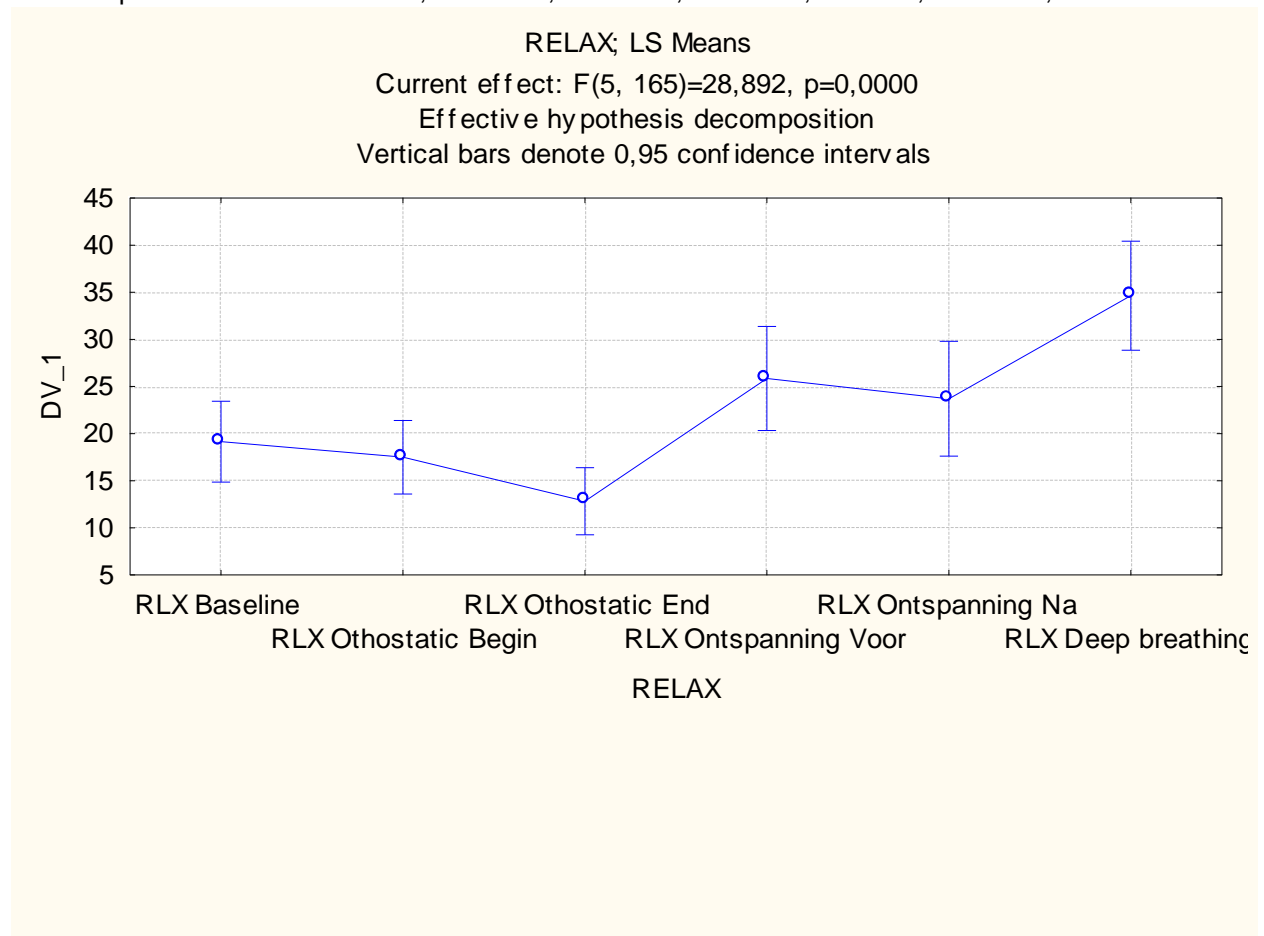
Results

Average changes as one group

Effect of RELAX on self-perceived stress at baseline

The results as one group show a slight (non-significant tendency) tendency to reduction in stress and muscle activity. (T and P denote to repeated-measures t-test).

	Mean	Minimum	Maximum	Std.Dev.	T	P
Stress (VAS) Before	28,2	0,0	79,0	23,0		
Stress(VAS) After	24,2	0,0	73,0	23,7	1,00	0,33
EMG Forehead Before	7,7	0,0	69,0	12,3		
EMG Forehead After	5,5	0,0	37,0	7,0	1,87	0,07
EMG Trapezius Before	3,3	0,0	21,0	4,1		
EMG Trapezius After	2,0	0,0	10,0	2,4	1,95	0,06



Heart rate variability changes during orthostatic test and deep breathing, but the effect of RELAX is minimal on average (p=0.29). There is large inter-individual variation, however.

Sex differences

There was no significant sex difference in the stress response to RELAX in ANOVA.

Effect	SS	Df	MS	F	P
sex	121,5	1,0	121,5	0,1	0,71
RELAX	423,1	1,0	423,1	1,6	0,22
RELAX*sex	231,1	1,0	231,1	0,9	0,36

Therefore sex has been omitted (both sexes included in the further analyses).

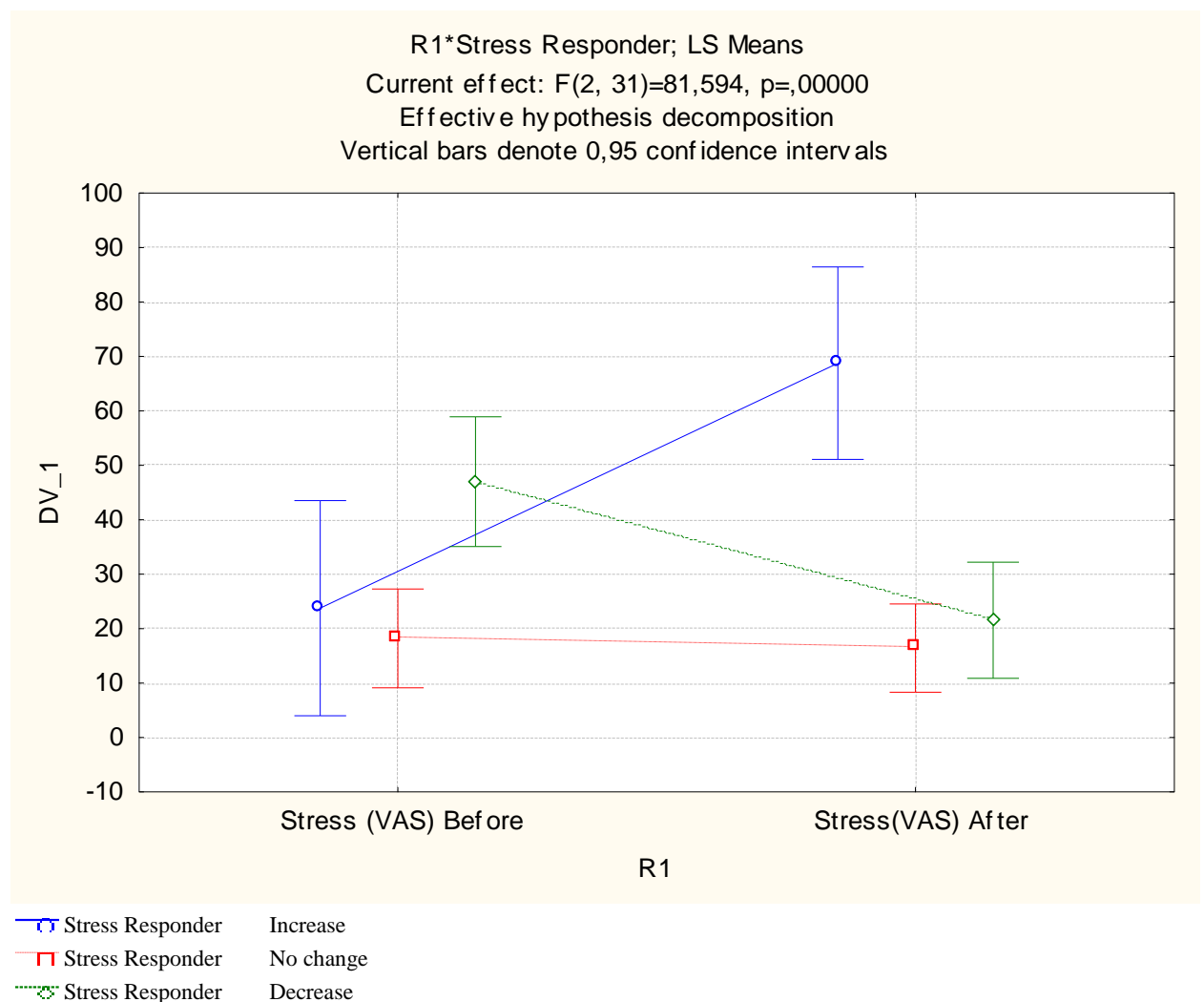
Effect of DBC on self-perceived stress

Only 12 subjects had gone through the DBC programme. However, the stress reduction was borderline significant regarding stress reduction.

	Mean	Std.Dv.	Diff.	Std.Dv.	t	p
Stress (VAS) Before	20,8	19,3				
Stress 2nd (VAS) Before	12,3	7,9	8,5	13,9	2,12	0,06

Classification into Better – Unchanged – Worse regarding self-experienced stress during relaxation

The stress responses are illustrated as follows:



The average change in the responders was 26 mm.

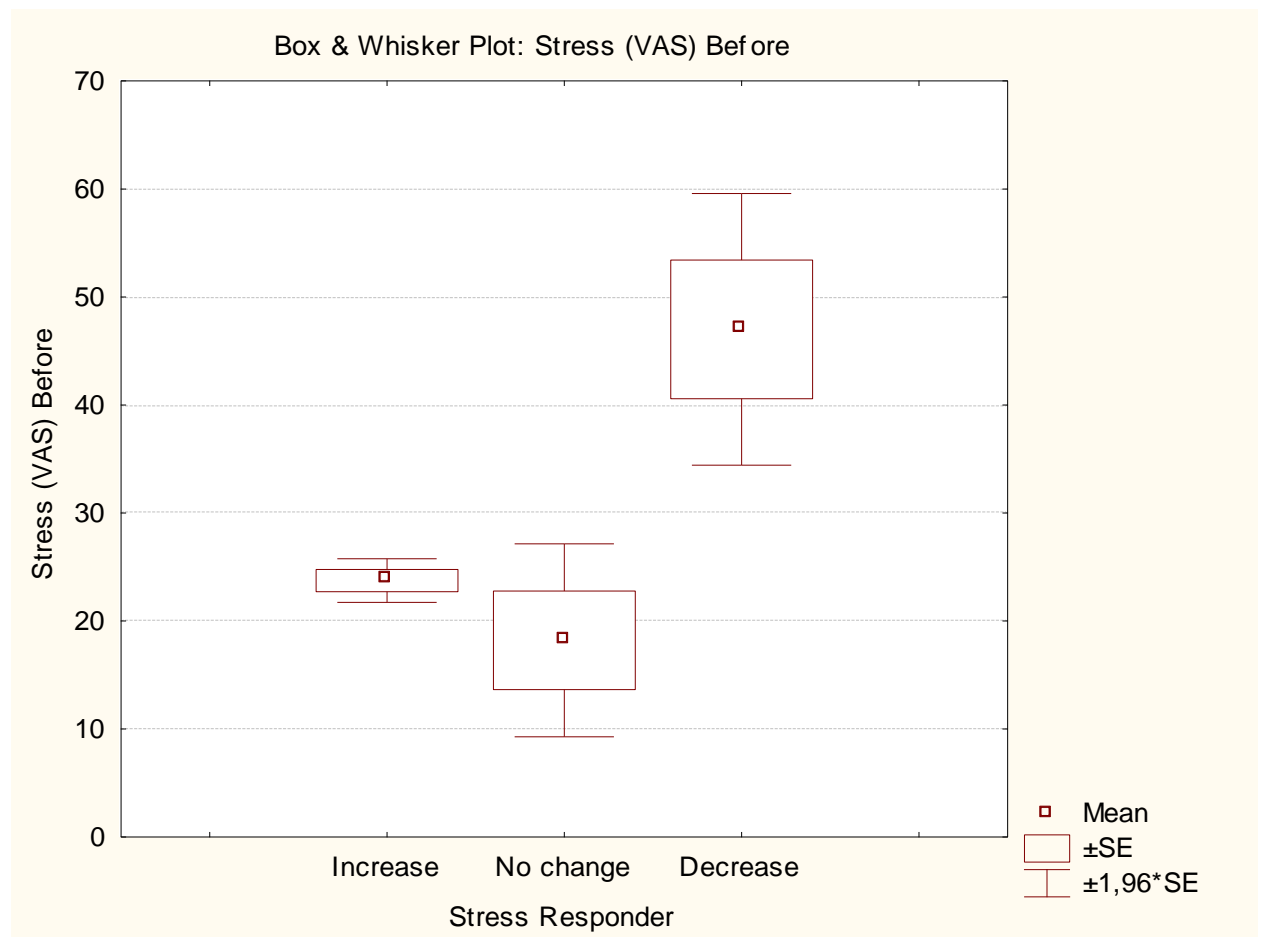
B-U-W group characteristics

The groups were different at baseline concerning stress levels, RLX and EMG values ($F_{MANOVA}=2.1$; $p=0.027$). The group differences are illustrated below:

	Increase	No change	Decrease	F	P
Stress (VAS) Before	23,8	18,2	47,0	7,8	0,002
RLX Baseline	21,5	19,4	17,9	0,1	0,883
EMG R Before	3,0	9,5	6,3	0,5	0,584
EMG L Before	9,0	2,4	2,8	5,8	0,007

Baseline stress

Baseline stress level of 30 mm discriminates the groups well:

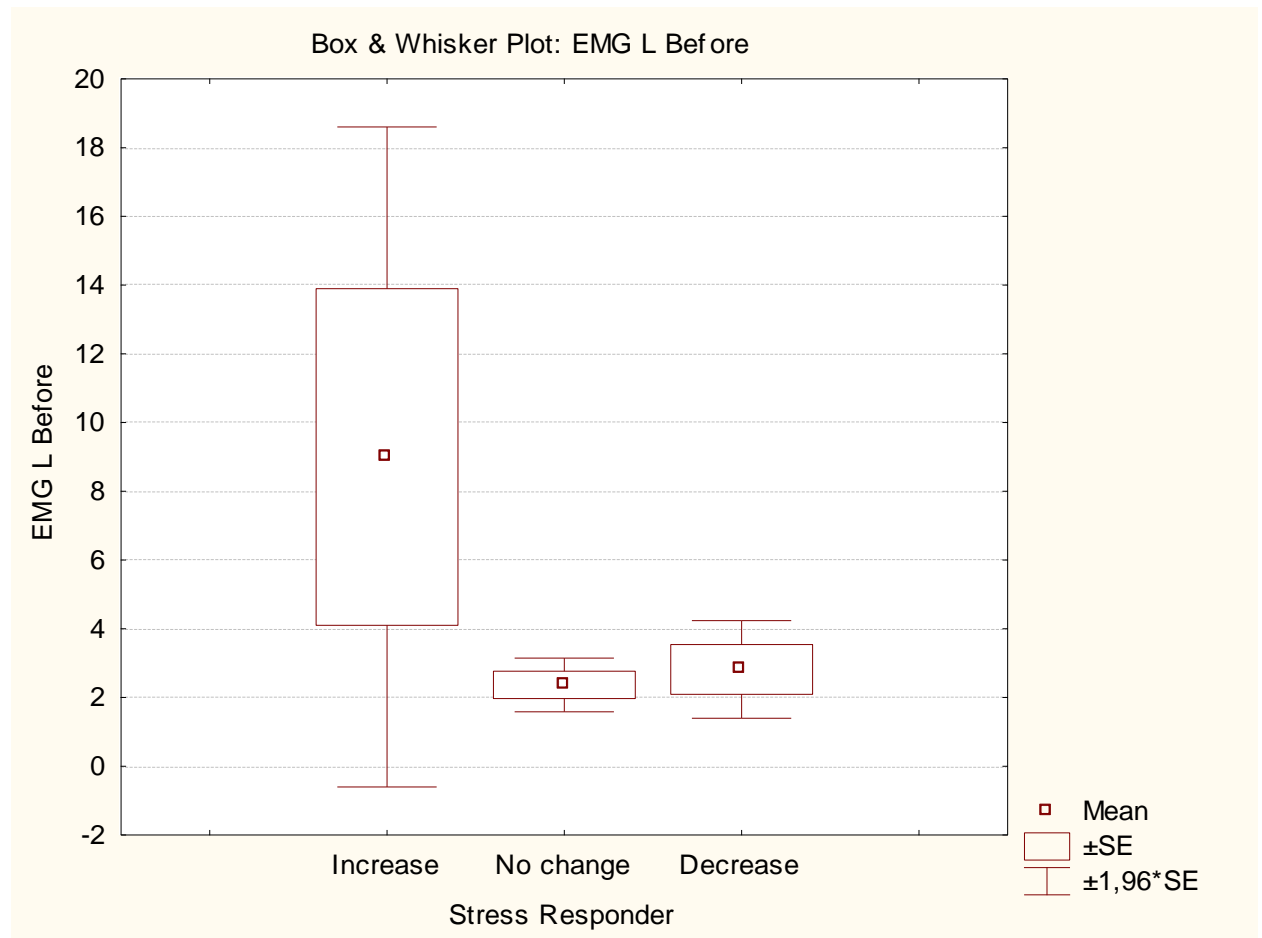


RLX values at baseline

There is no difference between the groups in any baseline RLX values.

EMG values at baseline

Trapezius EMG amplitude differs between the groups, but there is no difference in the forehead muscle activity. High baseline value (>4 uV) in trapezius activity predicts an increase in self-experienced stress during RELAX.



RLX changes

RLX decreases during the orthostatic test, but there is no difference in the response between the groups (ANOVA results).

Effect	SS	Df	MS	F	P
Stress Responder	16	2	8	0,046	0,955
R1 (orthostatic test)	366,6	1	366,6	5,308	0,028*
R1*Stress Responder	34,5	2	17,3	0,25	0,781

RLX does not change during RELAX and there is no difference in the response between the groups (ANOVA results).

Effect	SS	Df	MS	F	P
Stress Responder	239	2	119,5	0,235	0,792
R1	35,3	1	35,3	0,484	0,492
R1*Stress Responder	55,6	2	27,8	0,382	0,686

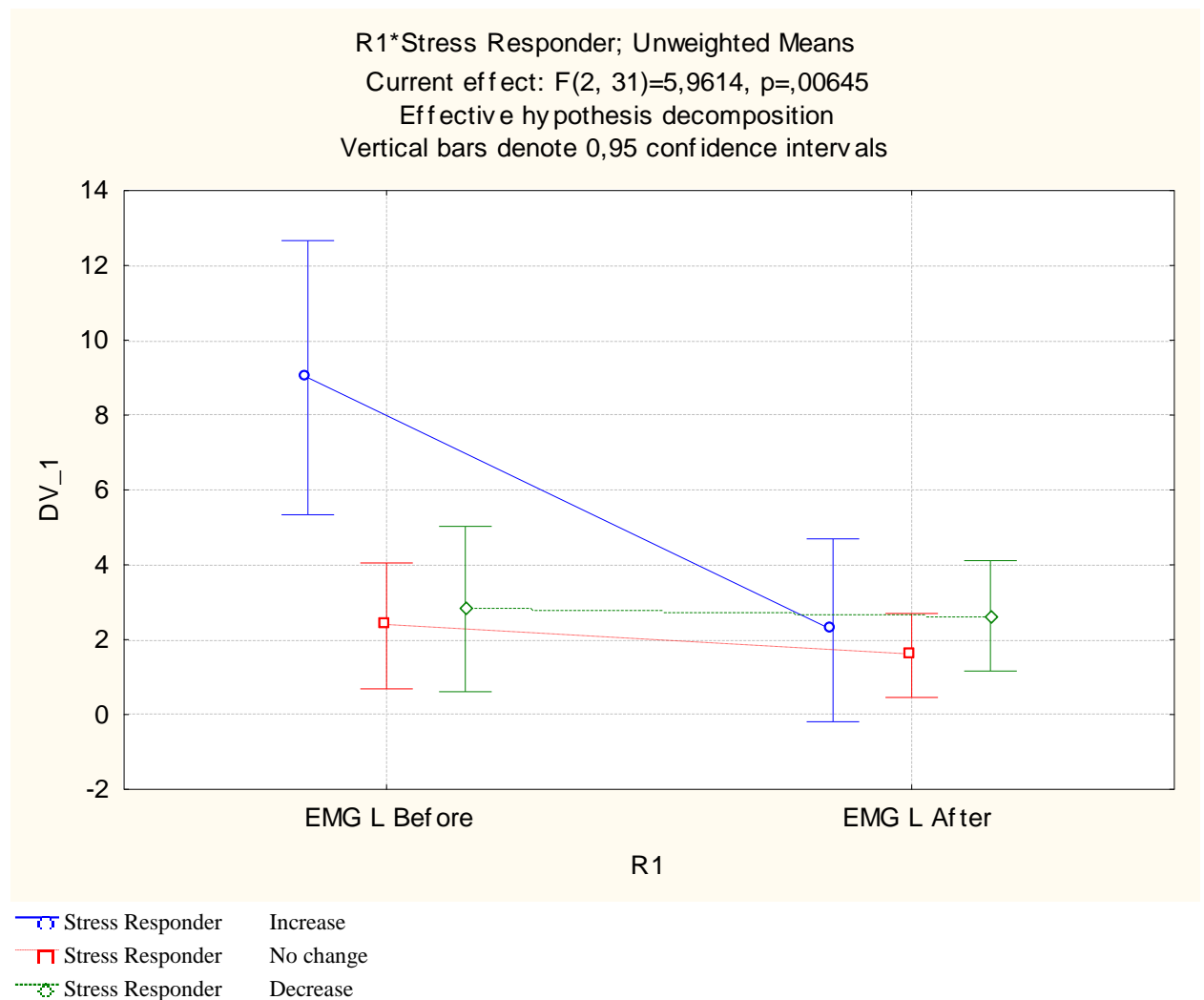
EMG changes

Forehead EMG activity does not change during RELAX and there is no difference in the response between the groups (ANOVA results).

Effect	SS	Df	MS	F	P
Stress Responder	195,9	2	97,93	0,534	0,591
R1	26,2	1	26,15	1,132	0,296
R1*Stress Responder	21	2	10,52	0,456	0,638

Trapezius EMG activity changes during RELAX and there is significant interaction in the response between the groups (ANOVA results).

Effect	SS	Df	MS	F	P
Stress Responder	88,32	2	44,16	3,43	,045*
R1	75,75	1	75,75	13,13	,001*
R1*Stress Responder	68,76	2	34,38	5,96	,006*



Although the non-responders experience an increase in self-experienced stress, their initially elevated trapezius activity levels normalize during RELAX.

Multivariate model

Stepwise discriminant analysis showed the two above-mentioned variables capable of discriminating the three groups.

	F(remove)	p-level
Stress VAS Before	7,7	0,0020
Trapezius EMG	5,7	0,0079

Interpretations

- 1) The subjects who have elevated self-experienced stress levels at baseline benefit from the physioacoustic chair-based 20-minute relaxation with on the average 24 mm reduction in stress level.
- 2) There is no sex difference in the finding
- 3) The cut-off limit to select subjects into the relaxation is 30 mm.
- 4) 11 out of 34 (32%) were eligible for the relaxation in this sample.
- 5) There is a subgroup of subjects with low levels of self-experienced stress to experience the physioacoustic relaxation as unpleasant and stressful.
- 6) It was typical for the non-responders to show elevated trapezius muscle activity, which, however, was normalized during the relaxation despite the self-experienced increase in stress.

To be done further

- 1) To include more subjects
- 2) Combine the data with the variables and outcomes of the clinical DBC database.
 - a. To look at the impact of diagnosis (specific vs. non-specific) and severity of the clinical problem on the findings with stress
 - b. To look at the predictive value of stress and relaxation capacity on pain and physical impairment during the DBC programme
- 3) Include more cases that have gone through the DBC programme.
 - a. To look at the effect of DBC programme on stress and its changes during RELAX.