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Research paper

## Mechanical massage and mental training programs effect employees' heart rate, blood pressure and fingertip temperature—An exploratory pilot study

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## ABSTRACT

**Introduction:** Inability to relax and recover is suggested to be a key factor for stress-related health problems. This study aimed to investigate possible effects of mechanical massage and mental training, used either separately or in combination during working hours.**Methods:** Employees were randomly assigned to one of the following groups: i) Mechanical massage combined with mental training (n = 19), ii) Mechanical massage (n = 19), iii) Mental training (n = 19), iv) Pause (n = 19), v) Control (n = 17). The study lasted for eight weeks. Heart rate, blood pressure and fingertip temperature were measured at start, after four and after eight weeks.**Results:** Between-group analysis showed that heart rate differed significantly between the groups after 4 weeks (p = 0.020) and tended to differ after eight weeks (p = 0.072), with lowest levels displayed in the massage group and the control group. Blood pressure and fingertip temperature did not differ between the groups. Within-group analysis showed that mechanical massage decreased heart rate (p = 0.038) and blood pressure (systolic p = 0.019, diastolic p = 0.026) and increased fingertip temperature (p = 0.035). Mental training programs reduced heart rate (p = 0.036). Combining the two methods increased diastolic blood pressure (p = 0.028) and decreased fingertip temperature (p = 0.031). The control group had a significant decrease in systolic blood pressure during the first four weeks of the study (p = 0.038).**Conclusion:** Receiving mechanical massage and listening to mental training programs, either separately or in combination, during working hours had some positive effects on the employees' heart rate, blood pressure and fingertip temperature. The effects were especially strong for employees who received mechanical massage only.© 2016 The Authors. Published by Elsevier GmbH. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

According to the World Health Organization (WHO) health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity [1]. Health promotion is the process of enabling people to increase control over – and improve – their health. The responsibility for health promotion lies not only on the health sector but also employers have a responsibility for their employees [2].

Stress-related health problems have increased in industrialized countries during recent years and they are often strongly influenced by the working environment (although some cultural differences exist). Stress-related illnesses, such as cardiovascular

disorders, type 2 diabetes, reduced immune function and cognitive impairment, typically develop over a very long time and cause much suffering for the affected individuals and can result in long periods of inability to work and in extended sick leave [3–5].

An inability to relax and recover, and thereby the inability to reduce stress levels, has been suggested to be a key factor for the increasing levels of stress-related health problems in industrialized countries. People seem to be able to work very hard without problems if they are able to rest and recover, but if they decrease or lose this ability, they become more sensitive to stress and develop stress-related health problems [5,6].

Two common activities performed by individuals to increase their ability to relax and recover, and hence promote their health, are massage and mental training. Previous research has shown that several positive effects accompany massage treatment, such as decreased levels of anxiety, increased perception of wellbeing and decreased perception of pain and, in addition, both heart rate and

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blood pressure are decreased [7–10]. Repeated massage treatments are associated with long-term expression of all these effects [11,12]. Non-noxious sensory stimulation, such as massage, results in a release of the neuropeptide oxytocin and many of the physiological effects induced by massage, are partly mediated by oxytocin [13].

Mental training has been shown to help a person reach a relaxed mental state, a state that seems to be linked to reduction of stress and tension and better health [14,15]. In addition, mental relaxation also can help to decrease heart rate and blood pressure [16].

An increased number of employers have started to work with various methods to help reduce their employees' stress and help them to stay healthy. One such method, which has been used by several companies in Sweden, is an armchair with massage capabilities and audio programs for mental training. Our research group has recently shown that employees who used this armchair during working hours experienced positive psychological effects on self-reported levels of anxiety and stress susceptibility [17]. However, the physiological effects of the mechanical massage and/or the mental training programs provided by the armchair have not yet been investigated.

The aim of this pilot study was to investigate possible effects on the employees' heart rate, blood pressure and fingertip temperature when using mechanical massage and mental training programs, both separately and in combination, during working hours.

## 2. Methods

### 2.1. Setting and study design

The study was performed in the southwest part of Sweden during 2013. Four different work places were strategically selected based on their geographical location and working areas including both small and large towns with employees living in both urban and rural districts, and workplaces in both private and public sectors. The participating employees had a variety of positions and responsibilities and both workers and people in management positions were included in the study.

In total, 93 employees participated in the study. Randomization occurred at each workplace where each participant was randomly assigned to one of the following five study groups: i) *Massage and mental training* (sitting in the armchair and receiving mechanical massage while listening to the mental training programs, n = 19); ii) *Massage* (sitting in the armchair and receiving mechanical massage only, n = 19); iii) *Mental training* (sitting in the armchair and listening to the mental training programs only, n = 19); iv) *Pause* (sitting in the armchair but not receiving either the mechanical massage or listening to the mental training programs, n = 19); and v) *Control* (not sitting in the armchair at all, n = 17).

The study lasted for a total of eight weeks. During these weeks, the participants in groups i–iii took a break from their regular work and sat in the armchair for 15 min three times each week, preferably between 1pm and 4pm. The participants who used the massage program (i.e., groups i and ii) all used the same program, but were able to make individual adjustments regarding the strength of the massage. The participants who listened to the mental training (i.e., groups i and iii) listened to different programs in the following order: "Recovery" – week one, "Mindfulness – learn to live in the present" – week two, "The way to a better and deeper sleep" – week three, "Reduce the negative stress" – week four, "Learn to think positively" – week five, "Increase your mental strength" – week six, "How to get a greater enjoyment of life" – week seven and "Recovery" – week eight. The participants in group iv took a break from their regular work and sat in the chair for

15 min three times each week; however, they did not use the massage program or listen to the mental training programs. Group v served as a control group and continued their work as usual, with no break. In one of the workplaces, due to a hectic schedule, the participants were assigned specific times to use the chair. The participants wrote in a journal each time they used the intervention. At the end of the study this journal was handed in to the researchers to allow for follow up whether the participant had done the activities assigned to them.

### 2.2. Participants

#### 2.2.1. Inclusion and exclusion criteria

**2.2.1.1. Workplaces.** Only companies who had no prior experience of the armchair were included in the study.

**2.2.1.2. Employees.** Employees without self-reported serious and/or chronic illnesses (physical or mental) who were able to perform their work assignment were asked if they wanted to participate in the study. The employees should work 75–100% within their own organizations. If working less than 100% the reason for not working full time should be stress related issues.

Employees with previous experience of using mechanical chair massage and/or the mental training programs were excluded from the study. In addition, employees who were pregnant, or who were suffering from influenza, colds, or fevers at the time, were also excluded from the study due to health risks. Employees working less than 75% were excluded from the study.

### 2.3. The armchair

The armchair used in the present study was the Recovery Chair included in the Promas Method™, provided by Promas AB, Sweden. The armchair is equipped with the ability to give mechanical massage to the neck, shoulders, back, and calves. This is performed through a combination of motors, gears, rollers and vibrating mechanisms. The chair has a motorized reclining system so the user can change the chair's position by pressing a button on the chair's control system and the user are allowed to adjust the intensity of the massage. While the user gets a massage, he/she may simultaneously listen to a mental training program developed and produced by Lars-Eric Uneståhl (Scandinavian International University) [14,15]. The mental training programs include verbal instructions, mental exercises and soft music. The aim of the programs are to help the user achieve mental relaxation. The mechanical massage programs or the mental training programs can also be used separately. At the workplaces, all the armchairs were located in a room where the door could be shut, so that user could be completely separated from other activities while sitting in the chair.

### 2.4. Data collection

The participants' heart rate, blood pressure and fingertip temperature were measured three times during the study period: at the start of the study (immediately before the randomization), after 4 weeks, and after 8 week (end of study). The measurements were performed during an individual meeting at the work place during regular working hours by a nurse and a researcher who had experience of and were well trained in this kind of measurements.

Heart rate, Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured with an automatic manometer (Omron M6 Comfort, Omron Healthcare, Hoofddorp, the Netherlands). The manometer was attached to the participant's left arm and placed in line with the heart. Fingertip temperature

was measured with a laser thermometer (Digital-Laser Thermometer, Esska.de GmbH, Hamburg, Germany). The participants were in a seated position during all measurements.

### 2.5. Statistical analyses

Statistical calculations were performed using the IBM Statistical Package for the Social Sciences (SPSS, version 22.0). Background data are presented as means and standard deviation (SD). To test for the differences between groups on separate occasions (start, four weeks, and eight weeks) the Kruskal Wallis Test for independent samples, as well as the Mann-Whitney Test for independent samples were used. To test for differences within each study group during the entire study period Friedman's Two-way Analysis of Variance by Rank was used. To test for differences between two occasions within each study group the Wilcoxon Signed-Rank Test was used. Changes were analyzed between start and four weeks, between four and eight weeks, and between start and eight weeks. Since this was an exploratory pilot study we chose to perform the paired test independently of the results from the Friedman test. P-values  $\leq 0.05$  were considered significant and P-values  $< 0.1$  were interpreted as tendencies [18].

### 2.6. Ethical considerations

The study was approved by the Local Ethics Committee in Gothenburg, Sweden (ref. nr: 980-12) and the Helsinki Declaration was followed [19]. The employees were informed and given the opportunity to ask questions about the study and their possible participation. They were also informed that all collected data would only be available to the researchers, not to their employers, and that their workload would not be affected by their

participation. All employees who chose to participate in the study signed written consent.

## 3. Results

A CONSORT flow chart of participant recruitment is shown in Fig. 1. Baseline data for the participants is shown in Table 1. Baseline data and the external dropout did not differ significantly between the five groups (data not shown).

### 3.1. Heart rate

A significant difference was observed between the five study groups after 4 weeks ( $p=0.020$ ) and this difference tended to remain after eight weeks ( $p=0.072$ ) (Fig. 2) (Table 2).

After four weeks, the message group, the mental training group and the control group had significantly lower heart rates compared to the pause group ( $p=0.026$ ,  $p=0.007$  and  $p=0.006$ , respectively). In addition, the message group tended to, and the control group had, significantly lower heart rates compared to the message and mental training group ( $p=0.057$  and  $p=0.008$ , respectively) (Fig. 2) (Table 2).

At the end of the study, both the message group and the control group had significantly lower heart rates compared to the message and mental training group ( $p=0.024$  and  $p=0.009$ , respectively). Both groups also tended to have lower heart rate compared to the pause group ( $p=0.073$  and  $p=0.080$ , respectively) (Fig. 2) (Table 2).

When each group was analyzed separately, both the message group and the mental training group showed significant decreases in heart rate when comparing the start with week 4 ( $p=0.039$  and  $p=0.036$ , respectively). For the message group, this decrease

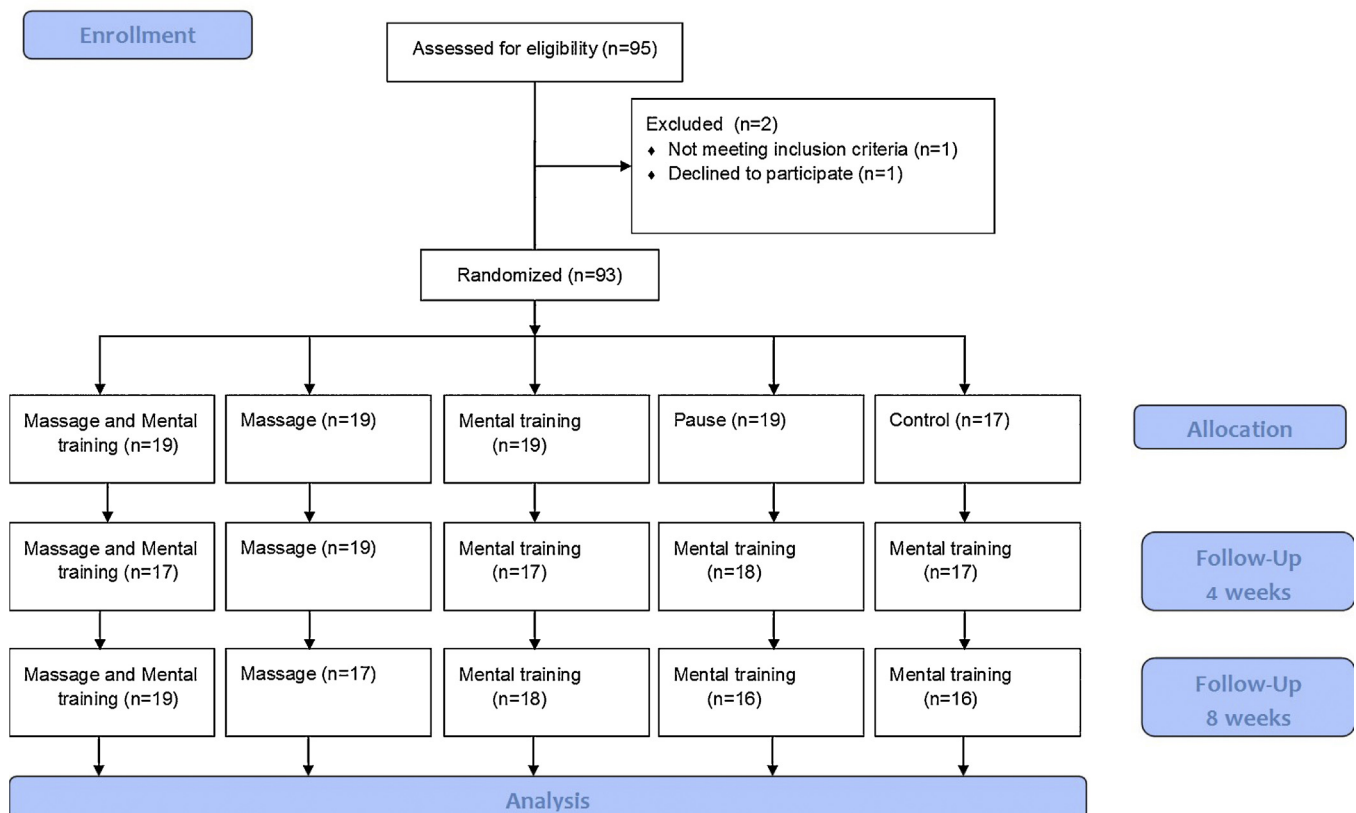
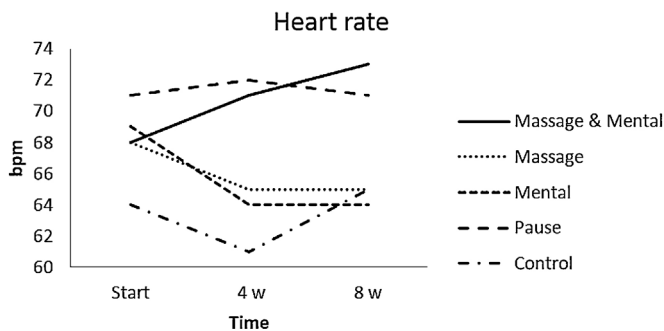


Fig. 1. Flowchart of the 93 employees' participants.

**Table 1**  
Baseline data for all groups.

	Massage and Mental training (n = 19)	Massage (n = 19)	Mental training (n = 19)	Pause (n = 19)	Control (n = 17)	p-value
Age						ns
Mean (SD)	50.4 (8.37)	46.5 (12.1)	49.3 (14.1)	47.9 (9.24)	46.6 (10.5)	
Sex						ns
Women; n (%)	16 (84)	15 (79)	13(68)	13(68)	12 (71)	
Men; n (%)	3 (16)	4 (21)	6 (32)	6 (32)	5 (29)	
Marital status						ns
Single, n (%)	4 (21)	3 (16)	2 (11)	2 (11)	2 (12)	
Partner/married, n (%)	15 (79)	16 (84)	17 (89)	17 (89)	14 (82)	
Living apart/other, n (%)	0	0	0	0	1 (6)	
Education						ns
Compulsory School, n (%)	1 (5)	1 (5)	1 (5)	0	1 (6)	
Senior high school, n (%)	5 (26)	3 (16)	2 (11)	4 (21)	2 (12)	
Higher education, n (%)	2 (11)	3 (16)	2 (11)	3 (16)	1 (6)	
University, n (%)	11 (58)	12 (63)	14 (74)	12 (63)	13 (76)	



**Fig. 2.** Heart rate (bpm) (median levels) for the five study groups. Massage and mental training group (n = 19), Massage group (n = 19), Mental training group (n = 19), Pause group (n = 19), and Control group (n = 17).

remained and was significant when comparing the start of the study with the end of study as well (p = 0.038) (Fig. 2) (Table 2).

**3.2. Systolic blood pressure (SBP)**

When all five study groups were compared with each other no significant differences were noted between the groups during the study.

However, when each group was analyzed separately it was found that SBP decreased significantly during the entire study period (p = 0.019) in the massage group. This decrease was particularly strong during the first four weeks (p = 0.002) (Fig. 3) (Table 2).

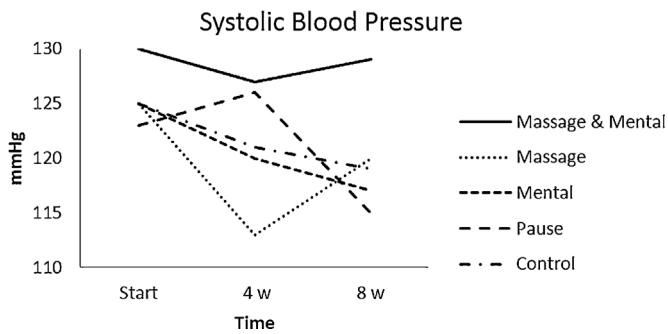
In the pause group, SBP tended to decrease when comparing SBP at the start of the study with SBP at the end of the study (p = 0.051). The control group had a significant decrease in SBP during the first four weeks of the study (p = 0.038) (Fig. 3) (Table 2).

For the other study groups, SBP remained unchanged. (Fig. 3) (Table 2).

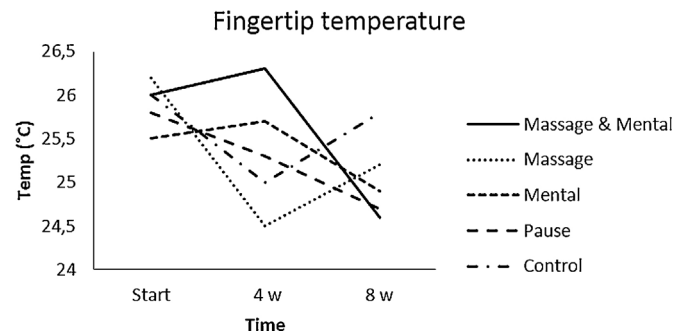
**Table 2**  
Heart rate, Blood pressure and Fingertip temperature for all groups.

	Heart rate (bpm) Median (Q25–Q75)			Diastolic blood pressure (mmHg) Median (Q25–Q75)			Systolic blood pressure (mmHg) Median (Q25–Q75)			Fingertip temperature (°C) Median (Q25–Q75)		
	Start	4 w <sup>£</sup>	8 w <sup>§</sup>	Start	4 w	8 w	Start	4 w	8 w	Start	4 w	8 w
Massage & Mental Training (n = 19)	68 (64–75)	71 (62–79)	73 (66–78)	84 (75–101)	85 (79–90)	87 <sup>^</sup> (77–96)	130 (118–137)	127 (116–139)	129 (114–141)	26 (24.8–28)	26.3 (24.6–28.3)	24.6* (22.6–26.2)
Massage (n = 19)	68 (60–73)	65 <sup>~</sup> (58–71)	65 <sup>~</sup> (56–69)	83 (77–94)	77 <sup>^</sup> (75–86)	79 <sup>~</sup> (74–86)	125 <sup>~</sup> (116–137)	113 <sup>~</sup> (109–120)	120 <sup>~</sup> (111–126)	26.2 <sup>~</sup> (25.4–28.9)	24.5 <sup>~</sup> (23.6–25.3)	25.2 <sup>~</sup> (23.9–28.9)
Mental Training (n = 19)	69 (58–79)	64* (56–74)	64 (57–81)	84 (78–92)	80 (76–93)	82 (74–95)	125 (113–145)	120 (111–140)	117 (112–141)	25.5 (24.3–27.6)	25.7 (24.8–29.5)	24.9 (22.1–27.3)
Pause (n = 19)	71 (64–85)	72 (66–81)	71 (63–81)	87 (75–93)	87 (72–94)	76 (74–89)	123 (108–144)	126 (103–140)	115 (104–133)	25.8 (24.9–27.4)	25.3 (23.8–27.4)	24.7 (22.5–27.3)
Control (n = 17)	64 (57–71)	61 (59–70)	65 (59–71)	80 (74–91)	77 (71–91.5)	82 (72–88)	125 (106–135)	119 (115–125)	121 (106–135)	26 (24.6–27.7)	25 (23.2–27.9)	25.8 (24.8–27.4)

£ Significant difference between the study groups (p < 0.05).  
 § Tendency to difference between the study groups (p < 0.1).  
 ~ Significant difference compared to start (p < 0.05).  
 ^ Significant difference compared to week 4 (p < 0.05).  
 ~ Significant difference over the entire study period (p < 0.05).  
 Tendency to difference compared to 4 weeks (p < 0.1).



**Fig. 3.** Systolic blood pressure (mmHg) (median levels) for the five study groups. Massage and mental training group (n = 19), Massage group (n = 19), Mental training group (n = 19), Pause group (n = 19), and Control group (n = 17).



**Fig. 5.** Fingertip temperature (°C) (median levels) for the five study groups. Massage and mental training group (n = 19), Massage group (n = 19), Mental training group (n = 19), Pause group (n = 19), and Control group (n = 17).

### 3.3. Diastolic blood pressure (DBP)

When all five study groups were compared with each other no significant differences were noted between the groups during the study.

However, when each group was analyzed separately it was found that the massage and mental training group showed a significant increase in DBP during the last four weeks of the study ( $p = 0.028$ ) (Fig. 4) (Table 2).

The massage group showed a significant decrease in DBP between the start and 4 weeks as well as between the start and 8 weeks ( $p = 0.031$  and  $p = 0.026$ , respectively) (Fig. 4) (Table 2).

For the other study groups, DBP remained unchanged (Fig. 4) (Table 2).

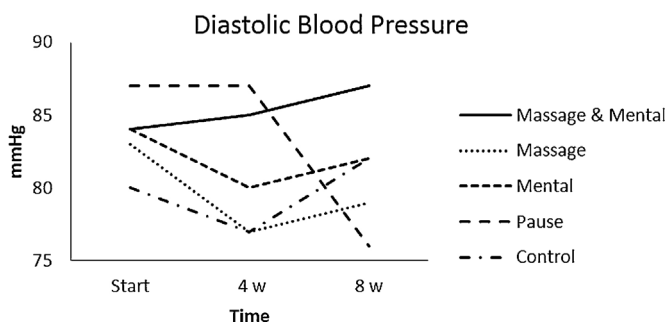
### 3.4. Fingertip temperature

When all five study groups were compared with each other no significant differences were noted between the groups during the study.

However, when the each group was analyzed separately it was found that the massage and mental training group showed a significant decrease in fingertip temperature when comparing start with end of study ( $p = 0.031$ ) (Fig. 5) (Table 2).

For the massage group there was a significant change over time ( $p = 0.003$ ) with a significant decrease during the first four weeks ( $p = 0.001$ ) followed by a significant increase during the next four weeks ( $p = 0.035$ ) (Fig. 5) (Table 2).

For the other study groups, Fingertip temperature remained unchanged (Fig. 5) (Table 2).



**Fig. 4.** Diastolic blood pressure (mmHg) (median levels) for the five study groups. Massage and mental training group (n = 19), Massage group (n = 19), Mental training group (n = 19), Pause group (n = 19), and Control group (n = 17).

## 4. Discussion

The aim of the present pilot study was to investigate if mechanical massage and mental training, used both separately and in combination, during working hours could affect employees' heart rate, blood pressure and fingertip temperature. These variables give a good representation of an individual's physiological health. Stress-related illness is often associated with hypertension, hence blood pressure and heart rate are good variables to study effects on the cardiovascular system. Stress is also associated with an increased activity in the sympathetic nervous system and hence fingertip temperature can be used as an indicator of sympathetic responses [20].

The results suggests that mechanical massage and mental training might have positive physiological effects for employees with the mechanical massage significantly decreasing the employees' heart rate as well as their systolic and diastolic blood pressure, and increased their fingertip temperature. In addition, the mental training programs significantly reduced the employees' heart rate.

Heart rate differed significantly between the five study groups after four weeks and tended to differ also after eight weeks. It was shown that the employees who received mechanical massage or listened to the mental training programs separately were the ones with the lowest heart rate. When these groups were studied separately a reduction in heart rate was seen for both groups, and it therefore seems that these two methods, when used separately, can help to reduce the employees' heart rate.

For blood pressure and fingertip temperature there were no differences between the groups for any of the three occasions, however, since this was an exploratory pilot study we also looked at each group separately. This analysis showed that the mechanical massage provided by the armchair might be effective in decreasing the employee's systolic and diastolic blood pressure. Manual massage/massage therapy has previously been shown to decrease blood pressure [12] and the present study shows that also mechanical massage might induce similar effects. The finding that mechanical massage can induce decreases in blood pressure could be especially important for people who dislike being touched [21].

The with-in group analysis from the pause group indicated that also a 15-min break taken during working hours might have positive effects on employee's systolic blood pressure.

Fingertip temperature can be used as an indicator of sympathetic responses [20] and although there were no differences between the groups at any of the occasions the massage and mental training group and the massage group still displayed changes in their fingertip temperature during the study period. However, the changes differed somewhat in these two groups.



During the last four weeks of the study the massage group displayed significant increased fingertip temperature whereas the combination group showed a decrease in fingertip temperature throughout the study period. The increase in temperature seen in the massage group might be because of an increased circulation out to the fingers due to a decreased sympathetic activity and an increased parasympathetic activity.

The participants in this study changed training programme each week during the study period. How this affected the results can only be speculated upon, but it might be that the changes caused some confusion and the results might have been stronger if the same training programme had been used throughout the entire study.

Based on the results from the present pilot study we can only speculate on the mechanism underlying the observed effects induced by the mechanical massage, and to some extent by the mental training programs, but they might be linked to an increased function in alpha 2-adrenoreceptors. These receptors, located presynaptically on noradrenergic neurons emanating from the LC and NTS, exert inhibitory effects on the release of noradrenaline, which then leads to decreased stress levels and less reactivity to stress [22,23].

Manual massage/massage therapy can induce oxytocin release [24] and has been linked to stress reducing effects such as decreased heart rate and blood pressure [13]. Since the mechanical massage used in the present study appears to induce the same effects as manual massage/massage therapy does, it most likely also causes oxytocin release. Oxytocin is produced in the paraventricular nucleus (PVN) and the supraoptical nucleus (SON) within the hypothalamus. During the massage, the oxytocinergic fibers emanating from the PVN cause an endogenous release of oxytocin into different brain areas, including the nucleus of the solitary tracts (NTS) and locus ceruleus (LC), which are of central importance for regulation of blood pressure and stress reactivity [25–27]. This increase in endogenous oxytocin levels may then increase the number of alpha 2-adrenoreceptors in the brain and thus exert stress-reducing effects. In addition, oxytocin can also decrease the activity within the HPA-axis [13]. Therefore, oxytocin released in connection with mechanical massage may have induced the stress-reducing effects seen in the employees in the massage group in the present study.

The control group continued with their work as usual and did not use any functions of the armchair or take a break in the armchair during working hours. However, they still displayed some stress-reducing effects such as lower heart rate and decreased blood pressure. The positive effects seen for this group of employees might be due to the “Hawthorne Effect”, i.e., individuals may change their behavior due to the attention they are receiving from researchers rather than because of any manipulation of independent variables [28]. Since it has been shown that positive social interactions can be related to health-promoting effects [29] the positive effects observed for the control group might also be a result of positive influences from the co-workers assigned to the other groups.

#### 4.1. Limitations

This exploratory pilot study included four different types of workplaces, since the purpose was to include a variety of workplaces and duties. In total, 93 participants were randomly assigned to one of five different study groups (including a control group). Even if the study population was small, the randomization can be regarded as a methodological strength.

Based on the results from this exploratory pilot study it's possible to draw some conclusion about sample size. In future studies it would be interesting to measure also the participants' salivary cortisol levels and if it should be possible to detect a 30%

reduction of the individual's cortisol levels in the intervention groups compared with the controls ( $\beta=0.8$  and  $\alpha=0.05$ ) each group should include 100 individuals. With an adequate powered study it would also be possible to consider different background variables in the statistical analysis, e.g., gender, type of positions in the companies, leisure activities etc.

Due to financial as well as timely limitations for the present study it was not possible to perform an adequately powered study, hence the lower number of participants than recommended. Therefore, the results from this explorative pilot study should be seen as a first step towards a larger randomized study within the study area.

It seems that there is a time difference for the different techniques to generate effects. It might be that the 8 week period in the present study was a too short time period to be able to detect changes. In future studies it would be suggested to increase the time period and also to take more measurements over the course of the study, and take several measurements at baseline, since this might add to validity.

Stress-related health problems have become an increasing problem in today's society and there is a need for development of evidence-based treatments for recovery and health promotion in workplaces. The complex nature of stress-related illness increases the need for more techniques that can address both somatic and psychic parameters of health at the same time. The armchair used in the present study was equipped with the ability to give mechanical massage and to play mental training programs. Employees who use this armchair had previously showed improvement in their self-reported psychic health [17]. The results presented in this paper shows that the armchair might also generate positive physiological effects. However, further research with a larger number of participants is needed to investigate the long-term effects of using the armchair and especially when combining the mechanical massage with the mental training programs.

## 5. Conclusions

Receiving mechanical massage and listening to mental training programs, either separately or in combination, during working hours had some positive effects on employees' heart rate, blood pressure and fingertip temperature. The effects were especially strong for employees who received mechanical massage only. However, the effects generated when combining mechanical massage and mental training programs need further investigation.

## Conflict of interest

None.

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## References

- [1] CONSTITUTION of the World Health Organization. Chron World Health Organ. 1947; 1(1–2):29–43.

- [2] World Health Organization W. Workplace health promotion [www.who.int/occupational\\_health/topics/workplace/en/index1.html](http://www.who.int/occupational_health/topics/workplace/en/index1.html). Available from: [http://www.who.int/occupational\\_health/topics/workplace/en/index1.html](http://www.who.int/occupational_health/topics/workplace/en/index1.html).
- [3] M. Danielsson, I. Heimerson, U. Lundberg, A. Perski, C.G. Stefansson, T. Akerstedt, Psychosocial stress and health problems: health in Sweden: the national public health report 2012. chapter 6, *Scand. J. Public Health* 40 (9 Suppl) (2012) 121–134.
- [4] R.P. Juster, B.S. McEwen, S.J. Lupien, Allostatic load biomarkers of chronic stress and impact on health and cognition, *Neurosci. Biobehav. Rev.* 35 (1) (2010) 2–16.
- [5] U. Lundberg, Stress hormones in health and illness: the roles of work and gender, *Psychoneuroendocrinology* 30 (2005) 1017–1021.
- [6] K. Gustafsson, P. Lindfors, G. Aronsson, U. Lundberg, Relationships between self-rating of recovery from work and morning salivary cortisol, *J. Occup. Health* 50 (1) (2008) 24–30.
- [7] M. Aourell, M. Skoog, J. Carleson, Effects of Swedish massage on blood pressure, *Complement. Ther. Clin. Pract.* 11 (4) (2005) 242–246.
- [8] M. Givi, Durability of effect of massage therapy on blood pressure, *Int. J. Prevent. Med.* 4 (5) (2013) 511–516.
- [9] M. Hernandez-Reif, T. Field, J. Krasnegor, H. Theakston, Z. Hossain, I. Burman, High blood pressure and associated symptoms were reduced by massage therapy, *Journal of bodywork and movement therapies.* 4 (1) (2000) 31–38.
- [10] I. Supa'at, Z. Zakaria, O. Maskon, A. Aminuddin, N.A. Nordin, Effects of Swedish massage therapy on blood pressure, heart rate, and inflammatory markers in hypertensive women, *Evid.-Based Complement. Altern. Med.: eCAM.* 2013 (2013) 171852.
- [11] T. Field, Massage therapy, *Med. Clin. North Am.* 86 (1) (2002) 163–171.
- [12] T. Field, Massage therapy research review, *Complement. Ther. Clin. Pract.* (2014).
- [13] K. Uvnäs-Moberg, L. Handlin, M. Petersson, Self-soothing behaviors with particular reference to oxytocin release induced by non-noxious sensory stimulation, *Front. Psychol.* 5 (2015) 1–16.
- [14] L.-E. Unestahl, P. Bundzen, Integrated mental-training—neuro-biochemical mechanism and psychophysical consequences, *Hypnos XXIII* (3) (1996) 148–158.
- [15] L.-E. Unestahl, P. Bundzen, E. Gavrilova, V. Isakov, The effects of integrated mental training on stress and psychosomatic health, *Hypnos XXXI* (2) (2004) 83–85.
- [16] R.M. Kaushik, R. Kaushik, S.K. Mahajan, V. Rajesh, Effects of mental relaxation and slow breathing in essential hypertension, *Complement. Ther. Med.* 14 (2) (2006) 120–126.
- [17] J. Muller, L. Handlin, M. Harlen, U. Lindmark, A. Ekstrom, Mechanical massage and mental training programmes affect employees' anxiety, stress susceptibility and detachment—a randomised explorative pilot study, *BMC Complement Altern Med.* 15 (2015) 302.
- [18] J. Pallant, *SPSS Survival Manual—A Step by Step Guide to Data Analysis Using IBM SPSS*, 5th ed., McGraw Hill, 2013.
- [19] W.M. Association, World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects, *JAMA* 310 (20) (2013) 2191–2194.
- [20] A. Kistler, C. Mariauzouls, K. von Berlepsch, Fingertip temperature as an indicator for sympathetic responses, *Int. J. Psychophysiol. Off. J. Int. Organ. Psychophysiol.* 29 (1) (1998) 35–41.
- [21] D.F. Zullino, S. Krenz, E. Fresard, E. Cancela, Y. Khazaal, Local back massage with an automated massage chair: general muscle and psychophysiological relaxing properties, *J. Altern. Complement. Med.* 11 (6) (2005) 1103–1106.
- [22] C.W. Berridge, B.D. Waterhouse, The locus coeruleus-noradrenergic system: modulation of behavioral state and state-dependent cognitive processes, *Brain Res. Brain Res. Rev.* 42 (1) (2003) 33–84.
- [23] N. Singewald, S.T. Kaehler, A. Philippu, Noradrenaline release in the locus coeruleus of conscious rats is triggered by drugs, stress and blood pressure changes, *Neuroreport* 10 (7) (1999) 1583–1587.
- [24] K. Uvnäs-Moberg, Massage relaxation and well-being: a possible role for oxytocin as an integrative principle? in: T. Field (Ed.), *Touch and Massage in Early Child Development*, Johnson & Johnson Pediatric Institute, 2004.
- [25] R.M. Buijs, G.J. De Vries, F.W. Van Leeuwen, D.F. Swaab, Vasopressin and oxytocin: distribution and putative functions in the brain, *Prog. Brain Res.* 60 (1983) 115–122.
- [26] J.P.H. Burbach, L.J. Young, J.A. Russell, Oxytocin: synthesis secretion and reproductive functions, *Knobil and Neill's Physiology of Reproduction*, 3rd ed., Elsevier, 2006.
- [27] M.V. Sofroniew, Vasopressin and oxytocin in the mammalian brain and spinal cord, *Trends Neurosci.* 6 (1983) 467–472.
- [28] J. McCambridge, J. Witton, D.R. Elbourne, Systematic review of the Hawthorne effect: new concepts are needed to study research participation effects, *J. Clin. Epidemiol.* 67 (3) (2014) 267–277.
- [29] K. Uvnäs-Moberg, Oxytocin may mediate the benefits of positive social interaction and emotions, *Psychoneuroendocrinology* 23 (8) (1998) 819–835.