Original Article

Risk Assessment for Work-Related Musculoskeletal Disorders in Thai Traditional Massage Therapists

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Abstract

Thai traditional massage (TTM) in spa businesses and hospitals has become popular for relieving muscle strain in Thai people as well as foreigners. Due to inherent risks in expertly performing massages, the massage therapists may become patients themselves. The aim of this study was to assess physiological strain and perceived workload in these health-related professionals. Sixty-one female TTM therapists volunteered to participate in the study. They were divided into three age groups: ≤ 34, 35-44, and ≥ 45 years. A questionnaire was used to assess the perceived discomfort. Actual physical manifestations were assessed by measuring %cardiovascular load (%CVL) and muscle strain (%maximum voluntary contraction, %MVC) of the trapezius and deltoids on both sides during a 50-minute treatment. The impact of the massage therapy on the therapist was assessed by comparing pre- and post-massage maximum voluntary contraction (MVC) test and measuring the shift in median power frequency (ΔMPF) of EMG to assess fatigue during the massage session. Results showed that %MVC was < 15% in all age groups, indicating safe levels of work, with no significant difference in physiological strain among groups. A trend in muscle capacity loss (decreases in MVC after a massage session) was observed. A mild fatigue level (ΔMPF) was found in the 35-44 years age group ($P < 0.05$). The levels of perceived discomfort and the objective measurement corresponded well in all age groups, supporting the assessment of subjective workload as a tool in risk evaluation. Moreover, this study showed that objective measurement of cardiovascular and muscle strains were possible in TTM setting. The protocol in this work can be a basis for further research to optimize work conditions in TTM and other therapeutic methods, to benefit therapists as well as patients.

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Introduction

The evolution in work systems – from manual work to mechanization and automation – drastically reduced the impact of heavy physical work on the health and safety of the operators. During the last decade, many research projects have focused attention on health and safety in order to reduce the frequency and severity of occupational injuries and diseases.[1] However, authorities and prevention experts faced a new challenge: namely the stagnation – even worsening – effect on unemployment rates in industrial activities with obvious lower physically demanding workloads, and failed to notice the concrete cause and effect evidence to tackle the absenteeism rates.[2] At present cumulative trauma disorders (CTD), or more generally, musculoskeletal disorders (MSD), meet vague preventive recommendations due to a lack of fundamental relevance in the management strategies.[3,4]

Manual therapy is built upon intensive muscle-work (both isotonic and isometric) and has a repetitive character in combining postural load within a formal or informal work-rest schedule.[5] As a paradox, the physiotherapeutic job conditions may include risks for increased load of the therapist's movement system.

Prevalence and incidence of musculoskeletal disorders in physical therapists

In the last decade, the appearance of musculoskeletal disorders (MSD) related to manual physical therapy revealed serious problems as many therapists became patients themselves. The reported lifetime prevalence of MSD for therapists is 91%. Furthermore, 1 in 6 physical therapists have moved within or left the profession because of a work-related MSD (WMSD), and 64% of those leaving were less than 30 years old.[6,7]

The observed WMSD among physical therapists focused on the lower back region (45%), the wrist/hands and fingers (29.6%), the upper back (28.7%), and the neck region (24.7%).[8] Despite the high job satisfaction of 88% among therapists in Germany, lower back pain surged to 62% of all disorders.[9] The prevalence rates varied from continent to continent: 68% in the UK, 61% in the USA, 91% in Australia, 85% in Turkey, 91.3% in Nigeria, and 47.6% in Kuwait. Based on a six-page

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questionnaire,[10] these figures have been confirmed by the high rates among Thai massage therapists (82.2% lower back, 80.2% upper back, and 78% neck). It is evident that recognizing the problem and its importance (size) has become an essential issue.

Musculoskeletal disorders: Methodological considerations

Prevention is an active strategy which requires vigilance and anticipation of potential problems. Identifying and acting on the warning signs in the preceding cumulative period is a crucial step. The cases of a CTD or MSD are concerned with the subjective perceived annoyances by individual therapists. An efficient prevention program requires a participatory approach in which the subjective experiences are a prerequisite condition for a successful participatory strategy.[1,11]

The subjective experiences gain value when they are supported by scientific arguments which ask for concrete figures supporting the experiences. Such criteria are, for example, the changes in the maximum voluntary contraction (MVC, obtained via a maximal effort test) that may indicate both central and peripheral fatigue via the loss in potential,[12] the MVCs may indicate the differentiation between peripheral and central fatigue;[13] as confirmed by Nordlund et al.[14] According to surface electromyography (sEMG) studies, it was shown that an increase in EMG amplitude or shifts in the spectrogram are indicators for muscle fatigue in static contractions.[15-20] Decreases in median frequency along with an increase in sEMG amplitude give a strong indication of muscle fatigue,[21] and a strong correlation with the subjective fatigue levels enhances the importance of the perceived assessment.[22,23]

The use of EMG to assess the impact of workload on the muscular systems of the therapists is a well known technique.[24] The most recruited muscles during the therapeutic performances are the trapezius, deltoids, wrist flexors and extensors, and the lower back muscles (erector spinae).

The aim of this study was to assess the work strain in Thai traditional massage (TTM) therapists in Bangkok and surrounding provinces. The ergonomic method that combined subjective and objective criteria was used to assess risks for WMSD and eventually other TTM health risks. The knowledge of the operational risks can be used as the basis for a strategy to anticipate biomechanical disorders.

Materials and Methods

This project was approved by The Human Ethic Committee from Research Institute of Rangsit University (21/2014).

Massage techniques

The traditional message techniques used in this study were Ratchsamnak and Chaloeysak styles, being the most popular for clients in spa businesses as well as in the treatment of patients in district hospitals. Formally, the Ratchsamnak technique is compulsory in the district hospitals. However, therapists have been observed to perform a mixture of both techniques. The Chaloeysak technique (or Wat Pho massage) is preferred by foreigners visiting the Wat Pho temple in Bangkok. According to a previous research,[24] the result of different massage styles, in terms of muscle strength, was not significantly different.

Figure 1 (***A***) Ratchsamnak massage; (***B***) Chaloeysak massage.

The Ratchsamnak style (Royal style, Figure 1A) provides deep muscle massage by exerting pressure using only thumbs (at contact points) with stretched arms (to transmit power) along the energy lines on the patient's body in sitting or lying positions. In this method, a certain distance must be kept between the patient and the therapist. Occasionally, devices with steamed herbs as well as the use of small appliances (wooden sticks) are applied to concentrate the pressure at specific spots.

The Chaloeysak style (Folk style, Figure 1B) is quite similar, but has a less formal approach. The practitioner uses hands, fingers, elbows, forearms, knees, or feet to exert pressure along the Sen Sib energy lines throughout the body. This method includes many stretching movements in positions which require some closer body contacts between the patient and the therapist. The pressing along the energy lines all over the body is meant to relieve blockages in energy transfer and to increase the functionality of tendons and joints.

Participants

Subjects were TTM therapists selected by a purposive sampling.

Inclusion criteria. Female therapists, aged 25 to

55 years, who had at least two years of experience in professional TTM. The number of clients on the test date was one to four.

Exclusion criteria. Therapists with the following conditions were excluded: 1) nerve compression or MSD symptoms, as confirmed by a physical therapist; 2) thyroid diseases, diabetes mellitus, and cardiovascular illnesses; and 3) having taken any medicine in the preceding seven days before the measurement date.

Sixty-one female therapists were recruited. All participated voluntarily and had given written informed consent before the study. They were subdivided into three age groups: ≤ 34, 35-44, and ≥ 45 years. All therapists had comparable skill-characteristics and experiences in the methods. Their general characteristics are summarized in Table 1.

The general characteristics were in accordance with the average Thai female population, and the inter-category differences fell within an acceptable range corresponding with age differences.

The muscles selected to study were the trapezius and deltoids,[24] because they are strongly involved in therapeutic movements, and the placement of electrodes did not obstruct their movements.

Experimental procedures

The procedure consisted of three phases: pre-, during and post-massage sessions.

Upon arrival, participating therapists were given the project details and signed the informed consent form. Body weight, height, resting heart rate and tympanic temperature were measured. Then they completed the subjective workload index (SWI) questionnaire before the massage session.[25,26]

To assess cardiovascular load (CVL), all participants were equipped with a heart rate recorder (Polar, Electro, Ltd, Finland) wrist watch and electrode-band at the chest. To assess muscle strain, surface electrodes for registering electromyography (EMG) were placed at the selected muscles, the trapezius and deltoids.[27] A portable EMG device (ME6000P, Mega Electronics, Finland) was used to register the signals, and the results were processed using Megawin software on PC following the procedure (Figure 2).

Figure 2 EMG device and samples of the graphic user interface from Megawin software, Finland, used for assessment.

Maximal voluntary contraction (MVC) test was performed in both pre- and post-massage sessions. For the trapezius, participants lifted the shoulders up as high as possible against a resistance (body weight) given by an experienced neutral researcher. For anterior deltoid muscles, participants stood with arms straight out in front and lifted their arms straight in the air as high as possible against a resistance given. The EMG amplitude (AEMG) was taken as MVC of the muscle (in μV). The post-massage MVC test was performed after 15 minute recovery period, during which the participant sat in a relaxed position.

During the massage session: After the MVC pre-test, participating therapists started to perform massage therapy on one patient while an observer recorded all activities every 30 s during the massage. Each massage session lasted 50 minute.

Assessment criteria

Subjectively perceived discomfort was assessed with the subjective workload index or SWI scores, which were interpreted as follow:[26,27] ≤ 2, very light to light work; 2 to ≤ 3, moderate work, some problems may occur; 3 ≤ 4: heavy to tough work, problems very likely; and ≥ 5, very seriously problematic. The higher the score, the more the coercive need for adjustments, e.g., in techniques, organization, and environment.

Objective assessments focused on cardiovascular

Table 1 Physical characteristics of participants, who were traditional Thai massage (TTM) therapists.

	≤ 34 years (n =18)		35-44 years (n = 23)		≥ 45 years (n = 20)		*F*	95%CI for mean	*P*
	Mean	SD	Mean	SD	Mean	SD			
Height (cm)	160.11	4.92	158.48	6.07	155.90	4.79	3.025	153.66, 162.56	0.056
Weight (kg)	63.72	19.84	65.09	13.19	62.64	9.51	0.153	53.85, 73.59	0.858
BMI (kg/m^2)	24.31	6.77	26.02	4.77	25.83	4.13	0.608	20.95, 28.08	0.548
Rest HR (bpm)	79.78	12.16	78.52	12.28	75.16	7.69	0.888	71.45, 85.82	0.417
Body temperature (◦c)	36.68	0.26	36.64	0.46	36.56	0.63	0.314	36.44, 36.84	0.732
Experience (years)	7.47	3.91	9.87	3.56	7.94	4.06	2.273	5.46, 11.41	0.113
Handgrip left (kg)	27.03	3.82	25.77	6.85	25.89	5.59	0.290	22.80, 28.73	0.749
Handgrip right (kg)	28.54	3.11	28.22	4.29	26.28	5.49	1.499	23.71, 30.09	0.232
Treatment duration (min)	50.39	13.37	51.47	20.23	57.86	29.03	0.667	42.71, 71.45	0.517

Between-group difference was tested with ANOVA; no statistically significant difference was found.

strain, and muscle capacity and strain.

Cardiovascular strain: Heart rate was transformed into an age-related relative cardiovascular load (%CVL), as detailed elsewhere.[26] The interpretation was as follow: < 30%, acceptable for a normal shift; 30-60%, substantial physiological fatigue requiring attention (e.g., reducing workload); > 60%, requiring an intervention within a short time; and 75-80%, CVL should be corrected promptly.[28,29]

Muscle capacity was indicated by MVC (EMG amplitude, or AEMG, in μV). The results from the pre *vs* post MVC tests indicated a loss in power due to the work period as compared with general thresholds found in the literature.[24] The initial MVC was considered as a baseline for the maximal power/capacity in order to attenuate the inter and intra individual differences.[29]

Muscle strain was indicated by %MVC. The standard threshold for work was set between 10-20% MVC for the efforts over the study period.[24] In addition, the median power frequency (MPF) during the massage session obtained from EMG signal analysis was employed for assessing the endurance-fatigue aspect. A MPF shift (ΔMPF) to a lower frequency or a change to a negative value indicated fatigue.[24,30-32]

Statistical Analysis

The difference in muscle load and strain between pre- and post-massage session for each age group was analyzed by using paired *t*-test. ANOVA with a confidence interval of 95% and a significant level at $P < 0.05$ was used to evaluate physical characteristics, perceived strain (SWI), and physiological strain for the three groups of massage therapists. Scheffe method was used for *post hoc* comparisons between age groups.

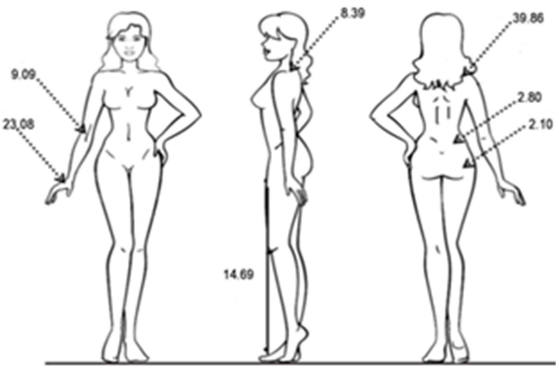

Figure 3 Formulated complaints.

Results

Subjective work strain assessment

Preliminary informal complaints: In the first screening interview with participants, some complaints were formulated. These are summarized in Figure 3. The results reflect the experienced levels, from annoying up to painful, for experience levels of 8.5 ± 1.0 years, and was indicative for the selection of the large muscle groups involved in the therapies (the trapezius and deltoids, left and right). An EMG assessment of smaller muscle groups involved in the therapy was not taken into consideration because the equipment (electrodes and wirings) could influence the movements of the forearms and hands. The most pressure-related problems were situated in the shoulder region (39.86%), followed by the wrists, hands, fingers (23.08%), legs (14.69%), arms (9.09%), and neck (8.39%). Moreover, less obvious minor annoyances were found in the lower back region (2.80%) and hips (2.10%). The lower limbs, (13.4%) were linked to the squatted posture of the therapists, i.e., knees bent at different angles, sometimes the buttock on the feet.

Table 2 Subjective workload index score and related workload factors.

Subjective aspects	≤ 34 years (n =18)		35-44 years (n = 23)		≥ 45 years (n = 20)		*F*	95%CI for mean	*P*	All participants	
	Mean	SD	Mean	SD	Mean	SD				Mean	SD
Fatigue	5.56	1.82	5.13	1.93	5.59	1.93	0.37	4.29, 6.59	0.690	5.43	1.88
Risk	5.67	1.41	4.65 **a**	2.56	3.50 **b**	2.59	3.93	2.16, 6.37	0.025	4.61	2.39
Concentration	6.78	1.92	7.48	2.08	8.35	2.31	2.44	5.82, 9.54	0.096	7.54	2.16
Complexity	6.17	2.74	4.87	2.54	4.18	3.02	2.38	2.62, 7.53	0.102	5.07	2.82
Work Rhythm	4.39	1.98	5.52	1.97	5.12	1.93	1.85	3.55, 6.38	0.166	5.01	1.90
Responsibility	8.17	2.06	8.30	2.16	9.59 **a,b**	0.87	3.21	7.14, 9.24	0.048	8.69	1.91
Job Interest	8.39	1.85	9.26	0.96	9.41	0.87	3.36	7.47, 9.86	0.051	9.02	1.33
Autonomy	7.06	1.83	8.35	1.77	8.77 **b**	1.52	4.8	6.15, 9.55	0.012	8.06	1.83
SWI score	**2.66**	**0.90**	**2.29**	**1.01**	**2.27**	**0.68**	**0.91**	**1.86, 3.08**	**0.409**	**2.41**	**0.89**

Participants were asked to subjectively grade the following aspects on the scale from 1 to 10: Fatigue, feeling of fatigue related to work; Risk, perceived risks in relation to work; Concentration, levels of concentration required during work; Complexity, difficulty related to work; Work Rhythm, repetitiveness of the work; Responsibility, levels of responsibility expected from the individual therapist; Job Interest, personal interest in the present job; Autonomy, perceived independence from authoritative control at work. **a**, Significantly different from ≤ 34 years age group, $P < 0.05$; **b**, significantly different from 35-44 years age group, $P < 0.05$; ANOVA, with *post hoc* Scheffe test.

Subjective workload experience (SWI)

The general average SWI was 2.41 (Table 2) representing moderate subjective workload for a 50-minute massage session for all levels of experience. Regarding workload factors asked, perceived risk (Risk, Table 2) was lowest in the oldest age group, whereas perceived responsibility and autonomy (Responsibility and Autonomy, respectively, Table 2) scored the highest ($P < 0.05$). (See legend of Table 2 for the definition of each factor.) Fatigue and risks for a disorder were estimated as relatively low.

Musculoskeletal and cardiac strain

Muscle capacity. Pre-post muscle capacity tests The results in Table 3 revealed a capacity decrease, i.e., MVC reduction, in all age groups and in most muscles. The overall %decrease [calculated from MVC data (µV) in Table 3, using the following formula for each muscle: (Pre-Post) x100/Pre, and then averaging for all muscles in each age group] was, 8.6%, 11.2 %, and 5.7%, youngest to oldest, respectively. Regarding individual muscle, there was a significant decrease in the left deltoid MVC in the youngest age group ($P < 0.05$). However, a slight MVC increase in the post-massage test were found for the left trapezius (+2.3%, %change, compared to the Pre value) in the youngest therapist and for the right trapezius (+5.8%) in the oldest, though these differences did not reach significance. There was a significant increase in MPF in all muscle groups in the oldest age group ($P < 0.01$). The subjective feeling of fatigue, when asked to grade from 1-10 (fatigue score; Table 3) was higher ($P < 0.001$) after massage session in the 35-44 years age group.

Cardiac and muscle response during the therapy. The measured physiological reactions (Table 4) during work showed a moderate to low cardio-vascular strain, with %CVL below the set level of 30% in all age categories. The highest %CVL was found in the youngest category (24.12%), somewhat higher than the two more experienced age groups.

Table 3 Muscle capacity test and fatigue score: Pre- *vs* post-massage comparison.

	Pre		Post		95% CI of	
	Mean	SE	Mean	SE	the difference	*P*
≤ 34 years (n = 18)						
Lt trapezius MVC, µV	685	100	701	101	-100.2, 69.3	0.705
Rt trapezius MVC, µV	657	84	596	75	-14.5, 135.0	0.107
Lt deltoid MVC, µV	689	92	531	62	2.5, 312.6	0.047*
Rt deltoid MVC, µV	727	69	695	75	-20.5, 82.7	0.220
Lt trapezius MPF, Hz	63	3	62	2	-2.0, 5.1	0.363
Rt trapezius MPF, Hz	62	2	58	4	-6.3, 12.6	0.489
Lt deltoid MPF, Hz	60	3	61	3	-5.7, 3.3	0.572
Rt deltoid MPF, Hz	62	3	66	3	-10.4, 1.7	0.149
Fatigue score	5	1	6	1	-1.9, -0.4	0.380
35-44 years (n = 23)						
Lt trapezius MVC, µV	714	131	596	90	-87.5, 322.5	0.247
Rt trapezius MVC, µV	754	90	731	95	-73.8, 119.7	0.627
Lt deltoid MVC, µV	769	65	670	88	-27.1, 224.6	0.118
Rt deltoid MVC, µV	826	96	725	81	-19.7, 221.4	0.097
Lt trapezius MPF, Hz	65	3	64	2	-3.1, 3.8	0.837
Rt trapezius MPF, Hz	67	2	67	3	-2.0, 1.6	0.841
Lt deltoid MPF, Hz	65	3	66	2	-4.0, 1.0	0.217
Rt deltoid MPF, Hz	68	3	69	2	-3.4, 2.1	0.650
Fatigue score	3	1	5	1	-2.7, -1.2	0.000***
≥ 45 years (n = 20)						
Lt trapezius MVC, µV	664	71	609	57	-17.5, 127.8	0.128
Rt trapezius MVC, µV	483	65	513	72	-71.6, 10.4	0.135
Lt deltoid MVC, µV	676	118	617	95	-29.1, 146.5	0.177
Rt deltoid MVC, µV	714	108	628	71	-109.3, 281.5	0.365
Lt trapezius MPF, Hz	63	3	82	6	-30.48, -6.99	0.004**
Rt trapezius MPF, Hz	65	4	85	6	-30.58, -8.27	0.002**
Lt deltoid MPF, Hz	60	3	77	6	-27.39, 7.35	0.002**
Rt deltoid MPF, Hz	66	4	85	7	-30.95, -6.60	0.005**
Fatigue score	3	1	4	1	-2.71, 0.86	0.282

MVC, maximum voluntary contraction; MPF, median power frequency; Fatigue score, subjective feeling of fatigue (scale of 1-10) asked in both pre- and post-massage phases. Significant difference between pre- and post-massage session: *$P < 0.05$, **$P < 0.01$, and ***$P < 0.001$; paired *t*-test.

Table 4 Comparison of physiological strain in TTM therapists among the three age groups

	≤ 34 years (n =18)		35-44 years (n = 23)		≥ 45 years (n = 20)		*F*	95%CI	*P*
	Mean	SE	Mean	SE	Mean	SE		for mean	
Cardiovascular load (%CVL)	24.12	2.41	19.02	1.85	23.66	1.85	2.048	15.19, 29.21	0.138
Lt trapezius (AEMG, µv)	27.94	4.34	24.83	2.71	25.20	2.47	0.274	18.79, 37.10	0.761
Rt trapezius (AEMG, µv)	28.06	3.95	23.87	2.63	20.65	2.03	1.533	16.40, 36.40	0.225
Lt deltoid (AEMG, µv)	27.67	3.96	20.78	1.39	25.85	2.43	1.934	17.90, 36.02	0.154
Rt deltoid (AEMG, µv)	31.94	3.89	25.43	3.78	23.95	2.67	1.356	17.60, 40.16	0.266
Lt trapezius strain (%MVC)	4.44	0.52	4.90	0.49	4.39	0.42	0.355	3.33, 5.92	0.702
Rt trapezius strain (%MVC)	4.49	0.42	4.19	0.67	4.83	0.39	0.353	2.80, 5.67	0.704
Lt deltoid strain (%MVC)	4.13	0.45	3.40	0.50	4.97	0.73	1.903	2.35, 6.51	0.158
Rt deltoid strain (%MVC)	4.59	0.50	2.91 **a**	0.19	4.15	0.40	5.996	2.52, 5.67	0.004
Lt trapezius fatigue (ΔMPF, Hz)	0.033	0.04	-0.16 **a**	0.04	0.06 **b**	0.02	10.358	-0.27, 0.12	0.000
Rt trapezius fatigue (ΔMPF, Hz)	0.013	0.05	-0.15	0.05	0.05 **b**	0.02	5.053	-0.27, 0.13	0.010
Lt deltoid fatigue (ΔMPF, Hz)	-0.07	0.03	-0.21	0.06	-0.04 **b**	0.02	4.383	-0.34, 0.17	0.018
Rt deltoid fatigue (ΔMPF, Hz)	0.07	0.04	-0.07 **a**	0.04	-0.04	0.02	4.424	-0.16, 0.16	0.017
SWI score	2.62	0.21	2.29	0.21	2.27	0.16	0.909	1.85, 3.07	0.409

AEMG, EMG amplitude during massage; %MVC, percentage of AEMG compared to maximum voluntary contraction; ΔMPF, shift in median power frequency, indicating fatigue. **a**, Significantly different from ≤ 34 years age group, $P < 0.05$; **b**, significantly different from 35-44 years age group, $P < 0.05$; ANOVA, with *post hoc* Scheffe test.

The muscle strain (%MVC) was less than 5% for all age groups and corresponded with the subjective experience. The highest values were found in the youngest category, with %CVL 24.12, SWI 2.62, and average %MVC 4.41, compared with the middle (35-44 years) and the oldest (≥ 45 years) groups: %CVL 19.02 and 23.66, SWI 2.29 and 2.27, and average %MVCs 3.85 and 4.58, respectively.

The change of MPF (ΔMPF) from the start until the end of massage session showed negative values indicating signs of fatigue in the 35-44 years age group ($P < 0.05$) compared to the youngest and oldest age groups.

Discussion

The body region with the highest complaints in this study were similar to the complaints reported by Bork et al.[8] These first mentioned body parts that steered the selection to objectify workload assessment were based on the seriousness of the perceived complaints affecting the functional capacities.

In general, SWI was the highest in the youngest age group, possibly due to lack of experience which may also reflect that self-management is a part of the learning process. The older age groups scored a higher degree of autonomy. This aspect may also be related to their interest in the job, the levels of responsibility, and the complexity, obviously linked with their experience.

The decrease in muscle capacity of the left deltoid after massage treatment in the youngest age group ($P < 0.05$) could be a result of peripheral fatigue.[32] An increase in capacity, seen in some muscles, could be a sign of warming up during the test (soliciting motor units) and also may be linked to left-right dominance of the extremities.[33] The values might be influenced by the spontaneous left-right handed preference, as higher risks for upper extremity musculoskeletal disorders are found on the preferred side.[34]

Muscle strain during the massage session (%MVC, Table 4) was less than 5% for all age groups, well below the established at risk threshold of 10% MVC,[33] and corresponded with the subjective experiences.[27] The average solicited motor units (AEMG, µV, Table 4) are comparable among the three age groups, with some minor differences, though the large amplitudes of the right deltoid intensities (µV) are the most intensive in younger age groups, but this value remained rather modest for eight hours of work.[35]

The negative value of median power frequency (ΔMPF) at the end of the recovery period revealed some fatigue in the 35-44 years group as compared to other age groups.[31-32,35] The results varied in general from light to no fatigue in the youngest group and were even improving for the most experienced age group (positive ΔMPF). The experienced age group may have developed a more efficient coping strategy to avoid fatigue.[31]

The relationship between muscle strain (%MVC) levels and MPF values within the same age group were quite opposite, and agreed with the Raman-Li findings[35] that reported the differences within gender or age groups as a result from the relationship between force and EMG spectral parameters associated with anatomical and geometric factors underlying the generation of EMG signals. These inter-individual differences in physical capacity and condition of therapists, as well as their patients, may have an influence on the musculoskeletal disorder (MSD) incidence rates.

There are some future considerations stemming from the present work. First, regarding assessment techniques and methodology, we have showed in this study that measuring cardiovascular and muscle strains are possible techniques to be used in the normal movement patterns of the therapists. The equipment did not disturb the movements nor the postures, and the measurement does not require special features nor specific conditions. Although all the therapists were MSD complaint-free, it would be useful to compare the results of this ‘healthy’ population with those having some physical annoyances or limitations.

Second, the work volume of participants in this study was limited to one TTM therapist doing one massage treatment on one client a day. It would be appropriate to evaluate the load by increasing the work volume in a future project, in order to define a realistic optimal daily quantum of treatments. Indeed, the research protocol and methods used in this project could be implemented in future research on therapeutic methods other than TTM to suggest an optimal number of patients per day, per week or longer periods.

Lastly, it may be essential in MSD-CTD prevention strategy to implement the assessment of subjective experience of the ‘patients’ (i.e. the therapists with MSD-CTD), using SWI or similar questionnaire, in combination with an objectifying research method, to establish an extensive database of the (positive and negative) therapist experience. Equally elementary in CTD prevention is probably the collection of recognizable complaints that can be analyzed objectively. Therefore, further research into different disorders, therapy programs, optimal recovery periods, are needed. In such a participative strategy, the match between the standardized collected complaints, supported by objectified studies of workload and strain will enhance the positive effects of TTM, as much for patients as for therapists.

Limitations. This field research conducted in actual working conditions. A full control of all influencing factors was not possible. The efficiency of the therapy and business aspects are limiting conditions. For example, permission from the business manager was necessary. The design of the research method took into account all those parameters.

Conclusion

This study demonstrated that objective assessment of cardiovascular and muscle strains were possible in TTM setting. Our sample population of TTM therapists in all three age groups worked at safe levels, and there was no significant difference in physiological strain among the groups. All were free from a musculoskeletal disorders (MVC < 15%). The perceived discomfort and objective assessment were in agreement in the three age groups, suggesting that the subjective assessment could be representative for the objectively observed parameters and a useful tool for work risk assessment. Our protocol can be applied in further research aiming at finding eventual preventive measures to reduce the work strain, which will be beneficial to therapists and their patients alike.

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Conflict of Interest

None to declare.

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