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ENERGY EXPENDITURE FOR MASSAGE THERAPISTS DURING PERFORMING SELECTED CLASSICAL MASSAGE TECHNIQUES

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Abstract
Objectives: The aim of the study is to evaluate the intensity of the effort and energy expenditure in the course of performing selected classical massage techniques and to assess the workload of a massage therapist during a work shift. **Material and Methods:** Thirteen massage therapists (age: 21.9±1.9 years old, body mass index: 24.5±2.8 kg×m^{-2}, maximal oxygen consumption × body $mass^{-1}$ ($VO_{2\,max}$×BM^{-1}): 42.3±7 ml×kg^{-1}×min^{-1}) were involved in the study. The stress test consisted in performing selected classical massage techniques in the following order: stroking, kneading, shaking, beating, rubbing and direct vibration, during which the cardio-respiratory responses and the subjective rating of perceived exertion (RPE) were assessed. Intensity of exercise during each massage technique was expressed as % $VO_{2\,max}$, % maximal heart rate (HR_{max}) and % heart rate reserve (HRR). During each massage technique, net energy expenditure (EE) and energy cost of work using metabolic equivalent of task (MET) were determined. **Results:** The intensity of exercise was 47.2±6.2% as expressed in terms of % $VO_{2\,max}$, and 74.7±3.2% as expressed in terms of % HRmax, while it was 47.8±1.7% on average when expressed in terms of % HRR during the whole procedure. While performing the classical massage, the average EE and MET were 5.6±0.9 kcal×min^{-1} and 5.6±0.2, respectively. The average RPE calculated for the entire procedure was 12.1±1.4. During the performance of a classical massage technique for a single treatment during the study, the average total EE was 176.5±29.6 kcal, resulting in an energy expenditure of 336.2±56.4 kcal×h^{-1}. In the case of the classical massage technique, rubbing was the highest intensity exercise for the masseur who performed the massage (%$VO_{2\,max}$ = 57.4±13.1%, HR_{max} = 79.6±7.7%, HRR = 58.5±13.1%, MET = 6.7±1.1, EE = 7.1±1.4 kcal×min^{-1}, RPE = 13.4±1.3). **Conclusions:** In the objective assessment, physical exercise while performing a single classical massage is characterized by hard work. The technique of classical massage during which the masseur performs the highest exercise intensity is rubbing. According to the classification of work intensity based on energy expenditure, the masseur's work is considered heavy during the whole work shift. Int J Occup Med Environ Health 2018;31(5):677–684

Key words:
Physiotherapy, Oxygen consumption, Exercise intensity, Energy expenditure, Classical massage, Heart rate reserve

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INTRODUCTION

Massage is currently one of the most popular physiotherapy treatments, primarily used in the case of musculoskeletal pain. It is also used in sports as a form of action to accelerate post-exercise recovery and to prepare an athlete for increased training workloads. It is also applied in the broadly understood biological renewal – relieving effects of long-term stress or in cosmetics – as part of care treatments [1–5].

The traditional division of massages is: therapeutic massage, sports massage, hygienic-cosmetic massage [6]. Some authors additionally mention relaxation massage and massage in aesthetic medicine [7]. Therapeutic massage is divided into classical massage, hydrotherapy (whirlpool, underwater, shower), specialized massages (segmental, periostatic, connective tissue and isometric) and instrumental massage (syncardial, vibratory, pneumatic) [6].

Classical massage is a form of treating causes or alleviating disease symptoms using an exogenous mechanical irritant stimulus that acts directly on the tissues of the person being massaged, causing localized and general reactions [7]. As a result of classical massage, the flow of blood and lymph in the treated tissues increases. Systolic blood pressure decreases, while there is an increase in venous pressure. The tissue response is the effect of reflex action via mechanoreceptors and chemoreceptors. These reactions may result in changes in distal tissues and organs translating into the effects of the general massage and improving the emotional state of patients [1–5,8].

Achieving the desired results requires a masseur to perform physical labor, based on dynamic efforts mainly involving the upper limbs, executed in a forced static standing position with the body leaning forward. In the social opinion, it is believed that the work of a masseur is related to intense effort which is very exhausting. This view is based on the subjective assessment of both the patients and the masseurs themselves. However, there is no existing objective research in scientific literature concerning the reaction of the masseuse's organism to the physical effort they perform during their professional work. Therefore, our objective is to evaluate the intensity of the effort and energy expenditure in the course of performing selected classical massage techniques and to assess the workload of the massage therapist during a work shift.

MATERIAL AND METHODS

Study participants

Thirteen men aged 19–25 years old were involved in the study. They were massage therapists – current graduates of the Higher Integrated School of Therapeutic Massage. Each participant had the required technical skills to perform classical massage in the area of the back in accordance with the accepted methodology. After being acquainted with the study aim and plan, the subjects agreed to voluntary participation in the project. Approval of the Bioethical Committee of the Regional Medical Chamber (101/KBL/OIL/2015) was obtained. The study was performed in accordance with the Declaration of Helsinki.

Somatic measurements

Body mass (BM) and body composition were determined using a multi-frequency (5 kHz, 50 kHz and 250 kHz) body composition analyzer (Jawon Medical IOI-353, Korea). Lean body mass (LBM) and percentage of body fat (PBF) were determined using bioelectric impedance analysis (BIA). Body height (BH) was measured to an accuracy of 1 mm (Seca 217 Stadiometer, Germany). Body mass index (BMI) was calculated for each participant (Table 1).

Cardio-respiratory fitness

Maximal oxygen consumption ($VO_{2\,max}$) was determined in the masseurs with the indirect method using the Åstrand-Ryhming cycle test [9,10]. The mean heart rate (HR) for the last 3 min of stress (in steady-state) was calculated, on the basis of which the absolute $VO_{2\,max}$ values were read from tables developed on the basis of the normal

Table 1. Somatic features of the studied massage therapists (N = 13)

Characteristics	M±SD
Age [years]	21.9±1.9
Body height (BH) [cm]	175.9±7.0
Body mass (BM) [kg]	75.9±11.0
Lean body mass (LBM) [kg]	60.7±7.1
Percentage of body fat (PBF) [%]	19.2±4.3
Body mass index (BMI) [$kg\times m^{-2}$]	24.5±2.8

M – mean; SD – standard deviation.

heart axis [9,11]. Results were referenced to body mass to obtain relative values ($VO_{2\ max}\times BM^{-1}$). Maximum heart rate ($HR_{max}$) was estimated on the basis of the formula [12]:

$$208–0.7 \times \text{age [years]} \quad (1)$$

Exercise intensity and energy expenditure while performing varied classical massage techniques

The stress test consisted in performing 6 selected classical massage techniques in the following order: 1) stroking, 2) kneading, 3) shaking, 4) beating, 5) rubbing and 6) direct vibration, during which assessment of the cardio-respiratory responses and the subjective rating of perceived exertion (RPE) using the Borg scale was conducted in the masseurs.

The measurement began with a 2-min resting period in a standing position. Then, the massage therapists performed individual classical massage techniques on the back area based on the methodology given by Zborowski [7]. Techniques were in the order of expected feeling of workload, starting with techniques that had the lowest expected intensity. All techniques apart from vibration were done using both hands. The time spent on performing the 5 techniques was 6 min each. These efforts were separated by 2-min intervals. The fifth technique (rubbing) was followed by a 3-min interval, and subsequently, 1.5 min of direct vibration which ended in a 3-min resting period. The men performed the massage techniques while standing by a massage table, each time adjusting it to their height to maintain the principles of ergonomics. During intervals, the therapists rested in a standing position. They were dressed in loose-fitted clothing that did not hamper their movement. Farmona (Poland) massage oils were used as a lubricant. The person undergoing massage, who was another masseur, laid down on the massage table with the treatment area exposed – the back.

Stroking consisted in the masseur gliding his hands along the massaged person's skin (60 movements/min); during the return movement, the masseur was in contact with the massaged tissues. Masseurs performed transverse kneading, which consisted of alternating skin-muscular folds, raised using the "pincer" grip – between the thumb and the remaining fingers of one hand, and the other hand (60 movements/min).

Shaking was based on performing alternating movements transverse to the long axis of the massaged body, with the usage of stiff hands and extended thumbs (240 movements/min).

The beating treatment consisted of alternatively hitting the massaged person's tissues with relaxed hands of the masseur (300 bpm).

Rubbing consisted in performing intense, alternating movements with the hands in the form of small circles, about 4 cm in diameter, arranged on the massaged person's body in a spiral shape (120 movements/min).

The last technique was direct vibration along the axis of the body. The exercise consisted in massaging the tissues by obtaining isometric contraction within the muscles of the upper limb of the masseur. The point of contact with the treatment area was the fingertip of the massage therapist from the second to the fifth finger (500 vibrations/min). The pace of performing individual massage techniques was dictated by a metronome.

The Cortex Metalyzer 3B (Germany) ergospirometer was used in the assessment of oxygen consumption, carbon dioxide excretion (VCO_2) and respiratory exchange ratio (RER). Heart rate was measured using the Polar S610i (Finland) pulsometer.

The average level of physiological indicators during the last 3 min of performing each massage technique (steady-state) was analyzed, with the exception of vibration, for which the average score for the entire period of performing the technique was analyzed. Intensity of effort during each massage technique was expressed as % $VO_{2\ max}$, % HR_{max} and percentage heart rate reserve (% HRR). The heart rate reserve (HRR) was calculated as the difference between HR_{max} and resting HR (before starting massage). Percentage heart rate reserve was calculated as:

$$\%\ HRR = (\text{submaximal HR} - \text{rest HR/HRR}) \times 100 \quad (2)$$

Resting and maximal values of % HRR were, by definition, 0 and 100, respectively [13]. During each massage technique, energy expenditure (EE) in net values and energy cost of work using metabolic equivalent of task (MET) (1 MET was equal to 3.5 ml $O_2 \times kg^{-1} \times min^{-1}$ of consumption) were determined. Net energy expenditure was calculated during the entire treatment. The energy expenditure was determined using the open-circuit indirect calorimetry method (based on oxygen consumption and the RER). It is assumed that the consumption of one liter of oxygen, depending on the RER, results in an energy expenditure of 4.66–5.02 kcal [14].

During resting periods, the subjects performed subjective assessment of RPE with respect to the completed massage technique, on a scale of 6–20 points (6 – no exertion at all, 20 – maximal exertion) [15].

Statistical analysis

Arithmetic mean and standard deviation (SD) were calculated for the analyzed variables. One-way ANOVA analysis of variance was used for evaluating the significance of differences between the compared averages. In the case of noting a statistically significant difference, the Tukey test – *post-hoc* analysis – was used for comparing the mean score during the stroking technique with the remaining classical massage techniques. Significant differences in the means were observed at $p < 0.05$ (Statistica 10, Statsoft, USA).

RESULTS

Mean $VO_{2\ max} \times BM^{-1}$ in the group of massage therapists was 42.3 ± 7 $ml \times kg^{-1} \times min^{-1}$, while the mean HR_{max} was 192.7 ± 1.3 bpm. The total time of performing the classical massage techniques for a single treatment during the study was 31.5 min, the interval was 42.5 min.

The intensity of exercise was $47.2 \pm 6.2\%$ on average as expressed in terms of % $VO_{2\ max}$ during the entire procedure. The exercise intensity (% $VO_{2\ max}$) was significantly lower ($p < 0.05$) when performing the shaking and beating techniques than in the case of performing the stroking technique. These results were lower by 11.1% and 12.6%, respectively (Table 2).

The mean value of % HR_{max} calculated for the whole treatment was $74.7 \pm 3.2\%$. The highest heart rate as well as the highest exercise intensity expressed as % HR_{max} and % HRR were found while performing the rubbing technique. These results were significantly higher ($p < 0.05$) as compared to those noted for the stroking technique (Table 2). The mean % HRR calculated for the entire massage treatment was $47.8 \pm 1.7\%$.

The RER value recorded during vibration was the highest and at the same time significantly differed in comparison to the stroking technique ($p < 0.05$). For other test techniques, the RER value was similar to that obtained during stroking (Table 2).

The mean value of metabolic equivalent during the whole procedure was 5.6 ± 0.2 MET. The highest value of MET was characterized by the rubbing technique, however,

Table 2. Comparison of circulatory-respiratory reactions (HR, VO_2, RER), exercise intensity (% $VO_{2\,max}$, % HR_{max}, % HRR, MET), rate of perceived exertion (RPE) and energy expenditure (EE) of the studied massage therapists (N = 13) performing selected classical massage techniques

Parameter	Stroking	Kneading	Shaking	Beating	Rubbing	Vibration
VO_2 [ml×kg⁻¹×min⁻¹] (M±SD)	22.20±3.90	18.80±2.50	17.80±2.90*	17.00±2.70*	23.60±3.80	18.20±3.10*
% $VO_{2\,max}$ (M±SD)	53.50±11.20	45.50±8.60	42.40±6.20*	40.90±8.10*	57.40±13.10	43.70±7.10
RER (M±SD)	0.89±0.06	0.89±0.03	0.90±0.03	0.87±0.07	0.89±0.04	0.97±0.12*
HR [bpm] (M±SD)	140.20±13.40	139.70±13.60	138.80±14.20	141.10±13.40	153.30±14.80*	150.40±13.30
% HR_{max} (M±SD)	72.80±7.10	72.50±7.20	72.10±7.60	73.30±7.00	79.60±7.70*	78.10±6.90
% HRR (M±SD)	44.00±14.20	43.20±15.30	41.90±17.70	44.60±15.10	58.50±13.10*	54.80±13.30
MET (M±SD)	6.30±1.10	5.40±0.70	5.10±0.80*	4.90±0.80*	6.70±1.10	5.20±0.90*
RPE [pts] (M±SD)	10.40±2.00	11.40±2.00	11.20±2.40	12.40±2.50	13.40±1.30*	14.00±1.60*
EE [kcal×min⁻¹] (M±SD)	6.70±1.60	5.30±1.20*	4.90±1.00*	4.60±1.00*	7.10±1.40	5.10±1.00*

VO_2 – oxygen uptake; % $VO_{2\,max}$ – percentage maximal oxygen consumption; RER – respiratory exchange ratio; HR – heart rate; % HR_{max} – percentage maximal heart rate; % HRR – percentage heart rate reserve; MET – metabolic equivalent of task (1 MET corresponds to 3.5 ml O_2×kg⁻¹×min⁻¹); RPE – rate of perceived exertion; EE – net energy expenditure.
M – mean; SD – standard deviation.
* Statistically significant difference compared to the average for the stroking technique ($p < 0.05$).

it was not significantly different from the MET values for stroking. The obtained ($p < 0.05$) MET values were found for shaking, beating and vibration to be significantly lower than for the stroking technique (Table 2).

The average energy expenditure while performing the classical massage was 5.6±0.9 kcal×min^{-1}. Energy expenditure during kneading, shaking, beating and vibration was significantly lower ($p < 0.05$) as compared to the energy expenditure during the stroking technique (Table 2). The average total energy expenditure during the performance of a classical massage technique for a single treatment during the study was 176.5±29.6 kcal, resulting in an energy expenditure of 336.2±56.4 kcal×h^{-1} (1 h of massage).

In the subjective assessment, the masseurs determined the techniques of rubbing and vibration (assessment according to the Borg scale) as the hardest to perform. The scores obtained for these techniques were significantly higher ($p < 0.05$), by 29% and 35%, respectively, than for the stroking technique (Table 2). The average RPE calculated for the entire procedure was 12.1±1.4.

The classical massage technique during which the masseur performed the highest intensity exercise was rubbing (Table 2).

DISCUSSION

The study has aimed to evaluate the energy expenditure and work intensity during particular techniques used by massage therapists during treatment.

The research has shown that during selected classical massage techniques, masseurs perform the work at a typical intensity of about 47% $VO_{2\,max}$, which at the same time, corresponds to 75% HR_{max}.

The classification of professional work intensity takes into account the repeatability of the work performed. It is assumed that the intensity of exercise during intermittent work should not exceed 50% $VO_{2\,max}$, assuming high physical performance of the employees [16]. In the workload classification connected with the performance of dynamic efforts, work intensity during massage in our research may be classified as hard work (30–50% $VO_{2\,max}$) [16].

The technique used in classical massage with the highest intensity was rubbing. During rubbing, the masseurs performed very hard work (> 50% $VO_{2\,max}$). The technique assessed by the massage therapists as the lowest in terms of work intensity – stroking – in objective assessment, was also associated with oxygen uptake exceeding 50% $VO_{2\,max}$, which was very hard work [16]. The results of the presented research indicate the need to implement breaks in between treatments performed by massage therapists.

The masseurs, performing subjective assessment of the work intensity according to the Borg Scale indicated 12 points on average. The most intense technique was vibration (14 points), while the lightest was stroking (10 points) [15], which in the objective evaluation, in order from the highest to the lowest results, turned out to be the second technique in terms of intensity of effort and second in evaluation of energy expenditure. The discrepancies in subjective and objective evaluation may be explained by the fact that stroking was the first performed technique by the subjects, and although it required the involvement of many muscle groups, the subjects did not yet feel fatigue. Vibration, which in the opinion of the tested masseurs was the most technically demanding, requires the person to perform isometric work in participation with large muscle groups in the area of the working upper limb. The energy system involved in such an effort is anaerobic, which causes a subjective feeling of a heavy workload.

During the study, performing classical massage techniques, not including the intervals, took the masseurs about half an hour. This may be assumed as the actual time of performing the massage in the conditions of a massage therapist's work. If the average energy expenditure during a treatment is about 180 kcal and the masseur usually performs 10 or more such treatments during a workday, then the energy expenditure associated with the work is at least 1800 kcal. According to the classification of work intensity based on energy expenditure during a work-shift, this is hard work (1500–2000 kcal; 6300–8400 kJ) [16,17]. Therefore, it is important to care for a massage therapist's physical fitness, allowing him/her to perform endurance natured efforts. In our own study, however, the masseurs were characterized by average aerobic performance ($VO_{2\,max}$ of about 42 $ml \times kg^{-1} \times min^{-1}$) [11].

In their research on the occupational load among female physical therapists working at hospital wards, Lewandowski et al. [18] demonstrated that they performed their professional duties at an average intensity of more than 50% $VO_{2\,max}$. The subjective assessment also characterized their work as hard. The classification of a physical or massage therapists' work as hard may be due to the specific nature of the performed duties. In both occupations, frequently assuming a forced body position, the endurance-type nature of the work and frequency of performing the work cause the work to be classified as hard according to the rules of hygiene and ergonomics, despite the moderate effort intensity during the performance of the particular professional tasks [18]. Work performed for many hours in a forced body position, especially while standing, may contribute to the development of pain due to overburdening the musculoskeletal system [19–22]. High risk factors for the development of overload syndromes related to the work of a massage therapist include but are not limited to working in a forced body position with bent body and inclined head, and performing repetitive movements within the same joints involving the same muscle. For upper limb work, repeated cycles are performed in equal or less than 30 s or more than 2–4 times/min for at least 4 h during a work-shift [21]. Thus, the issues of ergonomics and proper techniques used during manual therapy are of great importance [23], as well as prevention of musculoskeletal disorders by increasing the activity and physical fitness of therapists [18,24] and developing an occupational hazard data sheet for the massage therapist profession [25].

Limitation of the study

The presented research is the preliminary analysis of the intensity and energy expenditure during classical massage. The methodological limitations of the presented research are due to participants' medical contraindications (ophthalmologic) to perform efforts of maximal intensity. As a result, the level of cardio-respiratory was measured during the exercise of the individual massage techniques but the results were related to the maximum values obtained through indirect tests ($VO_{2\,max}$) or calculated in relation to the age of the participants (HR_{max}). It is advisable to continue research in which the energy expenditure would be evaluated at the time of continuous work during the actual massage treatment and during a work shift.

CONCLUSIONS

In the objective assessment, physical exercise while performing a single classical massage is characterized by hard work. The technique of classical massage during which the masseur performs the highest exercise intensity is rubbing. According to the classification of work intensity based on energy expenditure, the masseur's work is considered heavy during the whole work shift.

In conclusion, it should be stated that despite the difficulties in examining the changes in physiological parameters during the professional activities of a masseur, further studies involving a larger number of subjects should be continued to identify specific muscle groups involved in the work, and to evaluate the work of the masseur in a continuous manner during a whole work shift.

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