WATSU (Water-Shiatsu) increases body awareness and improves pain and mood: A randomised controlled study

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ABSTRACT

Background and purpose: WATSU (Water-Shiatsu) is a body-oriented therapy in warm-water pool with passive movements, massage and breathing techniques. The present study investigated the short-term effect of a single session of WATSU on body awareness.
Materials and methods: In a randomized-controlled study 60 volunteers (18–65 years) were assigned to a 20-min intervention of WATSU or to a 20-min lecture on WATSU. Immediately before and after the intervention they had to answer questionnaires. Primary endpoint of the investigation was the change of the total score of the non-verbal Awareness Body Chart (ABC). Secondary endpoints were the changes of the scores of the 14 single body parts of the ABC, of the Visual Analogue Pain Scale, of a German self-perception questionnaire (KEKS) and changes in mood scored with a German questionnaire on mood (Bf-SR). To compare groups, Mann-Whitney U tests were used.
Results: The WATSU group had a significantly higher increase in the ABC total score in comparison to the lecture group (WATSU: 0.3 (IQR 0 – 0.8), lecture: 0.1 (IQR -0.2 – 0.2), p = 0.014). In the KEKS no group differences were seen. In WATSU a significantly stronger improvement of pain (Visual Analogue Pain Scale: WATSU: −15 (IQR -29 to −8), lecture: −4 (IQR -9 – 2), p < 0.001) and of mood (Bf-SR: WATSU: −6 (IQR -14 to −2), lecture: −1 (IQR -5 – 1), p = 0.003) could be observed.
Conclusion: This study showed that WATSU immediately increases body awareness and improves pain and mood.

1. Introduction

This work focuses on the change of body awareness (BA) during a session of WATSU. WATSU (portmanteau word: water and shiatsu) is a passive body-oriented therapy in a warm-water pool. The method was established by Harold Dull in the 1980s in Harbin Hot Springs (California) and is now used worldwide in children and in adults. During the WATSU application, the recipient person usually lies in supine position in the water and is held and passively guided by the WATSU practitioner standing beside him/her. The practitioner introduces slow motions with increasing amplitude following elaborate patterns - according to the recipient's level of WATSU experience and applies massage grips. Thermoneutral water temperature of 35 °C = 95 °F = 308.15 K is

recommended to allow passive immersion of 20–60 min without causing stress of cold sensation. Warmth, buoyancy, touch, passive stretches and massage strokes as well as breath-stimulating techniques play a major role in the application [1].

Originally the method was established for wellness purposes in healthy persons (including pregnant women) in the field of spa and health promotion. Subsequently it was adopted for therapeutic issues, and in some countries it is medically prescribed for physical and mental complaints [2,3]. In a first systematic review about applications, indications and effects of WATSU, indications of the reviewed studies included psychiatric and psychosomatic diagnoses, complaints in the field of neurology, orthopaedics, internal medicine, gynaecology, etc. [4]. In a recent survey among WATSU practitioners it was confirmed

that WATSU was frequently applied in healthy individuals (pregnant women included), furthermore in various pain complaints (first of all low back pain, neck pain, etc.) and in stress-related conditions (as stress, depression, sleep disorders, fatigue, anxiety disorders) [2]. In the above mentioned survey of WATSU practitioners, a rank-list of observed effects was published. The top ten are: Physical relaxation, relief of physical tension, pain relief, enhanced mobility and flexibility, improved quality of life, spiritual experiences, increased psychological health, reduced anxiety, improved respiratory function and decreased muscle tone [2]. However, clinical studies on the effects of WATSU are urgently needed [2].

To our knowledge, the effects of WATSU on BA in particular have not yet been scientifically investigated at all, even though BA is an essential component by which mind-body-interventions exert their effects: regulating attention to the body, using body sensations to regulate oneself, listening to the body [5]. Generally, BA is a vital factor for well-being and physical and mental performance. Touch and movement as well as the immediate environment play an essential role in BA [6]. BA is of high interest for many disciplines, especially in health sciences. BA and the subjective body experience are often symptom carriers of psychological processes or psychiatric disorders and therefore BA is frequently in the focus of psychosomatic medicine and psychiatry. Changes in perception are not only a consequence, but possibly even the cause of a loss of inner balance. Conversely, a change in perception can even be an important step towards recovery and well-being [7,8]. The novel body experiences during a WATSU application – breathing techniques under water, passive movements and soft massages under water – can be supposed to increase BA, but until now we don't have data on this topic.

In literature, there are many different concepts of BA [7,9]. In this work, BA is defined as the subjective sensory experience of one's own body and the individual body parts in the present moment. It refers to the process by which the nervous system senses, interprets, and integrates signals coming not only from within the body (interoception in the narrow sense [9]), but also from outside the body or from the body in contact with the environment (interoception in the wide sense [10]). It consists of the physiological perceptions (especially kinaesthetic, tactile, visual, auditory, visceral as well as vestibular perceptions) and cognitive-affective processing in the nervous system. Concentration, vigilance and the present mental state have a profound influence on these processes which are constantly taking place on a subconscious level and can also be brought to consciousness. BA continuously interacts not only with emotional/affective but also with visceral dynamics and is integrated in motor control in the feedback and feedforward processing of sensorimotor signals [6,7,11]. Self-awareness – and in particular BA – is influenced by the knowledge of one's own anatomy and physiology marked by cultural imprint, memories, conditioning, attitudes, interpretation, beliefs, cognitive abilities, comparison with models, etc. The brain continuously provides a moment-by-moment mapping of the body's interoceptive landscape at unconscious and conscious levels [9].

As described above, many factors influence BA and do this instantly or very quickly. Furthermore, the changes of BA are supposed to have a high wash-out rate, as the brain is designed to constantly balance the situational context, body signals and all internal memories [12]. To narrow down the many influences, the aim of this study was to investigate the short-term effect of a single WATSU application on BA as well as on pain and mood.

2. Methods

A randomised controlled trial of the Institute of Physical Medicine and Rehabilitation of the Kepler University Hospital Linz was conducted in cooperation with the association "Academy for Holistic Well-Being – Academy for Education, Sport and Research for the Promotion of Holistic Health as well as the Joy of Living" and the Institute for Medical Informatics, Statistics and Documentation, Medical University of Graz,

between March and May 2023. The study was registered in the clinicaltrials.gov database (NCT05769543) and approved by the Ethics Committee of the Medical Faculty of the Johannes Kepler University Linz, Austria (EC-number: 1019/2023). For randomization, the online service "randomizer.at" from the Medical University of Graz, Institute for Medical Informatics, Statistics and Documentation, was used. To randomize participants to the intervention group or control group a randomization list (permuted blocks, block size: 6) was created. The assessments and interventions took place at the residence Sonnenhof Freinberg in Linz and at the Institute of Physical Medicine and Rehabilitation at the Neuromed Campus of the Kepler University Hospital in Linz. The intervention group (IG) received a WATSU application in a therapy pool, while the control group (CG) received a lecture about WATSU. For assessments, participants filled out self-report questionnaires immediately before and after the intervention. The questionnaires were anonymized and an external blinded statistician from the Medical University of Graz performed the analysis.

The study was conducted according to Consolidated Standards of Reporting Trials guidelines and the guidelines laid down by the Declaration of Helsinki with written informed consent obtained for each participant.

2.1. Participants

Interested adults were invited to participate in the study. The invitation was sent out via e-mail and social media to employees of the Kepler University Hospital and Sonnenhof as well as to members and interested parties of the Academy for Holistic Well-Being.

Inclusion criteria were age between 18 and 65 years, signature of informed consent, understanding of German language to be able to follow a lecture and fill in questionnaires. Exclusion criteria were pregnancy, chronic illnesses/impairments that contraindicated or complicated participation in a therapy pool session, current illness or injury, acute physical or psychological complaints on the day of participation in the study, current sick leave or aquaphobia. In order to ensure the inclusion and exclusion criteria, interested persons were informed about the details by the study supervisor. In case of suspected illness, the study supervisor could also refuse or interrupt the participation of the test person at any time.

Pre-registration for participation (name, age and gender) was made by e-mail to the study supervisor. After clarification of the prerequisites by telephone, the registered persons were randomly assigned to the two groups: IG or CG. Appointments were made by telephone or e-mail.

2.1.1. Sample size

In a related study, the change of BA was investigated in three groups: massage, exercise, lecture. The result was a change in BA, which scored on the Awareness Body Chart test (ABC) with 0.44 in the massage group, 0.27 in the gymnastics group and −0.03 in the lecture group with a common SD of 0.43. In WATSU a change comparable to the change in the massage group (also a passive intervention) was expected. It was therefore assumed, that there would be an improvement of 0.40 in the intervention group, no change (change = 0) in the control group and a common SD of 0.45. In order to detect the above differences between the changes in the two groups in a *t*-test with a power of 90 %, 27 people per group had to be included. In case that 10 % of the included persons could not be evaluated, the required sample size increased to 30 persons per group, therefore 60 persons had to be included.

2.2. Interventions

WATSU group (IG): Participants received a 20-min WATSU application. This took place in an individual setting in a therapy pool. The water temperature was 35 °C, the water depth 1.20 m.

In order to guarantee the homogeneity of the application, the WATSU session was always carried out by the same practitioner (E.I., a

female WATSU instructor with 22 years of practical experience) according to the same protocol: After a short explanation of the procedure of the WATSU application, the practitioner and the participant went into the pool and the necessary floating aids were determined and attached (mostly floaters for the thighs). After a short introduction, the session began in standing position. From that moment on, there was no verbal communication during the application. The practitioner began in the water with breath attunement, observed the person's breathing movements and synchronised her own breathing with the person's inhaling and exhaling. Then she brought the person to the supine lying position on the water (basic position). The person could close the eyes and keep them closed. The WATSU practitioner supported the person in all following actions with her body (especially with her arms) so that the face or at least the nose area of the participant was always kept above the water. In the basic position, the breathing movement was also accompanied by the practitioner's movements (the body automatically rises in the water during inhalation and lowers upon exhalation). This was followed by repeated gentle passive movements caused by 90° rotations by the practitioner to the left and back again, then to the right and back again. After that loosening and stretching grips on the flanks were applied. Then massage grips with stretching movements of the back were applied 'to open the chest'. Towards the end, there was the transition from lying to vertical position to bring the person back to the wall of the pool. Finally, there were gentle passive pressure massages on Shiatsu points on the face and head, as well as passive stroking of the shoulders and arms. When the person left the water, he/she was immediately given a towel to dry off and a bathrobe to put on.

Control group (CG): The control group received a 20-min lecture about WATSU in a group setting. This consisted of a short introduction and three short videos about WATSU (method, mode of action, areas of application). The introduction was given by the same WATSU practitioner who did the IG applications. She was also available to answer questions about WATSU on site.

2.3. Outcome measures

Primary endpoint was the change of BA determined by the total score of the Awareness Body Chart test (ABC) [13]. Secondary endpoints were the changes of BA in the different body parts of the ABC, pain intensity scored in the ABC, body perception scored with the German KEKS test (KEKS see below) and mood investigated with the German Bf-SR (Bf-SR see below).

2.3.1. Awareness Body Chart (ABC)

The ABC assesses the intensity of the momentary body awareness in the individual body parts using body charts with 51 subdivisions. These subdivisions can be coloured with five predefined colour pencils according to the intensity of perception (from black = "I cannot perceive" (coded with 1) to orange = "I can perceive with many details" (coded with 5)). The ABC thus contains 51 items with values from 1 to 5 on a Likert type response scale. Through factor analyses, 14 factors with clear assignments to body parts were categorized out of the 51 items. The 14 body parts and the total score showed an acceptable to high internal consistency (Cronbach's alpha $\alpha = 0.64$–0.97) as well as an acceptable to high test-retest reliability ($\rho = 0.71$–0.96). The correlation with the KEKS test (Short Questionnaire on Self-Perception of the Body, see below) confirmed the construct validity ($r = 0.66$, $p < 0.001$) [13]. In case of actual pain, in the ABC test the pain localisation can also be marked in the body chart (using a red pencil) and the momentary intensity of pain can be signed on a 100 mm Visual Analogue Scale (VAS) from 0 (no pain) to 100 (unbearable pain).

2.3.2. Kurzer Fragebogen zur Eigenwahrnehmung des Körpers ('Short Questionnaire on Self-perception of the body', KEKS)

The KEKS is a German test to survey self-perception of the body. It contains 20 items (body parts) to be marked on the five-point Likert type

response scale from "1 = I cannot perceive" to "5 = I can perceive with many details", from which a total score can be calculated. The authors of the KEKS describe that the questionnaire distinguishes four dimensions ("inner support", "protection and body-boundary", "inner space" and "control items"). The control items are the perception of "left heart valve" and "cerebellum", which are assumed not to be perceived. The KEKS is a reliable questionnaire (Cronbach's alpha $\alpha = 0.71$–0.93) [14].

2.3.3. Befindlichkeits-Skala – Revidierte Fassung ('mood scale – revised version', Bf-SR)

The Bf-SR [15] is a questionnaire to assess current mood. It can be used for healthy people, but also for people with physical or mental disorders. The scale can be applied repeatedly (e.g. to control therapy progress) to objectify changes in mood. Two parallel forms (Bf-SR and Bf-SR') are available. In this study, the Bf-SR was used. The test consists of 24 pairs of property words. One of these or <neither> is to be ticked in each case, depending on how it most closely corresponds to one's momentary state. Since its first publication, this questionnaire has established itself as one of the leading diagnostic instruments for assessing mood in German-speaking countries. In the revision (Bf-SR), the questionnaire was slightly shortened, the language was revised and it was re-normed on a sample representative of the population. The internal consistency (Cronbach's alpha) is $\alpha = 0.93$, the split-half reliability is $r = 0.91$. The convergent and divergent validity was demonstrated by factor analyses with construct-related and construct-remote procedures (Patient Health Questionnaire-4, Complaints List - Revised Version, Life Satisfaction Questionnaire, Quality of Relationships Inventory).

2.3.4. Additional questionnaires

The Simple Physical Activity Questionnaire (SIMPAQ) [16] collects data of physical activity during an average day. The Short Form Health Survey (SF-12), a short form of the SF-36 [17], assesses health status and related quality of life. As a possible indication of conspicuous psychological distress, the Brief Symptom Inventory (BSI) [18], was administered. The items result in nine scales: somatization, obsessiveness, insecurity in social contact, depressiveness, anxiety, aggressiveness/hostility, phobic anxiety, paranoid thinking, psychoticism. Raw scale scores are transformed into T-scores. Higher values indicate more psychological distress. T-scores ≥ 63 are indicative of clinically significant psychological distress. For further investigation of possible depressive tendencies, the Beck Depression Inventory II (BDI-II) [19] was also conducted. A BDI-II score of 9–13 is considered minimal depression, a score of 14–19 is considered mild depression, a score of 20–28 is considered moderate depression and scores of 29 and above are considered severe depression. The German version has already been used in many studies and was also tested on healthy people [20].

Furthermore, demographic data (age, gender, mother tongue, highest school education, marital status, questions about professional activity (whether in the medical field or whether sedentary) and experience with massage were evaluated. In addition, body weight and height were collected for the Body Mass Index (BMI) calculation (in kg/m2). Furthermore, chronic complaints and current illnesses were evaluated with the Charlson Comorbidity Index [21]. At the end, the participants were also asked to give their feedback on the test and the measures.

2.4. Data analysis

The data were first recorded in Excel and then analysed in SPSS (IBM SPSS 26.0, IBM Corp., Armonk, NY, USA) by an external statistician. In a first step, the scores of the individual questionnaires and the demographic variables were analysed descriptively (mean and standard deviation or median and interquartile range or absolute frequencies and relative frequencies). Differences between the two groups were investigated using t-tests or Mann-Whitney U tests for continuous data and

chi-square test or Fisher's exact test for categorical data.

For the analysis of group differences in the BA (ABC total score), the differences were calculated and their distribution checked. If there was a normal distribution of the differences in both groups, the differences were compared using a t-test. If there was no normal distribution, the differences were compared using non-parametric methods. Then, the differences in the individual areas of the ABC, in the pain VAS, in the KEKS and Bf-SR were also calculated and compared between the groups as described above. A p-value <0.05 was considered statistically significant. As an estimation effect size the Glass rank biserial correlation coefficient with 95 % confidence intervals were calculated.

3. Results

Sixty-six individuals were assessed for eligibility, fulfilled the inclusion criteria, and were randomized. Two of the IG and four of the CG missed the appointment. All the other participants received the allocated intervention and assessments. Therefore 60 participants could be included in the analysis (IG: n = 31; CG: n = 29; Fig. 1). Sociodemographic data and characteristics collected with the SIMPAQ, SF-12, BSI and BDI-II questionnaires of the two groups are given in Table 1. Groups were comparable regarding the baseline characteristics. The most frequently mentioned acute or chronical medical problems in the last four weeks were infectious diseases (eight participants) or back complaints (five participants). Only a small number of missing values (1.4 %) were observed in ABC data. No patient dropped out due to intolerance to the intervention. No harms occurred.

In the pre-intervention test no group differences for the ABC, KEKS and the Bf-SR could be detected with the exception of chest/abdomen in ABC (see Appendix Table A). Additionally, it was noticed that 12 participants scored the falsehood-items of the KEKS questionnaire (nine persons scored the left heart valve and seven the cerebellum).

3.1. Effects of the intervention

3.1.1. Primary outcome
The primary endpoint of this study was the change of BA in the total score of the ABC. The changes of the groups are listed in Table 2. Both groups increased in the ABC total score. In comparison to the control group, the WATSU group had a higher increase in the ABC total score (IG: 0.3 (IQR 0–0.8), CG: 0.1 (IQR -0.2 – 0.2), p = 0.014) with an effect of r_g = 0.43 (0.15–0.69).

3.1.2. Secondary outcomes
As secondary endpoints pre-post changes in the 14 ABC body parts, in the pain VAS, in the KEKS and in the Bf-SR questionnaire were analysed (group comparisons are given in Table 2). Concerning the 14 body parts, the IG showed a significantly higher increase of BA in lower legs (IG: 0.5 (IQR 0–1.5), CG: 0 (IQR 0–0.5), p = 0.007). A significantly stronger reduction of pain could be observed in the IG compared to the CG (IG: −15 (IQR -29 to −8), CG: −4 (IQR -9 – 2), p < 0.001). In the KEKS test no group differences were seen (IG: 0.2 (IQR -0.2 – 0.7), CG: 0 (IQR -0.1 – 0.4), p = 0.290). Mood scores (decrease of Bf-SR points) improved significantly more in WATSU compared to the CG (IG: −6 (IQR -14 to −2), CG: −1 (IQR -5 – 1), p = 0.003).

4. Discussion

Evidence-based literature on the effects of WATSU application is scarce. To the best of our knowledge, this is the first paper on changes of BA due to WATSU applications. In the present study, it was of particular interest to investigate the immediate impact of a single session of WATSU on BA scored on the ABC. The results showed that BA immediately increased and that the WATSU application of 20 min (IG) brought higher increase in the ABC total score compared to a 20-min lecture on WATSU (CG), showing a medium to large effect. Mood improved significantly more in WATSU compared to CG. Pain significantly decreased in WATSU as compared to CG.

The presented increase of BA in WATSU could have been expected looking at the hydrotherapy literature. There, much is reported about the mechanical effects of water on the body, such as buoyancy and hydrostatic pressure [22,23], and thermal effects, such as vasodilation and increase in blood flow and metabolism [24], which are all supposed to increase BA. During a floatation therapy in warm water, a reduced stimulation of the nervous system (by minimizing sensory signals from visual, auditory, olfactory, gustatory, thermal, tactile, vestibular, gravitational and proprioceptive channels) is induced and this appears to be "responsible for creating and mapping the sense of self" [25]. The authors of a recent study about floatation therapy report effects of relaxation and enhanced interoceptive awareness (specifically in cardiorespiratory visceral sensation) and reduction in muscle tension, particularly in the upper and lower back [26]. In WATSU, furthermore
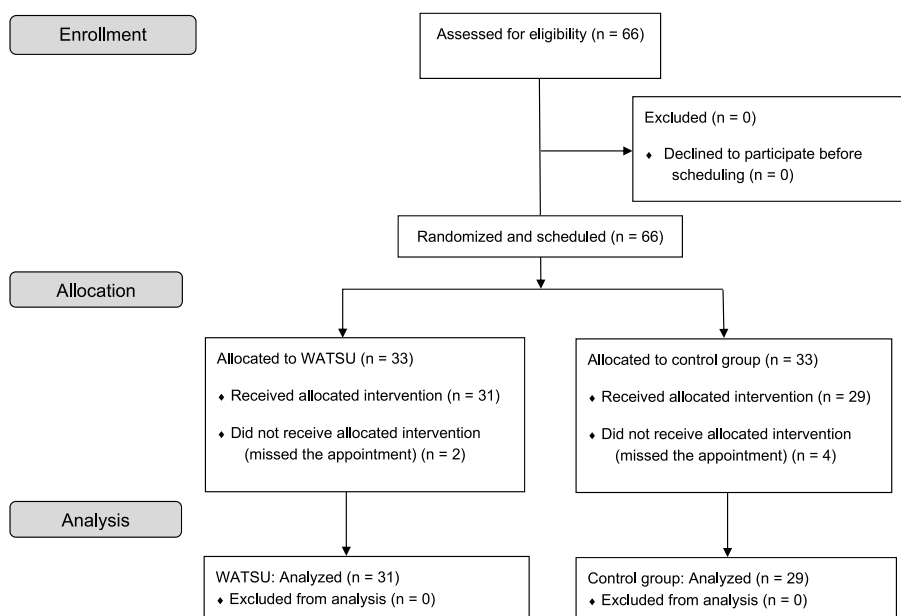

Fig. 1. CONSORT flow diagram.

Table 1
Baseline characteristics of the participants.

Characteristic	WATSU (n = 31)	Control (n = 29)
Age, y, median (IQR)[a]	44 (31–56)	46 (31–54)
Height, cm, median (IQR) [a]	170 (164–178)	169 (163–174)
Weight, kg, median (IQR) [a]	70 (56–82)	67 (60–80)
Body Mass Index, kg/m², median (IQR) [a]	23.03 (19.95–26.3)	23.39 (22.04–26.17)
Gender, n (%)[b]		
Male	9 (29)	5 (17.2)
Female	22 (71)	24 (82.8)
Mother language, n (%)[c]		
German	29 (93.5)	29 (100)
Other	2 (6.5)	0 (0)
Education level, n (%)[c]		
Compulsory schooling	2 (6.5)	1 (3.4)
College or apprenticeship	8 (25.8)	5 (17.2)
Highschool	5 (16.1)	11 (37.9)
University	16 (51.6)	12 (41.4)
Current work status, n (%)[c]		
Permanent employment/freelance	27 (87.1)	25 (86.2)
Retired	1 (3.2)	0 (0)
In training	3 (9.7)	4 (13.8)
Type of activity, n (%)[b]		
Sedentary work	11 (36.7)	9 (31)
Light physical work	15 (50.0)	14 (48.3)
Rather hard physical work	4 (13.3)	6 (20.7)
Medical staff, n (%)[b]		
No	5 (16.7)	11 (37.9)
Yes	25 (83.3)	18 (62.1)
Living situation, n (%)[c]		
Alone	8 (25.8)	6 (20.7)
With partner	11 (35.5)	11 (37.9)
With partner and children	7 (22.6)	7 (24.1)
With more persons	2 (6.5)	3 (10.3)
Other	3 (9.7)	2 (6.9)
Chronic illness, n (%)[b]		
No	25 (80.6)	23 (79.3)
Yes	6 (19.4)	6 (20.7)
Medical or therapeutic treatment in the last 4 weeks, n (%)[b]		
No	22 (71)	18 (62.1)
Yes	9 (29)	11 (37.9)
Reason of this treatment, n (%)[c]		
Covid-19	3 (33.3)	0 (0)
Infection	1 (11.1)	3 (27.3)
Incident	1 (11.1)	0 (0)
Back complaints	1 (11.1)	2 (18.2)
Other	3 (33.3)	6 (54.5)
Drugs, n (%)[b]		
No	25 (80.6)	20 (69)
Yes	6 (19.4)	9 (31)
Experiences with massage, n (%)[c]		
No experience	1 (03.2)	1 (3.4)
For therapeutic reasons	15 (48.4)	16 (55.2)
Prevention or wellness	15 (48.4)	12 (41.4)
SIMPAQ, h/day, median (IQR) [c]		
Time spent in bed	8 (7–8)	8 (7–8)
Sedentary behaviour	7 (6–10)	8 (6–11)
Time spent walking	3 (1.5–4)	2 (1–6)
Time spent exercising	1 (0.5–1)	1 (0.5–2)
Incidental activity	4 (2–6)	3 (1.5–5)
SF-12, median (IQR) [a]		
Physical component summary	45.59 (42.72–48.03)	46.89 (43.85–48.86)
Mental component summary	38.75 (34.7–41.04)	37.98 (33.09–40.35)
BSI, median (IQR) [a]		
Somatization	59 (54–70.5)	48 (48–56)
Obsession-compulsion	53.5 (48–62)	51 (46–56)
Interpersonal sensitivity	56 (50–65)	50 (41–60)
Depression	55 (43–60)	54 (43–56)
Anxiety	54 (40–55)	48 (40–55)
Hostility	57 (50–63)	53 (46–58)
Phobic anxiety	45 (45–45)	45 (44–54)
Paranoid ideation	54.5 (49–69)	50 (41–58)
Psychoticism	54 (44–58)	44 (44–62)
Global Severity Index	54 (49–64)	49 (41–60)
BDI-II, median (IQR) [a]		
Total score	7 (3–16)	5 (2–9)

SIMPAQ = Simple Physical Activity Questionnaire.
SF-12 = Short Form Health Survey 12. Higher values reflect a better state of health.
BSI = Brief Symptom Inventory. Higher scores indicate more psychological distress.
BDI-II = Beck Depression Inventory II. Higher scores indicate lower mood.
*p < 0.05.
 [a] Mann-Whitney U tests.
 [b] Chi square test.
 [c] Fisher's exact test.

Table 2
Changes in outcome measures.

Outcome measures	Differences within groups		p-value	r_g (95%CI)
	WATSU (n = 31)	Control (n = 29)		
ABC difference, median (IQR)				
ABC total score	0.3 (0–0.8)	0.1 (−0.2–0.2)	**0.014**	0.43 (0.15–0.69)
Cranium	0.3 (0–1)	0 (−0.3–0.3)	0.110	0.29 (−0.00–0.55)
Face	0 (−0.1–0.6)	0 (−0.8–0.5)	0.305	0.12 (−0.18–0.41)
Cervical/lumbar region	0 (−0.3–1)	0 (−0.3–0.3)	0.288	0.03 (−0.26–0.32)
Shoulder	0 (−0.7–0.7)	0 (−0.3–0.3)	0.852	0.01 (−0.29–0.30)
Chest/abdomen	0 (-1–1)	0 (0–1)	0.165	−0.20 (−0.47–0.08)
Upper arm	0.5 (0–1)	0 (0–0.5)	0.182	0.25 (−0.03–0.52)
Back	0.5 (0–1.5)	0 (0–1)	0.069	0.18 (−0.11–0.45)
Lower arm/elbow	0.3 (0–1)	0 (−0.3–0.7)	0.055	0.30 (−0.01–0.56)
Genital area	0 (0–0.5)	0 (−0.5–0)	0.159	0.31 (0.04–0.55)
Hand	0 (-1–1)	0 (0–0)	0.961	0.01 (−0.27–0.28)
Thigh/hip	0 (−0.3–1)	0 (−0.7–0.3)	0.170	0.18 (−0.13–0.47)
Knee	0 (0–1.5)	0 (0–0.5)	0.261	0.31 (0.02–0.57)
Lower leg	0.5 (0–1.5)	0 (0–0.5)	**0.007**	0.44 (0.19–0.66)
Foot	0 (−0.5–0.5)	0 (−0.5–0)	0.479	0.16 (−0.12–0.43)
Pain VAS difference, mm, median (IQR)				
Pain VAS score	−15 (−29–−8)	−4 (-9–2)	**<0.001**	−0.68 (−0.88–−0.40)
KEKS difference, median (IQR)				
KEKS total score	0.2 (−0.2–0.7)	0 (−0.1–0.4)	0.290	0.09 (−0.21–0.39)
Inner stability	0.2 (−0.2–0.8)	0.1 (−0.1–0.4)	0.784	−0.05 (−0.35–0.25)
Inner space	0 (−0.5–0.5)	0 (−0.3–0.3)	0.355	0.01 (−0.29–0.30)
Boundary	0.5 (0–0.8)	0 (0–0.6)	0.081	0.10 (−0.21–0.39)
Control items	0 (0–0)	0 (0–0)	0.734	−0.22 (−0.40–−0.03)
Bf-SR difference, median (IQR)				
Bf-SR score	−6 (−14–−2)	−1 (-5–1)	**0.003**	−0.45 (−0.70–-0.18)

ABC = Awareness Body Chart, Likert type response scale 1 to 5. Higher scores indicate higher intensity of body awareness.
Pain VAS = Pain visual analogue scale from 0 (no pain) to 100 (unbearable pain).
KEKS = a German self-perception questionnaire, Likert type response scale 1 to 5. Higher scores indicate higher intensity of self-perception.
Bf-SR = a German mood questionnaire with 0–48 possible points. Higher values indicate worse subjective mood, lower values better mood.
All comparisons are analysed using Mann-Whitney U tests.
p < 0.05 are bold.
r_g = Glass rank biserial correlation coefficient as an estimation effect size with 95 % confidence intervals.

the novel experience of movement perception especially the floating feeling in combination with non-habitual and nonlinear passive movements against water resistance, wave motions, micromovements, the intensive whole-body-experience of the own breathing, the very close body contact and gentle massage grips [27] could also have contributed to a focus on proprioception and in consequence to an increase of BA. The present findings concerning sensitisation of body perception are also in line with the experiences with WATSU described in Maczkowiak [3]. Furthermore, Tufekcioglu [28] highlights the integration of a variety of novel afferent inputs during WATSU into the sensory system. An increased BA throughout WATSU applications and the consequent cerebellar-motor cortex interactions can form a base for psychomotor functioning and development.

In our study, the larger increase in BA, i.e. the total score of the ABC, is mainly driven by a larger increase in BA of the lower legs, lower arms/elbows and back region. Interestingly, improvements of the range of motion of the lower limbs after WATSU were observed in children with cerebral palsy and in young swimmers [28]. A possible correlation between BA of the lower legs and lower limb range of motion could be investigated in future studies. However, to get higher impact on BA of other body parts, a more individualized program would be necessary.

Nevertheless, it was surprizing that only in one body part (lower legs) a significantly higher increase in BA was observed in the IG compared to the CG. Possibly, the WATSU application had a more balancing effect concerning BA in the different body parts as the body was mainly treated as a whole in contrast to classical massage or Shiatsu techniques where the individual parts of the body are stimulated one after the other. Furthermore, the boundaries of the body might be perceived less during warm-water immersion in comparison to a massage, especially during the sensation of floating which took up a substantial part of the WATSU application. A blurring of body boundaries during floatation therapy in warm water was also observed in a recent study by Hruby et al. [29].

The floating experience and blurring of body boundaries could additionally explain why in the KEKS no significant group differences were found, neither in the total score nor in the three dimensions "boundary", "inner space" and "inner stability".

In the present study, WATSU brought an immediate improvement of mood. In literature, baths in warm water and breathing techniques are also known for their relaxing and mood-enhancing effects [24]. An anxioloytic effect and increase in cardiorespiratory interoceptive sensations was observed in persons with anorexia nervosa [30] and in anxious patients [26] too. The strong anxiolytic effect in anxious patients while paradoxically improving their interoceptive awareness was further investigated in a study by Flux et al. [31]. They suggest that floatation therapy in warm water alters the balance of the autonomic nervous system towards a more parasympathetic state. Additionally, during WATSU application the water flow provoked by movements or soft waves can stimulate C-tactile fibres which promote a sense of comfort and well-being [32,33]. During WATSU gentle massage grips were used, which also could be assumed to lift mood as slow stroke massage techniques increased mood in major depression [34]. In literature, it is described that WATSU supports a "taste of stillness without being boring" [35]. Being submerged in water naturally allows a client to disengage from all competing sources of information, turning one's attention and awareness to the sensations or changing the sense of self [27]. In that sense it functions as a "door opener" for mindfulness exercises [35] or is itself a mind-body-intervention [36]. The general aim of mind-body interventions is to improve the state of mind. Very often (as in the example of WATSU), BA is of central relevance in body-oriented therapies. However, Pérez-Peña argues that "it is not just paying attention to the body that is important, but paying attention with an attitude of trusting and using this trusting awareness of the body to regulate one's distress" [5]. This is exactly what happened during the WATSU application: the practitioner was highly concentrated to create a climate of total trust and protection. Tufekcioglu et al. argue that the close presence of the trusted therapist can likely cause feelings of security and relaxation, resulting in the ease of expression of feelings [37]. This may form the basis of guiding the clients to fine-tune their renewed self-awareness which is an important goal in WATSU [27].

In WATSU, the practitioner holds the person very close to him/her – both in bathing costume – and touches the person softly for the massage and passive movements. This intimacy can increase the release of oxytocin [38] which is supposed to also influence interoceptive signals to provide an internal milieu of homeostasis and enhance relaxation and trust [39]. Furthermore, WATSU provides the activation of the somatic nervous system through gentle movements of body parts or the whole body in combination with a rich array of breaths. Simple motor execution of movements performed in relation to happy or satisfactory moments additionally increases positive affects [40]. All these considerations may explain the significantly increased mood score.

Interestingly, mood improved during the WATSU lecture too. The CG received a lecture on WATSU with impressive video illustrations with music, on big screens which could have caused high emotions in the participants, creating an imagination of the feeling of immersion and relaxation. These observations are in line with literature about the bodily impact of relaxation videos and especially of aquatic videos [41].

As mentioned already, pain scores also decreased in comparison to the CG. A pain-relieving effect of warmth and especially of warm water immersion in chronical pain is known and was recently confirmed [42]. Furthermore, analogue to the discussion on mood, the increase of BA can increase or decrease pain. Decisive is the attitude of trust [5], the existence of which has already been described above. If these positive effects on pain could be replicated in patients with pain disorder should be investigated in affected patients. Anyway, the present results are in line with WATSU literature concerning pain relief [2,3].

The findings of the present study open a great field for further research, especially concerning the aforementioned correlations of BA and increased motor performance [28,37]. Tufekcioglu showed that WATSU has a positive influence on the autonomic nervous system [28] by means of heart rate variability measurements which could be included in future studies to provide information on the relationship between BA and the autonomic nervous system.

The potential power of WATSU may lie in the enhancing and balancing effect on BA, relaxation and enhancement of mood. It can therefore be an antidote to the widespread problem of a fragmented sense of self and myofascial armouring which are often observed in trauma, stress and chronical illnesses [8,27]. Especially in trauma therapy, through therapeutic body techniques like WATSU, an increase of self-awareness can be an exciting first step to create ease in the system [27]. However, further research on the impact of WATSU on BA especially in persons with mental health issues is required.

4.1. Limitations of the study

It can be considered as limitation that the control group was not a neutral control, but turned out to also have impact on the outcome as described above. Nevertheless, differences could be identified between IG and CG.

Only adults of age below 65 years were included in the current study. It is therefore not possible to draw conclusions about the effects on all ages and especially not on patients with miscellaneous medical conditions. Further clinical studies with various patient populations are needed.

An important question about the extent to which gender influences the results could not be examined in this study because only a few men were included. This question must be answered in future, larger studies with a more balanced female to male ratio.

Further research is also needed to investigate long-term effects as in this study only short-term effects were observed.

4.2. Strength of the study

The framework conditions in this study were very good. There was a strong adherence of participants. No adverse events occurred. This is the first study on the impact of WATSU on BA scored with the ABC. The ABC proved to be useful to show differences in BA. This study serves as a basis for further trials on the long-term effects and for trials on the impact on various complaints.

4.3. Conclusion and outlook

WATSU can be a valuable mind-body intervention concerning BA and mood. In this study only the immediate effects of WATSU were surveyed. It was determined that a single application of WATSU in healthy adults can cause an immediate increase of BA, decrease of pain and lightning of mood. Further studies are required to investigate if these effects are sustainable and/or to establish how many applications would be required to achieve sustainable effects. A targeted improvement of trusting body awareness could be supportive not only in the prevention but also in the treatment of psychological and psychosomatic complaints. Whether WATSU can contribute to this, needs to be substantiated by further studies.

Trial registration

Registered in the clinicaltrials.gov database (NCT05769543)

Ethical approval

Approved by the Ethics Committee of the Medical Faculty of the Johannes Kepler University of Linz, Austria, (EC-number: 1019/2023).

Declarations of interest

The authors declare that there are no economic, personal or any other type of conflicts of interest that could have influenced the work carried out.

CRediT authorship contribution statement

Ursula Danner: Writing – original draft, Visualization, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Alexander Avian:** Writing – review & editing, Visualization, Supervision, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Elvira Ilming:** Writing – review & editing, Resources, Methodology, Funding acquisition, Conceptualization. **Christian Mittermaier:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ctcp.2024.101884.

References

[1] Dull H. Watsu, Freeing the Body in Water, third ed., Trafford Publishing, Victoria, BC, 2004.

[2] A.M. Schitter, L. Radlinger, N. Kurpiers, P. Frei, Application areas and effects of aquatic therapy WATSU - a survey among practitioners, Complement Ther Clin Pract 46 (2022) 101513.

[3] S. Maczkowiak, G. Hölter, H. Otten, WATSU - Zur Wirksamkeit unterschiedlich akzentuierter bewegungstherapeutischer Interventionen bei klinisch depressiven Patienten, Bewegungstherap. Gesundheitssport 23 (2007) 58–64.

[4] A.M. Schitter, J. Fleckenstein, P. Frei, J. Taeymans, N. Kurpiers, L. Radlinger, Applications, indications, and effects of passive hydrotherapy WATSU (WaterShiatsu)-A systematic review and meta-analysis, PLoS One 15 (2020) e0229705.

[5] M. Pérez-Peña, J. Notermans, O. Desmedt, K. Van der Gucht, P. Philippot, Mindfulness-based interventions and body awareness, Brain Sci. 12 (2022).

[6] R. Schmidt, F. Lang, M. Heckmann, Physiologie des Menschen, 31 ed., Springer, Heidelberg, 2010.

[7] P. Joraschky, T. Loew, F. Röhricht, Körpererleben und Körperbild, ein Handbuch zur Diagnostik, Schattauer, Stuttgart, 2009.

[8] M. Probst, L. Skjaerven, Physiotherapy in Mental Health and Psychiatry - a Scientific and Clinical Based Approach, Elsevier, 2018.

[9] S.S. Khalsa, R. Adolphs, O.G. Cameron, H.D. Critchley, P.W. Davenport, J. S. Feinstein, et al., Interoception and mental health: a roadmap, Biol Psychiatry Cogn Neurosci Neuroimaging 3 (2018) 501–513.

[10] Ceunen E, Vlaeyen JW, Van Diest I. On the origin of interoception. Front. Psychol. 2016;7:743.

[11] K. Grechuta, J. De La Torre Costa, B.R. Ballester, P. Verschure, Challenging the boundaries of the physical self, distal cues impact body ownership. Front. Hum. Neurosci. 15 (2021) 704414.

[12] A.D. Craig, The sentient self, Brain Struct. Funct. 214 (2010) 563–577.

[13] U. Danner, A. Avian, T. Macheiner, B. Salchinger, N. Dalkner, F.T. Fellendorf, et al., "ABC"-The Awareness-Body-Chart: a new tool assessing body awareness, PLoS One 12 (2017) e0186597.

[14] K. Pöhlmann, S. Berger, A. von Arnim, P. Joraschky, Der Kurze Fragebogen zur Eigenwahrnehmung des Körpers (KEKS): Entwicklung und Validierung, in: P. Joraschky, T. Loew, F. Röhricht (Eds.), Körpererleben und Körperbild, ein Handbuch zur Diagnostik, Schattauer, Stuttgart, 2009.

[15] K. Geue, B. Strauß, E. Brähler. Bf-SR/Bf-SR', Befindlichkeitsskala – Revidierte Fassung, in: Diagnostische Verfahren in der Psychotherapie, 3rd ed., Göttingen, Hogrefe 2016, p. 52-53.

[16] S. Rosenbaum, P.B. Ward, The Simple physical activity questionnaire, Lancet Psychiatr. 3 (2016) e1.

[17] M. Morfeld, I. Kirchberger, M. Bullinger, Fragebogen zum Gesundheitszustand. SF-36. 2. ergänzte und überarbeitete Auflage. Manual, Hogrefe, Göttingen, 2011.

[18] G.H. Franke, BSI Brief Symptom Inventory von L.R. Derogatis (Kurzform der SCL-90-R) - Deutsche Version: Manual, Beltz Test GmbH, Göttingen, 2000.

[19] A. Beck, R. Steer, G. Brown, Beck Depression Inventory-II, Psychological Corporation, San Antonio: TX, 1996.

[20] C. Kühner, C. Bürger, F. Keller, M. Hautzinger, [Reliability and validity of the revised Beck depression Inventory (BDI-II). Results from German samples], Nervenarzt 78 (2007) 651–656.

[21] M.E. Charlson, P. Pompei, K.L. Ales, C.R. MacKenzie, A new method of classifying prognostic comorbidity in longitudinal studies: development and validation, J Chronic Dis 40 (1987) 373–383.

[22] J. An, I. Lee, Y. Yi, The thermal effects of water immersion on health outcomes: an integrative review, Int J Environ Res Public Health 16 (2019).

[23] C. Jimenez, J. Regnard, C. Robinet, L. Mourot, D. Gomez-Merino, M. Chennaoui, et al., Whole body immersion and hydromineral homeostasis: effect of water temperature, Eur. J. Appl. Physiol. 108 (2010) 49–58.

[24] E. Mur Gimeno, F. Campa, G. Badicu, E. Castizo-Olier, E. Palomera-Fanegas, R. Sebio-Garcia, Changes in muscle Contractile Properties after cold- or warm-water immersion using tensiomyography: a cross-over randomised trial, Sensors 20 (2020).

[25] O. Al Zoubi, M. Misaki, J. Bodurka, R. Kuplicki, C. Wohlrab, W.A. Schoenhals, et al., Taking the body off the mind: decreased functional connectivity between somatomotor and default-mode networks following Floatation-REST, Hum. Brain Mapp. 42 (2021) 3216–3227.

[26] J.S. Feinstein, S.S. Khalsa, H. Yeh, O. Al Zoubi, A.C. Arevian, C. Wohlrab, et al., The Elicitation of relaxation and interoceptive awareness using floatation therapy in individuals with high anxiety Sensitivity, Biol Psychiatry Cogn Neurosci Neuroimaging 3 (2018) 555–562.

[27] I. Keating, H. Dull, P. Schoedinger, J. Olejownik, M. Seamster, K. David, et al., The Heart of WATSU®: Therapeutic Applications in Clinical Practice, Jessica Kingsley Publishers, 2023.

[28] E. Tufekcioglu, The effects of Watsu therapy on autonomic cardiovascular modulation and flexibility of children with cerebral palsy, Baltic J. Health Phys. Act. 12 (2020) 3.

[29] H. Hruby, S. Schmidt, J.S. Feinstein, M. Wittmann, Induction of altered states of consciousness during Floatation-REST is associated with the dissolution of body boundaries and the distortion of subjective time, Sci. Rep. 14 (2024) 9316.

[30] E.M. Choquette, M.C. Flux, S.E. Moseman, S. Chappelle, J. Naegele, V. Upshaw, et al., The impact of floatation therapy on body image and anxiety in anorexia nervosa: a randomised clinical efficacy trial, EClinicalMedicine 64 (2023) 102173.

[31] M.C. Flux, T.H. Fine, T. Poplin, O. Al Zoubi, W.A. Schoenhals, J. Schettler, et al., Exploring the acute cardiovascular effects of Floatation-REST, Front. Neurosci. 16 (2022) 995594.

[32] F. Fidanza, E. Polimeni, V. Pierangeli, M. Martini, A better touch: C-tactile fibers related activity is associated to pain reduction during temporal summation of second pain, J. Pain 22 (2021) 567–576.

[33] A. Schirmer, I. Croy, R. Ackerley, What are C-tactile afferents and how do they relate to "affective touch"? Neurosci. Biobehav. Rev. 151 (2023) 105236.

[34] M.M. Arnold, B. Müller-Oerlinghausen, N. Hemrich, D. Bönsch, Effects of Psychoactive massage in outpatients with depressive disorders: a randomized controlled Mixed-methods study, Brain Sci. 10 (2020).

[35] F. Zimmermann, Mindfulness-based practices as a resource for health and well-bing, Med. Acupunct. 27 (2015).

[36] A.M. Schitter, M. Nedeljkovic, H. Baur, J. Fleckenstein, L. Raio, Effects of passive hydrotherapy WATSU (WaterShiatsu) in the Third trimester of pregnancy: results of a controlled pilot study, Evid Based Complement Alternat Med 2015 (2015) 437650.

[37] E. Tufekcioglu, F. Konukman, F. Kaya, D. Arslan, G. Ozan, M. Erzeybek, et al., The effects of aquatic watsu therapy on gross motor performance and quality of life for children with cerebral palsy, Montenegrin J. Sports Sci. Med. 10 (2021).

[38] K. Uvnäs Moberg, H. Julius, L. Handlin, M. Petersson, Editorial: sensory stimulation and oxytocin: their roles in social interaction and health promotion, Front. Psychol. 13 (2022) 929741.

[39] E. Quattrocki, K. Friston, Autism, oxytocin and interoception, Neurosci. Biobehav. Rev. 47 (2014) 410–430.

[40] M.E. Moneta, H. Kaechele, A theoretical and clinical perspective of an embodied view in psychotherapy of somatic symptoms disorders, Res Psychother 26 (2023).

[41] R.L. Piferi, K.A. Kline, J. Younger, K.A. Lawler, An alternative approach for achieving cardiovascular baseline: viewing an aquatic video, Int. J. Psychophysiol. 37 (2000) 207–217.

[42] L.F. Loose, J. Manuel, M. Karst, L.K. Schmidt, F. Beissner, Flotation restricted environmental stimulation therapy for chronic pain: a randomized clinical trial, JAMA Netw. Open 4 (2021) e219627.