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ORIGINAL RESEARCH
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An experience with Holotropic Breathwork is associated with improvement in non-judgement and satisfaction with life while reducing symptoms of stress in a Czech-speaking population

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ABSTRACT

Background: Holotropic breathwork (Grof[®] Breathwork), was developed by Stanislav Grof and Christina Grof as a ‘non-drug’ alternative technique to evoke altered states of consciousness (ASC). Interestingly, although HBW has been anecdotally reported to evoke experiences and mental health effects corresponding to those of psychedelic substances, the scientific literature on the matter is scarce. **Aims:** The objective of this study was to assess the (sub)acute and long-term effects of HBW on satisfaction with life, and whether these depend on the depth of the experience evoked by the HBW session. **Methods:** A naturalistic observational design was employed in the present study. Between January 2019 and July 2020, 58 Czech-speaking participants who had an experience with HBW were assessed using three separate anonymous online-surveys created and hosted on Qualtrics. Assessments of mindfulness, satisfaction with life, depression, anxiety, and stress were made once prior to (baseline), and two times following (sub-acutely and 4-weeks) the participants’ experience with HBW. The ego dissolution inventory and the 5-dimensional altered states of consciousness scale was used to quantify the HBW experience. **Results:** Despite low ratings of the psychedelic experience (mean range of 0–34% out of 100%), ratings of non-judgement significantly increased sub-acutely following the HBW session and persisted for 4-weeks. Stress-related symptoms significantly decreased while satisfaction with life significantly increased at 4-weeks after HBW. **Conclusion:** An experience with HBW may be associated with improvement in non-judgement, satisfaction with life, and reductions of stress-related symptoms.

KEYWORDS

holotropic breathwork, mindfulness, mental health, altered states of consciousness, hormesis

INTRODUCTION

Holotropic breathwork (Grof[®] Breathwork), hereinafter referred to as HBW, is a breathing method developed by Stanislav and Christina Grof. The word *holotropic* was coined by Stanislav Grof in the 1980’s, referring to the Greek words *holos* and *trepein* (Grof, 1985). The former means ‘whole’, and the latter means ‘moving towards’, translating into ‘moving towards wholeness’. HBW was developed as a ‘non-drug’ alternative for inducing altered states

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 AKJournals

of consciousness (ASC) in order to facilitate self-exploration and personal growth (1985; 2010). HBW features prolonged voluntary hyperventilation alongside evocative music, and support from facilitator (often through physical touch, better known as ‘focused bodywork’, if consent is given by the participant) with the aim to release physical and emotional blockages causing physical pain (not related to or due to an injury) or suppressed emotions. Such releases have been termed somatic and cognitive catharsis (Grof & Grof, 2010; Taylor, 2007). The latter refer to re-experiencing of significant life events, that have not been adequately processed and cause emotional and physical problems in a person’s life. During the process of HBW, reliving of personal events may be accompanied by a powerful emotional release accompanied by cognitive insight and positive therapeutic change (Grof & Grof, 2010; Taylor, 2007). It is at the current time unknown how HBW may facilitate such experiences. This requires further multidisciplinary research. Finally, after the breathing session, artwork (i.e. drawing of mandalas), and group sharing are typically used to help integrate the experience (Grof & Grof, 2010; Watjen, 2014).

Anecdotally, participants of HBW sessions have reported a wide range of positive effects such as recovery from various psychological (e.g. anxiety and depression) and psychosomatic conditions (e.g. asthma and migraines) (Grof & Grof, 2010), increased processing traumatic memories (Byford, 1993), as well as mystical experiences (Pressman, 1994). Available research on the clinical effects of HBW suggests that it can decrease anxiety and depression (Cervantes & Puente, 2014; Lalande, Bambling, King, & Lowe, 2012; Sudres, Ato, Fouraste, & Rajaona, 1994), aid in the treatment of substance abuse (Brewerton, Eyerman, Cappelletta, & Mithoefer, 2012; Metcalf, 1995), as well as increasing self-esteem (Holmes, Morris, Clance, & Putney, 1996) and self-awareness (Miller & Nielsen, 2015). Further research has found HBW to help participants improve their sense of connectedness to others (Holmes et al., 1996), their communication skills (Denisa, 2003), and their openness towards previously rejected opinions (Denisa, 2003). Moreover, in a study by Puente (2014), volunteers rated their HBW experience as having substantial personal meaning and as evoking an increase of personal wellbeing. Finally, with regard to physiological effects, HBW has also been found to increase heart rate variability (HRV), a common physiological proxy of overall stress and mental health (Cervantes & Puente, 2014; Kim, Cheon, Bai, Lee, & Koo, 2018; McEwen & Wingfield, 2003; Negrao, Deuster, Gold, Singh, & Chrousos, 2000). It is worth highlighting that none of these studies were placebo-control studies.

Interestingly, HBW participants have reported experiences of ASC similar to those manifested following ingestion of a psychedelic substance such as for example Lysergic acid diethylamide (LSD) (Grof, 1988; Nichols, 2016). Specifically, previous research found that the following manifestations of ASC typically emerged after approximately 8 min of hyperventilation: ringing/roaring in the ears, clouded vision, feelings of astonishment, lightness and/or euphoria. After approximately 15 min, more dramatic changes in

consciousness have been documented, including perceptual distortions and subjective “visions” (Agadzhanian, Panina, Kozupitsa, & Sergeev, 2003). In fact, 82% of psychiatric inpatients that experienced HBW in a study conducted by Eyerman (2014) described their experience as ‘psychedelic’. Furthermore, in a group of 134 individuals who participated in a daylong workshop of HBW, 9.7% met the criteria for a “complete” mystical experience, as assessed by The States of Consciousness Questionnaire (SCQ) (Griffiths, Richards, McCann, & Jesse, 2006; Puente, 2014). These results are directly comparable to the percentage of participants reporting mystical experiences after being administered a 10mg/70 kg psilocybin dose (11.1% of participants) (Griffiths et al., 2011).

As HBW is a rather unexplored avenue in the field of ASC research compared to psychedelics, we aimed to assess sub-acute and long-term mental health effects of HBW (particularly in terms of mindfulness, subjective satisfaction with life, and affect), and to see whether effects on mental health related variables were predicted by the depth and quality of the subjective experience evoked during the HBW session through a naturalistic observational design. Given the anecdotal similarity between experiences evoked by HBW and psychedelics (Puente, 2014), we expected to see similar effects on mental health variables as shown in former studies on psilocybin, ayahuasca and 5-methoxy-N,N-dimethyltryptamine (5-MeO-DMT), as well as a similar link of positive mental health effects depending on the degree of the psychedelic experience and ego dissolution experienced during the HBW session (Mason, Mischler, Uthaug, & Kuypers, 2019; M. Uthaug et al., 2019; M. Uthaug et al., 2018; M. V. Uthaug et al., 2020).

METHODS

Study procedure

A naturalistic observational design was employed for the present study. Participants completed three anonymous online-surveys in total; one before the HBW session (baseline), within 24 h of the HBW session (sub-acute) and one 4-weeks after the HBW session (follow-up). The surveys were created and hosted on an online platform called Qualtrics. The estimated time for completing the questionnaires (see ‘Test Battery’ section) was approximately 20–40 min.

Participants

Recruitment and data collection occurred from January 2019 to July 2020. Participants were volunteers attending a HBW session at their own initiative in Prague, The Czech Republic. The HBW session was hosted by a male facilitator. Eligibility criteria for participating in the present study were as follows: able to provide informed consent, being at least 18 years of age, Czech-speaking and having a valid email-address. In total, 74 participants consented to partake in the online-survey study after reading the goals and methods of the study explained on the participant information sheet. Of



those who consented, 58 (28 female, 30 male) participants completed parts of the baseline measurements, 40 completed the test battery the morning after the HBW experience, and 21 completed the measurement after 4 weeks.

The participants' highest completed levels of education were graduate school (49.2%), undergraduate school (14.0%), or secondary school (36.8%). Mean (SD) participant age was 38.2 (9.7). Over half of the participants (56.1%) reported previous experience with a psychedelic substance, including DMT, psilocybin, mescaline, LSD, 2CB and/or Iboga, while 10.5% reported previous experience with ketamine.

Almost half of the participants (40.4%) had never participated in an HBW session before, whereas some participants (26.3%) reported it was their second time, and others (33.3%) reported that they had done HBW more than twice. Most participants (64.9%) reported that their motivation to attend the HBW session was 'to understand myself', while the rest of the participants reported 'to resolve problems' (43.9%), 'curiosity' (24.6%), and 'other' (28.1%).

Overall, quite a few participants reported being medically diagnosed by a clinician with depression (8.8%), anxiety (17.5%), PTSD (1.8%), substance abuse (1.8%), personality disorders (12.3%), and other mental health disorders that were not listed (71.9%). Others reported having self-diagnosed symptoms of depression (21.1%), anxiety (35.1%), PTSD (17.5%), substance abuse (10.5%), personality disorders (5.3%), and other mental health disorders (17.5%). See Table 1 for a summary of participant demographics. **The setting of the HBW session.**

The session was facilitated by a male clinical psychologist who was an experienced HBW (Grof® Breathwork) facilitator certified by Stanislav and Christina Grof in 1992. Participants took part in a mandatory 4-h introductory meeting at approximately 2 weeks (sometimes more) prior to the HBW session. Overall, in this meeting, participants were given information on the structure of a HBW session, contraindications for HBW (i.e., previous bad experience in altered states of consciousness), recommended preparations, information about how to signal 'stop' at any point throughout the session, what experiences could be expected during the session, as well as some history of HBW and ASC. Participants were also invited to share a bit about their 'coping strategy' if faced with challenging situations in life. Moreover, they were encouraged to eat more lightly, exclude alcohol and other addictive substances, meditate, walk in nature, and reduce external stimulation (e.g., media) starting ten days prior to the HBW session. The participants were also advised not to eat much in the morning before the session.

After signing up for the HBW session, the participants would receive an email including information about the current study and were invited to partake in the study following their informed consent. This email also contained links to the respective questionnaires and information when to complete them before the session (baseline), sub-acutely (within 24 h of the HBW session) and the 4-week after the session (follow-up).

Table 1. Overview demographics

Demographics (N = 58)	%
Mean Age (SD)	38.2 (9.7)
Gender	
N Female	28
N Male	30
Education	
Graduate school	49.2
Undergraduate school	14
Secondary school	36.8
Previous experience with a psychedelic substance	56.1
Previous experience with ketamine	10.5
No previous experience with HBW	40.4
Second experience with HBW	26.3
HBW more than twice	33.3
Motivation to attend HBW session	
To understand myself	64.9
To resolve problems	43.9
Curiosity	24.6
Other	28.1
Diagnosed by clinician	
Depression	8.8
Anxiety	17.5
PTSD	1.8
Substance abuse	1.8
Personality disorders	12.3
Other mental health disorder not listed	71.9
Self-diagnosed (not by clinician)	
Depression	21.1
anxiety	35.1
PTSD	17.5
Substance abuse	10.5
Personality disorders	5.3
Other mental health disorder not listed	17.5

On the day of the HBW session, after arriving to location, participants were given practical instructions regarding session duration, facilitation, and safety. They were also reminded that to signal the need for assistance at any point during session (for example to use the restroom or to receive focused bodywork) they should simply raise their hand. Participants were then asked to find a mattress to lay down on and get comfortable. After they were guided through a body scan exercise whilst wearing an eye-mask to induce relaxation and enhance the focus on the bodily sensations prior to the start of the breathing session. The breathing session lasted for 2.5–3 h. Throughout the session, evocative music was played, and supportive physical touch (i.e., focused bodywork) was offered to the participants by the facilitator (consent was obtained from the participant prior to any touch). At the end of the session, the facilitator asked all participants about their state of mind and offered additional support (for example supportive physical touch [i.e., holding the participants' hand] or guiding a breathing exercise) to participants who had found their experience difficult or challenging. Once all participants had completed their process, they would be invited to draw mandalas to and integrate the experience. Following this, they would be



invited to have a light meal consisting of bread, fruit, chocolate, and tea, before finally taking part in a ‘sharing circle’ where they could talk about their experience. Participants were however encouraged to not share details about their experience. This was done to avoid intellectualization of the experience. Instead, the participants were invited to share more about emotional and bodily experiences that were experienced. Finally, the facilitator closed the HBW session with some general advice on helpful follow-on integration practices (e.g., writing about their experience, walking in nature and other forms of self-care practices), and reassured the participants that should they encounter difficult or intense after-effects, he would be available for phone or in-person consultations.

Test battery

Besides a demographic section, and some questions about the experience with HBW overall (for example, *did you experience any somatic effects that felt therapeutic during the experience?*), the test battery included the Five Facets Mindfulness Questionnaire 15 (FFMQ-15), Satisfaction with Life Scale (SWLS), Depression, Anxiety, and Stress Scale-21 (DASS-21), the Ego Dissolution Inventory (EDI) and the 5-Dimensional Altered States of Consciousness Scale (5D-ASC). The test battery was completed at baseline, sub-acutely and at 4 weeks after HBW.

Baseline, sub-acute and follow-up metrics of mental health

FFMQ-15. The FFMQ-15 is a 15-item self-report questionnaire which measures five different factors; 1) Observe: noticing thoughts and emotions; 2) Describe: describing internal experiences; 3) Acting with awareness: focus on the present activity; 4) Non-judgement: not evaluating or judging the present experience; 5) Non-reaction: allowing thoughts and feelings to come without acting on them (Baer et al., 2008; Gu et al., 2016). The purpose of this scale is to assess an individual’s mindfulness-related capacities. The participants answered by rating their agreement with each statement on a 5-point Likert-scale ranging from 1 “*never true*” to 5 “*very often or always true*”. The sub-scale scores are obtained by adding the relevant items for each of the five facets. Facet scores range from 8 to 40, except for the non-reactivity facet, which ranges from 7 to 35. The internal consistency of the total scale in the current sample was low (Cronbach’s alpha = 0.382).

SWLS. The Satisfaction with Life Scale (SWLS) is a 5-item self-report scale (Diener, Emmons, Larsen, & Griffin, 1985). Sample items include: “*In most ways my life is close to my ideal*” and “*So far I have gotten the important things I want in life*”. The purpose of the scale is to assess someone’s satisfaction with life. The items are answered on a Likert-scale ranging from 1 “*Strongly disagree*” to 7 “*Strongly agree*”. The total score is obtained by summarizing the ratings from each item and ranges between 5 and 35, with higher scores indicating a greater life satisfaction. The

internal consistency of the total scale in the current sample was good (Cronbach’s alpha = 0.853).

DASS-21. The DASS-21 is the shorter version of the original self-report questionnaire Depression, Anxiety, Stress Scale 42 (Henry & Crawford, 2005). The purpose of the DASS-21 scale is to measure depression, anxiety, and stress on a scale from 0 (normal) to 42 (extremely severe). The participants responded by rating the agreement with each statement from 0 “*Did not apply to me at all*” to 3 “*Applied to me very much, or most of the time*”. The sub-scale scores for depression had a range from normal = 0 to severe = 28+, anxiety had a range from normal = 0 to severe = 20+ and stress had a range from normal = 0 to severe = 34+, calculated by summing the scores for the relevant items to the characteristic being measured (Henry & Crawford, 2005). As the original DASS has 42 questions, the sum of the DASS-21 is multiplied by 2 to ascertain comparable scores. The internal consistency of the total scale in the current sample was excellent (Cronbach’s alpha = 0.947).

Sub-acute metrics of the subjective experience

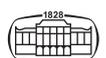
EDI. The EDI is an 8-item self-report scale that assesses the participant’s experience of ego dissolution (Nour, Evans, Nutt, & Carhart-Harris, 2016). The participants reported their experience by placing a mark on a line that ranging from “*No, not more than usual*” (0%) to “*Yes I experience this completely/entirely*” (100%). The total EDI is scored by calculating the mean percentage of all the 8 items and ranges between 0 and 100%. The higher the total score, the stronger the experience of ego dissolution. The internal consistency of the total scale in the current sample was excellent (Cronbach’s alpha = 0.925).

5D-ASC. The 5D-ASC is a 94-item self-report scale that assesses the participants’ alterations from normal waking consciousness (Adolf Ditttrich, 1998; A Ditttrich, Lamparter, & Maurer, 2010; Studerus, Gamma, & Vollenweider, 2010). The participant is asked to place a mark on the line below each statement to rate to what extent the statements applied to their experience in retrospect (i.e., from 0% “*No, not more than usually*” to 100% “*Yes, more than usually*”). The 5D-ASC measures 11 sub-scales: experience of unity, spiritual experience, blissful state, insightfulness, disembodiment, impaired control and cognition, anxiety, complex imagery, elementary imagery, audio-visual synesthesia and changed meaning of perception. The internal consistency of the total scale in the current sample was excellent (Cronbach’s alpha = 0.958).

Reports of somatic effects. Participants were asked to report any somatic effect they may have experienced during the HBW session.

Statistical analysis

Statistical analysis was conducted in SPSS Statistics 24 using a linear mixed model analysis that included Session (three



levels: baseline, sub-acutely (within 24 h after HBW session), and 4 weeks after HBW (follow-up) as a within-subject factor. The covariance structure was chosen according to best fit and could vary across outcome variables. Different covariance structures used included compound symmetry heterogeneous (CSH) and first lag autoregressive (AR1) structures. If a main effect of Session was found, separate contrasts were performed between baseline and the follow-up sessions with Bonferroni adjustment for multiple comparisons. The alpha level of significance was set at 0.05. To investigate the association between the experience of ASC during the HBW session, and changes in subjective parameters, Spearman's correlations were carried out between ratings on the 5D-ASC and the EDI, and baseline changes scores of the SWLS, DASS-21, and FFMQ-15 (sub-acutely [within 24 h after] – baseline; 4 weeks after (follow-up) – baseline).

RESULTS

In total, 58 participants completed parts of the test battery at baseline, 40 completed the test battery the morning after the HBW experience, and 21 completed the measurement after 4 weeks. Mean subjective ratings of mental health parameters and significant changes from baseline are given in Table 2.

Baseline, sub-acute and follow-up metrics of mental health

FFMQ-15. Main effects of Session reached significance on one mindfulness parameter, i.e., non-judgement ($F_{2,51.49} = 6.494$, $P = 0.003$). Separate contrasts revealed an increase in non-judgement from baseline to sub-acute ($P = 0.006$) and from baseline to follow-up ($P = 0.011$). Median ratings of non-judgement over time are shown in Fig. 1. The parameters observe, describe, aware, and non-reactance were not significantly affected by the HBW session.

SWLS. Analysis revealed a significant main effect of Session ($F_{2,48.75} = 5.19$, $P = 0.009$) on individuals' responses to the SWLS. Contrasts indicated that, compared to baseline, satisfaction with life significantly increased 4 weeks after

HBW ($P = 0.013$), with a trending increase sub-acutely ($P = 0.053$). Median ratings of SWL over time are shown in Fig. 2.

DASS-21. Mixed model analysis revealed main effects of Session on stress ($F_{2,43.15} = 3.68$, $P = 0.033$). Contrasts indicated that, compared to baseline, ratings of stress significantly decreased 4 weeks after HBW ($P = 0.029$). Although ratings on depression and anxiety decreased from baseline to follow-up, the changes did not reach significance. Median ratings of stress over time are shown in Fig. 3.

Retrospective metrics of the subjective ratings of consciousness during the HBW experience

EDI. Mean (SE) ego dissolution rating was 33.73 (3.90). Overall, the total EDI rating varied between 0% (no dissolution) and 100% (maximal dissolution), as shown in Fig. 4. The experience of ego dissolution did not predict any of the improvements in mental health parameters reported in the sub-acute or follow-up survey.

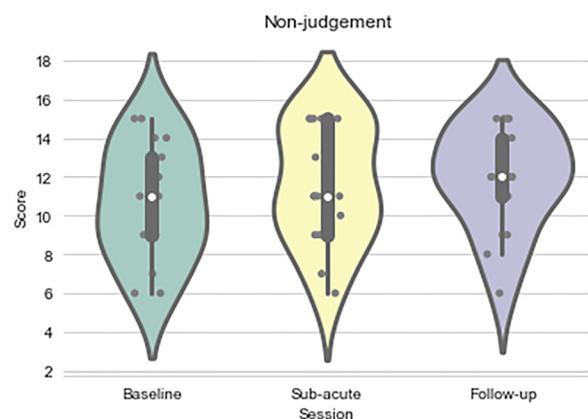


Fig. 1. Ratings of non-judgement before, 1-day after and at a 4-weeks after a session with Holotropic Breathwork. The thick line indicates the interquartile range, whereas the white dot indicates the median. Each grey dot indicates a data point, whereas the density is scaled to the relative count across all bins. Wider sections of the violin plot represent a higher probability of observations taken a given value.

Table 2. Mean (SE) subjective ratings of SWL, DAS-21 and FFMQ-15 at baseline and at 1 day and 4 weeks after HBW. * $P < 0.05$ when comparing to baseline

Measure	Baseline	1-day after	4-week follow-up
SWLS	22.298 (0.778)	23.025 (0.981)	23.095 (1.294)*
DASS-21			
Depression	25.526 (1.442)	23.350 (1.495)	23.523 (2.224)
Anxiety	19.123 (0.854)	19.150 (0.922)	17.524 (1.344)
Stress	27.649 (1.152)	25.650 (1.333)	23.333 (1.720)*
FFMQ-15			
Observe	10.684 (0.287)	11.000 (0.363)	10.904 (0.620)
Describe	10.509 (0.289)	10.275 (0.392)	10.047 (0.595)
Awareness	9.807 (0.302)	9.675 (0.367)	9.857 (0.544)
Non-judgement	10.333 (0.382)	11.225 (0.421)*	11.809 (0.584)*
Non-reactance	9.543 (0.306)	9.800 (0.431)	10.238 (0.555)

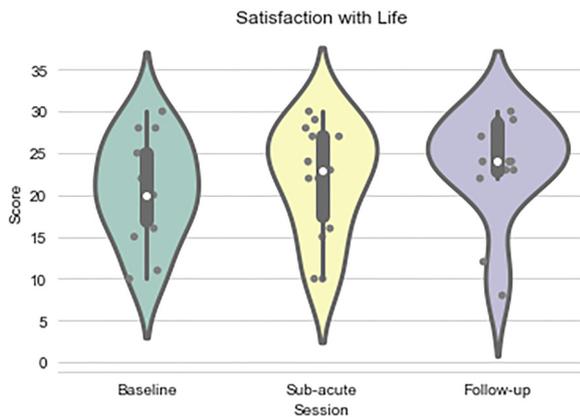


Fig. 2. Ratings of satisfaction with life before, 1-day after and at a 4-weeks after a session with Holotropic Breathwork.

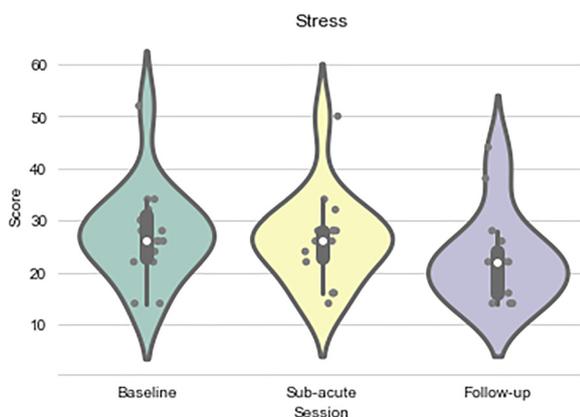


Fig. 3. Ratings of stress before, 1-day after and at a 4-weeks follow-up after a session with Holotropic Breathwork.

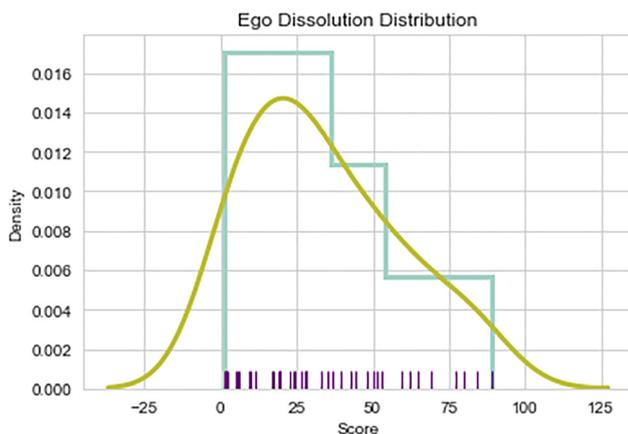


Fig. 4. Distribution plot of the experience of ego dissolution as assessed by the EDI after one session with Holotropic Breathwork. The plot consists of a histogram (green), probability density (kernel density estimation, yellow) and raw data points (purple).

5D-ASC. Overall, typical aspects of a psychedelic experience were only rarely experienced by participants, with an occurrence of <20% across all sub-scales. Specifically, the average (SE) rating of the 11 sub-scales of the 5D-ASC sub-acutely

after the HBW session was; Experience of Unity: 19.84% (2.66), Spiritual experience: 11.09% (1.44), Blissful state: 16.12% (1.61), Insightfulness: 10.38% (1.21), Disembodiment 8.7% (1.35), Impaired control cognition: 11.10% (1.37), Anxiety: 5.73% (1.13), Complex imagery: 8.16% (0.96), Elementary imagery: 10.96% (1.62), Audio and visual synaesthesia: 6.35% (1.18), Changed meaning of perception: 5.75% (0.87). See Fig. 5 for overview. Out of the 11 sub-scales, only 5D-ASC sub-scale ratings of ‘Blissful state’ and ‘Spiritual experience’ predicted mental health parameters reported in the follow-up survey (4-weeks after), specifically they were positively correlated with satisfaction with life ($r = 0.512$, $P = 0.036$, $N = 17$; $r = 0.492$, $P = 0.045$, $N = 17$, respectively).

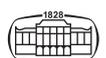
Somatic effects

97% of participants reported that they experienced somatic effects (i.e., tremors, tense muscles, or a physical release of energy) during the HBW session. Most of the respondents gave written reports about what the somatic effects consisted of. Some of these reports were as follows; “*Strong tension and shaking at the same time. Thanks to the sitters and their work with the body, this tension was strongly released, and a very pleasant feeling appeared*” and “*Great tension, cramps in the forearms, fingers, upper legs. Later, shaking mainly the left hand, but also the whole body, followed by a feeling of heat in my right arm (which had been hurting me for several months as a result of an injury)*”. Appendix 1 gives an overview of all written reports by most of the participants who reported somatic effects during the HBW session (translated from Czech to English).

DISCUSSION

The present study aimed to shed further light onto the sub-acute and long-term effects of HBW (Grof[®] Breathwork) on mental health parameters, using a naturalistic observational approach. Specifically, this study sought to investigate whether one experience with HBW evoked changes in mindfulness, satisfaction with life and affect and to evaluate whether such changes were related to the magnitude of the psychedelic experience evoked by the HBW session. We found that a single HBW session was associated with significant increases in non-judgement, both sub-acutely and long-term, as well as improvement in satisfaction with life and reductions in stress at the 4-week follow-up.

Our finding that a single HBW session was associated with significant increases in non-judgement from baseline to sub-acutely and follow-up (4-weeks) corresponds well to previously reported effects of the psychedelics ayahuasca and 5-MeO-DMT (M. Uthaug et al., 2019; M. Uthaug et al., 2018; M. V. Uthaug et al., 2020). Regarding ayahuasca, it was found that one ayahuasca session significantly improved not only non-judgement, but also other mindfulness related facets such as observation and awareness sub-acutely, but not at a 4-week follow-up (M. Uthaug et al., 2018). As for 5-MeO-DMT, a significant increase of non-judgement was



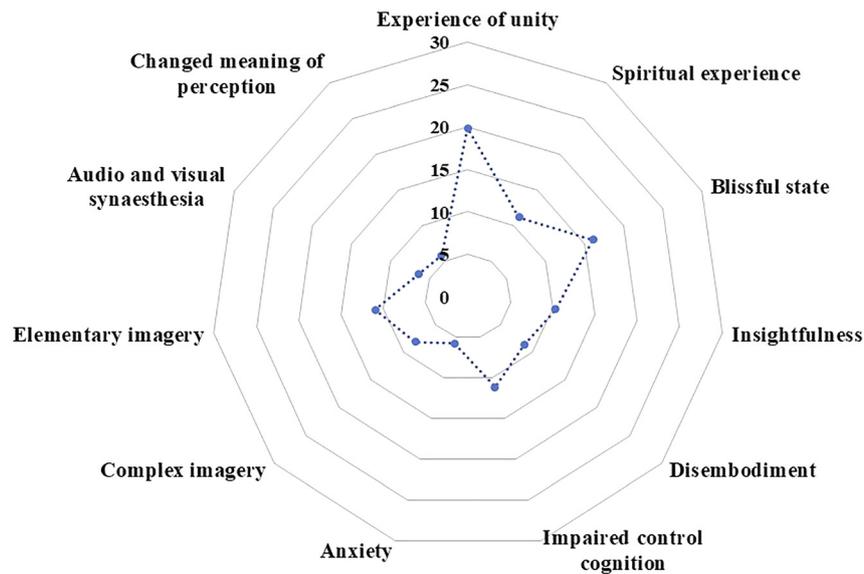


Fig. 5. Mean ratings (range 0-100%) of the psychedelic experiences as assessed with the 11 5D-ASC sub-scales after Holotropic Breathwork.

found sub-acutely (M. V. Uthaug et al., 2020) as well as at a 4-week follow-up (M. Uthaug et al., 2019). It should be noted however that the internal consistency of FFMQ rating was very low, which may suggest that participants may not have fully understood the questions and in similar ways. The findings should therefore be interpreted with caution.

Our analyses also highlighted that participants' satisfaction with life significantly improved at the 4 weeks follow-up. Furthermore, stress levels (as measured by the DASS-21) also significantly decreased four weeks later. This is in line with previous studies reporting effects of HBW on various aspects of mental health such as personal well-being (Puente, 2014) and affect (Cervantes & Puente, 2014). These findings are comparable to those found with psilocybin, ayahuasca and 5-MeO-DMT (Mason et al., 2019; M. Uthaug et al., 2019; M. Uthaug et al., 2018; M. V. Uthaug et al., 2020).

In terms of subjective experiences evoked by the HBW session, the mean rating of experiences of ego dissolution as assessed by the EDI was 33.73% (out of 100%). These ratings can be considered relatively low, e.g., compared to EDI ratings of 50–75% for experiences evoked by ayahuasca or 5-MeO-DMT (M. Uthaug et al., 2019; M. V. Uthaug et al., 2020). Furthermore, the mean ratings regarding psychedelic aspects of the subjective experiences as assessed by the 5D-ASC subscales were between 5.73% and 19.84% (out of 100%), which is also considered low compared e.g. to the 60–75% ranges found with 5-MeO-DMT (M. Uthaug et al., 2019; M. V. Uthaug et al., 2020). It is also lower than experiences previously reported because of breathwork (Sviderskaya & Bykov 2006). Still, increments in satisfaction with life were positively correlated with 5D-ASC sub-scale ratings of 'blissful state' and 'spiritual experience'. This finding is in line with previous research showing that mental health improvements following a single ayahuasca ceremony or use of 5-MeO-DMT are strongly associated with the magnitude of the psychedelic experience (M. Uthaug et al.,

2019; M. Uthaug et al., 2018). Both 'blissful state' and 'spiritual experience' are central elements of the mystical-type that can be evoked by psychedelics and that have been associated with positive therapeutic outcomes (Bogenschutz et al., 2015; Griffiths et al., 2016; Johnson, Garcia-Romeu, & Griffiths, 2017; Klavetter & Mogar, 1967; Kurland, Grof, Pahnke, & Goodman, 1972; MacLean, Johnson, & Griffiths, 2011; O'Reilly & Funk, 1964; Pahnke, Kurland, Unger, Savage, & Grof, 1970; Richards, Rhead, DiLeo, Yensen, & Kurland, 1977; Ross et al., 2016). It is therefore not surprising that they show a similar relationship between change in consciousness and mental health outcomes was observed in the context of a HBW ceremony. Thus, this seems to suggest that an experiential change in consciousness during HBW and psychedelic ceremonies is central to the occurrence of a positive change in mental health. Further research is warranted to better understand the mechanisms in which HBW exert its effect on mental health.

While subjective experiences comparable to those evoked by psychedelics were uncommon in the HBW setting studied here, participants almost unanimously (97,4%) reported somatic effects (i.e., tremors, tense muscles, or a physical release of energy), a phenomenon also reported previously (Sviderskaya & Bykov 2006). More research is needed to explore whether this may correlate with improvement in mental health related parameters sub-acutely and at follow-up. The way in which HBW exert its effects remains undetermined as previously stated. Yet, several explanatory concepts may be relevant for future researchers to consider so to elucidate HBW mechanisms of effect in the future. We have identified three plausible frameworks that may be worthy of further exploration through multidisciplinary efforts. These frameworks include the Self Determination Theory (SDT) by (Deci & Ryan, 2008), pivotal mental states (PIMS) (Brouwer & Carhart-Harris, 2020), and finally the process of hormesis (Mattson, 2008b; Pruijboom & Musket, 2018). Regarding

the former, it may be that HBW may have fulfilled the three psychological needs, namely *autonomy*, *competence*, and *relatedness* as outlined in the SDT which ultimately may have driven improvements in mental health related variables (Watjen, 2014). For example, participant autonomy may have been supported by the facilitator encouraging the participants to follow their own instincts and bodily sensations during the session. Competence may have followed from the HBW session through the participant being empowered to care for their own well-being and growth through participating in the HBW session. Relatedness defined as ‘the sense of being cared for’ or ‘connected with the other’ may have been achieved by the facilitators’ aim to ‘hold a safe space’ for the participants and while being in connection to the other participants (Watjen, 2014). The second framework, namely PiMS, has been defined as “*transient, intense hyper-plastic states of mind and brain that have the potential to mediate rapid, major and potentially enduring psychological change*” (Brouwer & Carhart-Harris, 2020). The PiMS model suggests that physiological stress (e.g., based on food or sleep deprivation, or inflammation, or hypoxia, or extreme heat/cold or pain) increase serotonin 2A receptor signalling. In a supportive setting, and when entered voluntarily, such upregulated 5HT-2A signalling can trigger PiMS which in turn allow the subject to make rapid behavioural changes. That said, one limitation of the PiMS model is that it focuses mainly on cognitive and psychological aspects, but not other physiological reactions that occur during a stress response (such as increased Heart Rate [HR] and decreased Heart Rate Variability [HRV]). It would be of interest to explore this further by extending physiological assessments of responses to stressors such as HBW as well as other mind-altering practices including use of psychedelics. This may aid in shedding further light on the possibility of a ‘pivotal somatic state’ through identifying ‘biomarkers’ of change in physiological processes, assessed for example through a clinical study or by on-site assessments at the HBW session (i.e., a naturalistic observational approach) so to track biological effects by assessment of HR, HRV (as by electrocardiogram), brain activity (as determined by imaging techniques such as for example electroencephalogram [EEG]), and cytokines (as assessed by biomedical sampling of biofluids [i.e., saliva, urine and blood]) (Brouwer & Carhart-Harris, 2020; Brown Jr, 1953; Gotoh, Meyer, & Takagi, 1965; Hilaire et al., 2010; Ley, 1985; Meuret, Ritz, Wilhelm, & Roth, 2005; Sharma & Rawat, 2019; Turpin, 1986; M. V. Uthaug et al., 2020; Van Diest et al., 2001). This brings us to our third framework, namely the process of ‘hormesis’ which is defined as an adaptive response of cells and organism to moderate stress (Mattson, 2008b; Pruijboom & Muskiet, 2018), echoing Darwin’s term; ‘the survival of the fittest’ (1909) and Nietzsche’s saying; “*what doesn’t kill me makes me stronger*” (Zimmermann, Bauer, Kroemer, Madeo, & Carmona-Gutierrez, 2014). Examples of hormesis include exercise and dietary restrictions (Gomez-Pinilla, 2008; Kouda & Iki, 2010), which are both considered beneficial ‘mild stressors’, and have been linked to the activation of pathways that are linked to the

production of neurotropic factors (such as BDNF) and cellular stress resistance proteins (Mattson, 2008a). One may speculate whether the voluntary prolonged hyperventilation during the HBW experience may be considered a ‘hormetic intervention’ that consequently may bring about betterment in several mental health related variables (Prujboom & Muskiet, 2018), both cognitively and somatically, by reversing dysregulation or dysfunction in adaptive stress responses and aid in the building of resilience to various environmental stressor (biological, emotional as well as cognitive) (Faye, McGowan, Denny, & David, 2018; Zimmermann et al., 2014). It has been previously suggested that identification and understanding of the physiological mechanisms involved in homeostatic systems, would enhance the ability to employ these mechanism therapeutically to reverse pathological states in chronic diseases of homeostasis (Billman, 2020; Kotas & Medzhitov, 2015). Obviously, this warrants further research, which may yield important implications relevant for furthering development of ‘*hormetic interventions/treatments*’. This is important as dysregulation of adaptive stress responses (i.e., due to inability to cope with a stressor) is known to lower resilience and health which increases vulnerability to dysregulation in immune and inflammatory function (Elenkov, Iezzoni, Daly, Harris, & Chrousos, 2005), development of pathological conditions such as depression (Gold, 2015), as well as neurodegenerative diseases such as Alzheimer’s disease and Parkinson’s disease (Calabrese, Scuto, & Calabrese, 2020).

To empirically explore the validity of these ideas, future studies will need to conduct rigorous assessments in both a naturalistic and lab-based settings dissecting different aspects of the HBW experience (or other mind-altering practices) including physiological and biological factors, as well as preparation and setting (i.e., group dynamics and music). In particular, while some of the physiological effects evoked by HBW have been explained by research on the effects of prolonged hyperventilation, especially in terms of respiratory alkalosis (Foster, Vaziri, & Sassoon, 2001). The connection of these physiological processes to the evoked subjective experiences remains elusive.

That said, this research is not without limitations. For example, it is worth mentioning that the internal consistency of the measure FFMQ-15 was found to be moderately low (Cronbach’s $\alpha = 0.382$). It is not clear why this is the cause, but it may suggest that the individuals in the sample population may not have understood the questions in similar ways. Moreover, while we believe that a naturalistic observational approach is important to explore mental health effects that are experienced by participants in a typical HBW practice, this does result in one important limitation: The study did not feature a control group to assess the influence of confounding parameters such as the impact of set and setting and expectancy on any of the outcome measures. Previous studies have demonstrated that personal expectations can drive alterations in mental health parameters and constitute a placebo effect (Heaton, 1975; Szigeti et al., 2021; M. Uthaug et al., 2021).

Despite potential confounding caused by set and setting and expectancy effects it is still important to note that a single



HBW experience (including preparatory and integrative practices) has the capacity to significantly improve mental health outcomes. Further studies should aim to systematically dissect which parts of a HBW session (including the direct physiological effects of the changed breathing rhythm) might contribute the most to its overall outcome.

In summary, findings in the present study suggest that one session of HBW can evoke long-term improvements in non-judgement and satisfaction with life and reductions in stress. This calls for further investigations into the mechanisms that may steer this improvement in mental health related variables in a HBW experience. Doing so may bring about inferences relevant to advance progress in alternative treatment methods and approaches for patients with mental health related as well as neurodegenerative disorders.

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Conflict of interest: The authors declare that they have no competing interests. MU, NM, MH and JR were not involved in the organization of the HBW sessions, but were responsible for data collection, statistical analysis and writing of the current manuscript. MV hosted the HBW sessions but was not involved in collection, analysis, and interpretation of data.

Ethical standards: This study was approved by the Local Standing Ethical Committee in Maastricht, the Netherlands.

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APPENDIX

Table A1.

PPT	Yes	No	Report (in Czech)	Report (in English)
1	X		<i>brnění svalstva, uvolnění, vzrušení (ne sexuálního charakteru)</i>	muscle tingling, relaxation, arousal (not sexual)
2				
3	X		<i>Jako terapeutické považují výsledek dýchání - dokonalé fyzické uvolnění</i>	I consider the result of breathing - perfect physical relaxation - as therapeutic
4	X		<i>zažil jsem třes, chvílemi křečovitý, který ale nebyl nepříjemný, měl v sobě jakousi "katarzi", tj. snad by se dalo mluvit o "terapeutické" účinku</i>	I experienced tremor, at times convulsive, but it was not unpleasant, it had a kind of "catharsis" in it, ie perhaps we could talk about a "therapeutic" effect
5				
6				
7	X		<i>Svaly v napětí, křeče a následně energetické uvolnění, prakticky asi ve třech fázích. Vždy do úplného uvolnění.</i>	Muscles in tension, cramps and subsequent energetic relaxation, practically in about three phases. Always until complete release.
9	X		<i>třes, průchod a uvolňování energie, změny v pociťování tělesné teploty (chlad, horko), napětí a uvolnění svalů</i>	tremor, passage and release of energy, changes in the feeling of body temperature (cold, heat), tension and muscle relaxation

(continued)



Table A1. Continued

PPT	Yes	No	Report (in Czech)	Report (in English)
10				
11	X		<i>Napatie-hlava, ruky, nohy</i>	<i>Tension-head, arms, legs</i>
13		X		
14	X			
15				
16	X		Třes svalů, bolesti v předloktí, nafoukle a oteklé nohy, křeče v rukou	<i>Muscle tremors, forearm pain, swollen and swollen legs, cramps in the hands</i>
18				
19	X		Všechny uvedené + zvuková exprese a kašel	<i>All listed + audio expression and cough</i>
20	X		třes, průchod a uvolňování energie, změny v pocit'ování tělesné teploty (chlad, horko), napětí a uvolnění svalů	<i>tremor, passage and release of energy, changes in the feeling of body temperature (cold, heat), tension and muscle relaxation</i>
22	X		Vibrace panve, resp tela	<i>Vibration of the pelvis or body</i>
23	X		jako kdyby mnou procházela elektrina, uvědomovala jsem si svoji vlastní energii	<i>as if electricity were flowing through me, I was aware of my own energy</i>
25				
26				
28	X		Silné napětí a třes zároveň. Díky sitrům a jejich práce s tělem došlo k silnému uvolnění tohoto napětí a dostavil se velmi příjemný pocit.	<i>Strong tension and shaking at the same time. Thanks to the sitras and their work with the body, this tension was strongly released and a very pleasant feeling appeared.</i>
29	X		Velké napětí, křeče v předloktích, prstech na rukou, v nadkolení. Později třes hlavně levé ruky, ale i celého těla, následně pocit horka v pravé paži (která mě několik měsíců bolí jako následek úrazu)	<i>Great tension, cramps in the forearms, fingers, upper legs. Later, shaking mainly the left hand, but also the whole body, followed by a feeling of heat in my right arm (which hurts me for several months as a result of an injury)</i>
30	X		chut' tlačit proti protitlaku, protahovat se.	<i>the desire to push against the back pressure, to stretch.</i>
31				
32	X			
34	X		Velké, svalové křeče, pláč, potom velké uvolnění energie fyzické během	<i>Big, muscle cramps, crying, then a big release of physical energy during</i>
36	X		Ano, křeče v rukou, třes, neskutečné uvolnění	<i>Yes, cramps in his hands, tremors, unbelievable relaxation</i>
38	X		uvolnenie celeho tela	<i>relaxation of the whole body</i>
39				
40				
41				
42	X		Brneni v celem tele i obliceji, privaly energie, lehky tres.	<i>Armored in the whole body and face, energy, light tremor.</i>
43			Ano, teplo v dlanich, proudění vibrací celým tělem, pocit propojení koncetin s tělem, ruzny tres. . .	<i>Yes, warmth in the palms, vibration flow through the whole body, the feeling of connection of the limbs with the body, various tremors...</i>
44				
47				
48	X			
49	X		tres v rukou, oblicejove svaly byly aktivni, pohyb, tanec, velke uvoneni.	<i>tremor in the hands, facial muscles were active, movement, dance, great relaxation.</i>

(continued)



Table A1. Continued

PPT	Yes	No	Report (in Czech)	Report (in English)
50	X		třes celého těla, tělo v napětí ale také následně uvolnění, křeče v nohách a rukou, bolest na hrudi	<i>tremor of the whole body, the body in tension but also subsequent relaxation, cramps in the legs and arms, chest pain</i>
52				
53	X		svaly v napětí při prožívání opětovného porodu, výkřiky	<i>muscles in tension while experiencing rebirth, screams</i>
54	X		Příjemné uvolnění	<i>Pleasant relaxation</i>
55	X		Ano, mirne brnění v prstech na ruce	<i>Yes, lightly tingling in the fingers</i>
56	X		Třes nohou a panve, křeče v nohou od palce po lýtka, křeče v rukou od konečku prstu do předloktí. Vibrace na různých místech těla. Všechny fyzické reakce propojeny s nějakou silnou emoci, vzpomínkou.	<i>Tremors in the feet and pelvis, cramps in the feet from the toe to the calf, blood in the hands from the tip of the toe to the forearm. Vibrations in different parts of the body. Moreover, all physical reactions are connected with some strong emotion, a memory.</i>
57	X			
58	X		Tlak a horko a třes okolo pupku, pak následně uvolnění bylo osvobozující	<i>Pressure and heat and shaking around the navel, then the subsequent release was liberating</i>
59	X		Brnění v těle, samovolný pohyb končetin a těla nevycházející z vědomého "chtění". Různé pocity tlaku, tíhy, tenze.	<i>Armor in the body, spontaneous movement of limbs and body not based on conscious "wanting". Different feelings of pressure, heaviness, tension.</i>
60				
61	X		třes, strnulost, necitlivost, napětí v různých částech těla, které se za pomoci práce s tělem podařilo postupně uvolnit - zkušenost, že jde s tělem i emocemi uvězněnými v těle pracovat i jinak než jak to běžně (rizikově) dělám já.	<i>tremor, stiffness, numbness, tension in various parts of the body, which we managed to gradually release with the help of working with the body - the experience that it is possible to work with the body and emotions trapped in the body differently than I normally do (risky).</i>
62				
63				
65	X		těžké ruce třesy těla uvolnění ve fázích se zadržným dechem zahazování problémů pohybem rukou jako když zahazují kámen	<i>heavy hands shaking the body release in stages with held breath throwing problems by moving hands like when throwing a stone</i>
66	X		Mírný třes, po dýchání mám do jisté míry pocit mírného uvolnění celého těla.	<i>Mild tremor, after breathing I have a feeling of a slight relaxation of the whole body.</i>
67	X		Polití horka přes hlavu až na ramena a vzápětí zima po celém těle. Brnění na puse, v rukách a nohách. Ruce se mi zkroutily. Pláč, který vedl k uvolnění.	<i>Pouring heat over your head all the way to your shoulders and then the cold all over your body. Armor on the mouth, arms and legs. My hands twisted. Crying that led to relaxation.</i>
71				
72	X		Ano, od ztuhlých rukou, které ale bylo svým způsobem uvolňující a vedlo k uvolnění energie, po uvolňování energii v těle přes vyjádření hlubokého smutku který se uvolnil pláčem	<i>Yes, from stiff hands, which were in a way relaxing and led to the release of energy, to the release of energy in the body through the expression of deep sadness which was released by crying</i>
73	X		třes, křeče, uvolnění křečí a následné teplo	<i>tremors, convulsions, relief of convulsions and subsequent heat</i>
74	X			
75	X		Napätie v celom tele miestami až křeče a třes.	<i>Tension throughout the body in places up to cramps and tremors.</i>

(continued)



Table A1. Continued

PPT	Yes	No	Report (in Czech)	Report (in English)
76	X		Mírný třes, napětí svalů, bolest při práci s tělem = uvolňující a terapeutické	<i>Mild tremor, muscle tension, pain when working with the body = relaxing and therapeutic</i>
77	X		Uvolnění energie, napětí ve svazech	<i>Energy release, muscle tension</i>
78	X		třes, napětí, bolesti v břiše, u srdce, v hlavě, bolest zubu	<i>tremor, tension, abdominal pain, heart pain, headache, toothache</i>
79	X		Třes, tlaky v různých částech těla, brnění obličeje, energetické působení v různých částech těla	<i>Tremor, pressures in different parts of the body, tingling in the face, energetic action in different parts of the body</i>
80		X		
81	X		třes břicha, hlasité vzdechy	<i>tremor of the abdomen, loud sighs</i>
82	X		křeče v rukách, svalové napětí, křeč v zadní straně stehna - to vše když pomocí bodyworku polevilo, tak nastala obrovská úleva	<i>cramps in the hands, muscle tension, cramps in the back of the thigh - all when it eased with bodywork, there was a huge relief</i>
83	X		stažení čelistních svalů - zlepšení pomocí práce s tělem a masáže	<i>contraction of the jaw muscles - improvement through body work and massage</i>
84	X		Třes, svaly v napětí, ztuhlost, tlak na hrudi	<i>Tremor, tense muscles, stiffness, chest tightness</i>
85	X			
86	X		Ano, mé tělo se celé zprvu "zabalilo" do energie, cítila jsem energii v obličeji a v dlaních. Později jsem tělo příliš nevnímala.	<i>Yes, my whole body first "wrapped" in energy, I felt energy in my face and palms. Later, I didn't notice the body very well.</i>
87	X		třes, svaly v napětí i uvolnění, uvolnění a průchod energie tělem	<i>tremor, muscles in tension and relaxation, relaxation and passage of energy through the body</i>
88	X		Pociťoval jsem velké napětí v celém těle. Třes v rukách i nohách. Drkotání zubů a tlak v břiše.	<i>I felt great tension throughout my body. Tremors in my arms and legs. Teeth chattering and abdominal pressure.</i>
89	X		brnění celého těla, bolest břicha, bolest končetin, bolest na srdci, bolest v krku, fyzické uvolnění energie	<i>whole body tingling, abdominal pain, limb pain, heart pain, sore throat, physical release of energy</i>
90	X		Velmi příjemný a současně uvolňující-relaxační stav po zadržení dechu, která následovala po intenzivním dýchání. Blahodárné tělesné pocity pociťovány při bodyworkingu asistentu.	<i>A very pleasant and at the same time relaxing state after breath holding, which followed intense breathing. Beneficial bodily sensations felt during the assistant's bodyworking.</i>

