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IMMERSING IN THE WIM HOF METHOD: THE EXPERIENCES OF THE ATHLETES.

by

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Abstract

This study investigated the potential benefits of implementing the Wim Hof Method (WHM) in the Sport and Exercise context. The growing popularity of the Wim Hof Method in the sport and exercise population, along with an almost complete lack of research on the method highlights the necessity for research. The following two research questions were the focus of this exploratory study.: (1) What are the perceived benefits and underlying mechanisms of practicing the WHM in sports? (2) How do athletes incorporate the WHM into their daily routines? A screening survey and semi-structured interviews formed the basis of the research design. Both were conducted in an online environment. The survey was answered by 138 participants, while 8 interviews were included in the final version of the study. The interview guide was influenced by Elliott's (2008) Client Change Interview schedule, which attempts to assess certain therapies or interventions from the perspective of the client. Analysis of the responses demonstrated that athletes perceive the method to provide a variety of physical (endurance, recovery, strength) and psychological benefits (arousal and anxiety management, self-awareness). Additionally, practical guidelines for the implementation of the method were obtained. This research encourages the appliance of the WHM in Sport and Exercise, although it must be emphasized that further studies are necessary to make firm recommendations and develop specific protocols.

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Introduction

Wim Hof is a 62-year-old Dutch extreme athlete. He holds 21 Guinness World Records, mainly related to excessive cold exposure. Such feats include climbing Mt. Everest, running a half marathon above the Arctic Circle, wearing only shorts, swimming underneath the ice, being covered in ice cubes for nearly two hours, etc. (www.wimhofmethod.com).

Since 2009, scientists have been studying his method (The Wim Hof Method). Initial research (Kamler & Stewart, 2009; Kox et al., 2012, 2014; G. Buijze, 2014; Muzik, Reilly & Diwadkar, 2018) suggests that the WHM enables individuals to influence the immune and autonomic nervous system. Repercussions of these findings may be significant for public health, sports, and wellbeing. The three pillars of WHM are cold exposure, breathing, and mind training (Agarwal, Chovatiya, & Rana, 2020; Hof, 2020). The method's uniqueness is in the interaction of these three components, as opposed to various other techniques addressing individual aspects of the WHM (Bahenský, Bunc, Marko, & Malátová, 2020; Bahenský, Malátová, & Bunc, 2019; Houtman, 2018; Kox et al., 2012; Kox et al., 2014; Malátová, Bahenský, Mareš, & Rost, 2017; Muzik et al., 2018).

In 2019, RMIT University performed a survey to explore the experiences of WHM practitioners. Based on 3252 participants' answers average WHM practitioner has one year of experience in the method; takes a cold shower for up to one minute with the breathing exercise in the morning. The most frequently reported benefit was resistance to cold, followed by increased energy levels, mood, and focus. Improvements in general health, coping with stress, athletic performance, pain tolerance, and recovery were also reported.

The WHM has its roots in the Buddhist practice of Tummo breathing. This breathing method has been shown to increase the practitioners' body temperature to moderate fever zone (up to 38.30C, while being performed in subzero temperatures), accompanied by increases in alpha, beta, and gamma brainwaves (Kozhenikov, Elliott, Shephard & Gramann, 2013). Two key differences between Tummo breathing and WHM breathing are (1) WHM doesn’t have any religious background and (2) Tummo breathing includes visualizations of fire, whereas WHM does not.

Cold

During one of his World Record attempts, Wim Hof increased his core temperature while fully immersed in ice. After 75 minutes of immersion, his core temperature was at the lowest point of 31.5^0C (hypothermia usually occurs if the core temperature drops below 35^0C). However, he increased it in the next 25 minutes up to 34.5^0C (Kamler & Stewart, 2009). In a recent book, The Wim Hof Method (2020), the author claims every cold shower (CS) causes a drop in 15-30 beats per minute (after ten days of consistent practice), with the effects lasting up to 24 hours. This claim is partially supported in the literature; CS or cold immersions (CI) were shown to lower the exercise and recovery heart rate when used as a pre (Falls & Wibers, 1965; Michael Jr., 1957) or post-exercise intervention (Ajjimaporn et al., 2019). Those findings are of particular relevance in the athletic world, as lower heart rate (HR) is widely accepted as a crucial indicator of athletes' conditioning (Zavorsky, 2000).

Furthermore, one of the most frequently discussed sport psychology topics, pre-competitive anxiety, is correlated with an increase in HR (Fortes, 2017). Despite this interest, no one examined the connection between heart rate and consistent practice of CS to the best of the researcher's knowledge, but there are suggestions that cold exposure can lead to increased stress tolerance (Siems, 1993). Leppäluoto and colleagues (2008) observed an increase in cortisol, norepinephrine, and ACTH in an experiment where swimmers were asked to take part in cold water swimming 3 times per week for the duration of 12 weeks. In Huttunen, Rintamäki, and Hirvonen's (2001) research with experienced cold water swimmers an initial increase in the secretion of catecholamines after the first CI (beginning of the cold water swimming season) was observed, but the measures diminished after the 3month period. Results suggest that cold adaptation attenuates the secretion of hormones and neurotransmitters which play essential roles in stress response.

The first scientific case study of the WHM was conducted in 2012 by a Radboud University research team (Kox et al., 2012). Researchers aimed to analyze the effects of the method on Hof's autonomic nervous system and the innate immune response. In the first part of the experiment, Hof practiced his breathing/mindfulness technique for 30 minutes before being immersed in ice for 80 minutes while various blood tests were obtained. The results showed a

significant increase in cortisol levels even before immersion and then another increase during immersion, after which cortisol decreased to below-average levels. It is hypothesized that this proactive sympathetic stress response allowed the participant to prepare for CI. Meditation is generally associated with the reduction of stress and catecholamine/cortisol levels (Carlson et al., 2007; Witek-Janusek et al., 2008). According to Kox and colleagues, the WHM differs from other similar mindfulness techniques, as it can activate the nervous system rather than relax it. Importantly, the innate immune response was influenced as inflammatory proteins' production significantly reduced after the immersion compared to pre immersion measures. Remarkably, after six days, the participant's cells were still producing a lower number of inflammatory proteins, implying that there are long-term benefits from CI to be obtained.

In a more recent study, Muzik, Reilly & Diwadkar (2018) from Wayne University conducted multi-modal imaging assessments of the Wim Hof and the control participants' brains and periphery (fMRI and PET/CT) during cycles of mild hypothermia caused by wearing a specially designed suit. Hof' fMRI scan was acquired in two separate sessions: in a typical (passive) state and following the practice of WHM. When Hof was in an inactive state (he didn't perform his breathing technique), his skin temperature was comparable to the control group, and it had regular ups and downs caused by the cooling of the water in the suit. On the contrary, when he was performing the WHM breathing, his skin temperature slightly increased and stayed stable throughout the experiment. What stood out in the analysis is that Wim Hof “willfully activated parts of his brain previously thought to be inaccessible”. Namely, higher-order cortical areas (insula), part of the brain associated with self-reflection, and primary control centers for descending pain/cold stimuli modulation in the periaqueductal gray (PAG) area. The increased movement, sympathetic innervation, and glucose consumption in the intercostal muscle generated heat.

Another important finding which was in line with previous research on the method (Kox et al., 2014) was an increase in pH level, causing the blood to be more alkaline. An increase in pH is a possible pathway that explains why deep breathing can improve tolerance of a noxious stimulus, like the cold. A drop in pH activates pain receptors, but a rise in pH to around the levels achieved by hyperventilation can deactivate them effectively, improving the pain threshold. Increasing the pH levels was shown to improve muscle function in cyclists (Chaitow, Bradley, &Gilbert, 2014)

and hyperventilation-induced respiratory alkalosis enhanced cycling sprint performance in a study by Leithäuser et al. (2016).

Muzik et al. interpreted this data in the following way “It appears that hyperventilation induced activation of the sympathetic stress response primes the autonomic system through the release of stress hormones, with subsequent initiation of stress-induced analgesia mechanisms through cold external stimulus. This mechanism might mediate the release of endogenous opioids/cannabinoids in both the periphery (via the descending pain/cold suppression pathway) and the CNS (via connections to the medial PFC, anterior cingulate, and posterior insular cortex) leading to a feeling of euphoria, anxiolysis and a sense of wellbeing, which further promotes an attentionally focused (mindful) state that augments the analgesic effect of endocannabinoids”.

The authors concluded results provide initial evidence for the brain's priority (CNS) over the body (peripheral mechanisms) in mediating the participant's responses to cold exposure.

Breathing

Wim Hof's breathing protocol takes around 20 minutes to complete. The technique begins with 30-40 deep diaphragmatic breaths while inhaling more intensely than exhaling. After this period of hyperventilation (HV), a practitioner is advised to hold his breath (BH) after exhaling until the gasp reflex occurs and repeat the entire process three to four times. HV induces hypocapnia and elevates blood pH (Saladin & Miller, 2004), while BH causes respiratory acidosis (Pflanzer, 2004). BH after inhalation creates tension in the respiratory muscles, but retention after exhalation is calming and leads to increased CO2 tolerance (Chaitow et al., 2014; Courtney &Cohen, 2008). Breathing exercises focusing on maximal carbon dioxide retention in the lungs have been shown to increase antioxidant output, boost anaerobic threshold (Joulia et al., 2003), and improve physical fitness (Hruzevych et al., 2017; Salnykova et al., 2017). During the breath retention phase body enters a controlled hypoxic state, with blood oxygen saturation decreasing to 30-50%. The 2019 Nobel Prize in physiology was jointly awarded to Kaelin Jr, Ratcliffe, and Semenza, whose research focuses on the cell level effects of changes in oxygen levels, specifically the positive impact of low oxygen saturation.

Diaphragmatic breathing for stress management has a long tradition in yogic practices and meditation (Bhavanani, Sanjay, & Madanmohan, 2012; Brown & Gerbarg, 2005; Harinath et al., 2004). It is also an important part of several cognitive-behavioral interventions for general stress reduction (Davis, Eshelman, & McKay, 2008) Mindful deep breathing is also a core component of mindfulness-based stress reduction (Kabat-Zinn, 1990). Additionally, researchers at Stanford University (Yackle et al., 2017) were able to identify specific neurons in mice's brains that regulate both breathing rhythms and the balance between calm and arousal states. These neurons project on locus coeruleus, a brain center implicated in attention, arousal, and panic control. Hypoxic and oxidative stress are both examples of hormetic stress (Shevchuk, 2008). Epel (2021 in press) proposes that acute intermittent stressors of moderate-intensity (hormetic stress) can produce stress resilience, the ability for quick recovery, and possibly rejuvenation of cells and tissues. Cold exposure is another hormetic stressor (Macciochi, 2018).

In the previously mentioned Kox et al. experiment (2012), besides analyzing blood during cold immersion, researchers observed the breathing technique's effect on the inflammatory proteins before, during, and after administering a mild dose of E-coli bacteria. The participant only had a minor headache, compared with a historical cohort of 112 participants who experienced nausea, fever, shivering, and headaches. Hof was able to decrease the immune response by increasing epinephrine production and stimulating anti-inflammatory protein release, IL-10. After the endotoxin administration, the increase in cortisol was much more pronounced in the study participant than in the control group. Both plasma norepinephrine and epinephrine levels peaked after WHM breathing. The researchers suggested that Hof influenced his immune and autonomous nervous system to counter the effects of cold and bacteria. The data lead to a hypothesis that this technique evokes a stress response characterized by activation of the sympathetic nervous system.

In 2014, Kox et al. conducted a follow-up endotoxemia research, with 24 volunteers randomly assigned to control and experimental groups. Wim Hof trained the experimental group's participants for four days after which they continued practicing at their homes for another six days before being tested. Throughout the three hours of the experiment, they performed the breathing technique under the supervision of Hof. Changes in heart rate in hyperventilation and retention phases were very apparent, as well as a significant drop in oxygen saturation during the

third retention phase. The results of Kox and colleagues (2014) were comparative with the previous endotoxemia experiment. Participants who were practicing the technique experienced considerably fewer flu-like symptoms. In addition, they produced fewer pro-inflammatory proteins (TNF-α, IL-6, and IL-8) and more anti-inflammatory proteins (cytokine IL-10) compared to the control group. TNF-α is a protein that is secreted in states of fatigue (Moss, Mercandetti, & Vojdani, 1999). Importantly, experimental group participants' epinephrine levels profoundly increased 30 minutes after starting the breathing technique. Epinephrine levels in trained individuals were higher than those reported in a recent study in which acute stress was elicited by a bungee jump (van Westerloo et al., 2011). The effects on epinephrine are likely a consequence of both the hyperventilation phase and hypoxia due to breath retention, as both have been demonstrated to increase epinephrine secretion (Staubli et al., 1994; Mantysaari et al., 2011). In addition, the trained participants' results showed acute respiratory alkalosis, which normalized quickly after cessation of breathing (pH levels reaching up to 7.75), a significant decrease of oxygen saturation (dropping to 50% in some cases), and higher leukocyte concentration. The experiment confirmed a voluntary activation of the autonomic nervous system, which triggered an increase in epinephrine production. This resulted in the suppression of the activation of the immune system. However, this study design does not eliminate the possibility of a placebo. The authors wrote a follow-up study about how optimism and the mental expectation of the outcome affected the result (Middendorp, Kox, Pickkers, et al., 2014).

G. Buijze (2014) observed and took part in an expedition to Mt. Kilimanjaro. The goal was to utilize the WHM to prevent and reverse acute mountain sickness symptoms (AMS). The tour was led by Wim Hof and comprised 26 volunteers, inhabitants of low altitudes, non-athletes with little to no climbing experience. Some participants were diagnosed with multiple sclerosis, rheumatoid arthritis, and metastasized cancer. The ascent to the peak of Mt. Kilimanjaro (5895m) on average takes 4-7 days and is completed by 61% of trekkers. This expedition reached the summit in 48 hours with 92% of participants. None of the participants had severe AMS, and none had used any prevention method besides the WHM.

The “mind training”component

The mind training part of the method is not nearly as accentuated as the cold exposures and breathing protocol, both in practice (its merely mentioned as a recommendation) and research of the method. This is the reason why this component received less attention in the current study. It consists of breath and emotion-focused mindfulness meditations, visualizations, and body scans. Proposed benefits are increased performance and health through improving focus and attention, handling chronic and acute stress, etc. (Hof 2020). Meditation practice has been shown to allow the practitioner to influence the Autonomic Nervous System (ANS) (Green & Green, 1997; Benson et al., 1974). Practitioners could activate the parasympathetic response by influencing hearth rate oscillations in research by Wu and Lo (2008).

Mindfulness has been an increasingly popular topic in sport psychology research over the last decade and is now considered a common complementary mental skills training approach for athletes (Bühlmayer, Birrer, Röthlin, 2017; Birrer, Röthlin, & Morgan, 2012). One of the main areas of improvement suggested in the literature is handling stress and anxiety (Goodman, Kashdan, Mallard & Schumann, 2014). Visualizations and body scans are thoroughly researched themes in sports psychology (Weinberg et al., 2010; Filgueiras, Conde & Hall, 2017; Holmes & Collins, 2007; Cremades 2016).

WHM & Sport

There is no shortage of first-person accounts online of athletes' experiences with the Wim Hof Method, including Novak Djokovic, English Premier League club Burnley FC, MMA champion Alistair Overeem, Olympic athletes, NFL champions, and various others.

Recognizing the WHM's importance, Alistair Overeem stated that:

"On the day of the fight, I felt the nerves coming, but I just reverted to my breathing exercises that I've been practicing daily, and I just felt very calm, very calm on the fight day, very calm during the whole process. Of course, you feel a little tension, but every time I felt that tension, I went back to breathing, and I was calm. And I felt energetic. During the fight, I was breathing correctly. Usually, a fight is three rounds; I finished him on knockout at the end of the second

round. But I also wasn't tired. So, for my cardio, it really increased, just by breathing, breathing correctly."

Furthermore, Joey Barton, (at the time) a football player for Burnley FC described the effects of the WHM in the following way:

"I feel the benefits every time I do it; it allowed me to be a better teammate, allowed me to help my teammates do what they need to do, and you feel the benefits of having a clarity of mind."

These evidence can be found via YouTube (Wim Hof, 2017). Some sports-related topics mentioned in many other WHM testimonials are confidence, injury rehabilitation, focus, anxiety, breath, and energy management.

In the first scientific study about WHM in a sports context, Bahensky et al. (2020) compared two groups of 8 middle- and long-distance runners on various cycling tasks. Each round of cycling was preceded by either a seated rest or WHM breathing. Every participant in the test group was able to complete the final cycling task (4 W·kg-1), whereas 5 of the control group's participants dropped out. Significantly greater oxygen consumption was observed in the experimental group (2.4–4.9%; $p<0.05$), together with lower perceived effort (Borg scale) throughout the training session (18.5±1.2 vs. 17.4±1.1; $p<0.01$), and trend level decrease in heart rate following breathing exercises. These findings are led authors to believe that the WHM breathing may have accelerated the cardiorespiratory responses of their participants. Bahensky et al. speculate that breathing exercises “elicited a controlled stress response characterized by activation of the sympathetic nervous system”, and lowered heart rate is responsible for lower ratings of perceived effort in experimental group participants. The authors concluded that integrating a WHM breathing protocol in a warm-up routine may lead to an improvement in endurance performance.

As opposed to Bahensky et al. (2020), Langiewicz (2020) explored the effects of WHM breathing on an anaerobic task. A total of 16 medium and long-distance runners performed two trials of maximum effort wall-sit. The first one was without the breathing technique and the second (one week later) with the WHM breathing. Statistically significant increased duration of the exercise (11.3 seconds) across all participants was observed, coupled with trend level blood pressure and heart rate decrease. The authors concluded that although breathing exercise

managed to increase the duration of the wall sit, studies with a higher number of participants and more sophisticated equipment are necessary in order to understand the underlying mechanisms of the physiological changes observed.

Although no further research was done on the WHM specifically, cold water immersion is a significant area of interest in sports science and physiotherapy. It is considered as a method that helps to handle acute soft tissue injuries to reduce pain, swelling, metabolism, and inflammation (Knight, 2000) and is suggested as a way of preventing and treating muscle soreness in two recent literature reviews (Bleakley et al., 2012; Higgins et al., 2016). According to the authors, cold immersion resulted in significantly greater improvements in muscle soreness at four-time points (24, 48, 72, and 96 hours). Adding to potential recovery benefits, intermittent cooling of glabrous skin (palms and bottoms of the feet) in between sets of exercises caused a significant performance increase in sprint and strength exercises in collegiate athletes at Stanford University (Heller et al., 2015). There may also be a psychological mechanism whereby the body feels more' awake' with a reduced sensation of fatigue after exercise (Cochrane, 2004; Bleakley et al., 2012; Higgins et al., 2016). One article suggested that cold water increased mitochondrial activity in cyclists (Aguiar et al., 2016). In addition, there are examples of scientists exploring the effects of hyperventilation on sports and exercise performance. Implementing hyperventilation during recovery between rounds of cycling significantly improved performance in an experiment by Sakamoto et al. (2014), while pre-exercise hyperventilation enhanced 50m crawl performance (Jacob et al., 2015). Furthermore, the significant positive effects of respiratory alkalosis caused by hyperventilation on the Wingate anaerobic test (WAnT) were observed in research by Leithäuser et al., 2016).

Research suggests that regular deep diaphragmatic breathing (Prinsloo, Derman, Lambert, & Rauch, 2013) and cold exposures (Mäkinen et al., 2008; Mejía-Mejía et al., 2020) are related to an increase in chronic heart rate variability (HRV). HRV is the varying interval of the heart rate, where an increase reflects a greater capacity to handle physical (Dong et al., 2018), mental (Castaldo et al., 2015), and emotional stress (Arza et al., 2015). HRV is described as an increasingly popular method for optimizing training loads and managing recovery in a recent review by Dong (2016). Training plan based on HRV resulted in performance enhancement in cyclists (Javaloyes et al., 2018) It is important to notice, however, that these topics are not

thoroughly researched and therefore no firm conclusions cannot be provided; but the initial evidence suggests that an increase in HRV is a potential mechanism through which WHM could influence sport performance.

Initial scientific evidence suggests that Wim Hof Method (WHM) is a technique with a variety of health benefits, and it's increasingly popular across sports and other high-performance fields. Only two studies have examined the benefits of the technique in the areas mentioned above. This explorative case study aims to address this gap in the literature by answering the two research questions.

RQ1: What are the perceived benefits and underlying mechanisms of practicing the WHM in sports?

RQ2: How do athletes incorporate the WHM into their daily routines?

Method

Design

The study design consists of an online screening survey and a qualitative study for which semi-structured interviews were conducted. The methods are described separately below.

Screening survey

A digital survey was shared online on various Facebook groups, Subreddits, Instagram accounts, and Discord channels related to the method. A total of 138 responses were collected. This questionnaire was used to gather information on demographics, habits, and routines related to the method, motivations, and perceived benefits. These questions can be found in the appendix. After finishing the survey, participants were asked to leave their email in case they wanted to be contacted for a follow-up interview.

Online semi-structured interviews

Participants

The first selection criterion was the willingness to participate. Out of 136 participants in Study 1, there were 47 who expressed initial interest in the follow-up interview. However, only 17 agreed to schedule a video call. The second criterion was participants' experience with the Wim Hof Method, which was not shorter than 12 months at the moment of the interview. This criterion narrowed the list of potential participants to 13. As a result of numerous technical issues, and the interviewer's initial lack of interview knowledge, 5 interviews were excluded. Finally, 8 interviews were included in Study 2. It is important to add that all the participants compete, or used to compete, at at least regional, and at most Olympic level. All participants but one, are practitioners of martial arts. Two participants' (aged 40 and 39) main sport was Brazilian Jiu-Jiutsu, two participants were from Boxing (35 and 28), and one from MMA (36), Judo (33), and

Aikido background (38). The last participant was a 60-year-old tennis player. The majority of the participants (6) were involved in coaching in their respective sports.

Interview guide

The interview guide was heavily influenced by Elliott's (2008) Client Change Interview schedule, which aims to evaluate specific treatments or interventions from the client/patient perspective. It's important to notice that the interview guide was semi-structured in the sense that it was adapted for each participant depending on their answers on the survey. In general, interviews consisted of questions about motivations, experiences, suggestions for practice, perceived benefits, and attributions. The interview guide can be found in the appendix.

Procedure

The interviews were conducted by the researcher through Zoom video calls. Email communication in which participants were informed about the aims of the research and asked for permission to record preceded the interviews. Video calls lasted about 45 minutes on average, and the recordings were transcribed verbatim and coded for analysis. Transcripts were sent back to participants via email for member checking, along with additional questions that were deemed important after the analysis.

Data analysis

Every interview transcript was subject to categorical content analysis (Lieblich, Tuval-Mashiach & Zilber, 1998) with the purpose of developing a general knowledge about the major themes covered by participants in their stories. According to Lieblich et al. (1998) "The narrative story is dissected, and sections or single words belonging to a defined category are collected from the entire story or from several texts belonging to a number of narrators". The purpose of this "dissection" is to examine the thematic similarities and differences between narratives provided by several people. The strength of this form of analysis lies in its capacity to develop knowledge about the themes that make up the content of the stories generated. The data in this study was subject to line-by-line coding, from which initial themes evolved, and those were later merged

into a smaller number of more inclusive categories. All of the analysis was performed by one researcher.

Trustworthiness

Substantial efforts were taken to ensure the trustworthiness of the results in several phases of the research. First, credibility was achieved through prolonged engagement of the researcher with combat sports, and occasional engagement with the Wim Hof Method himself. Being a practitioner of the WHM was a potential source of bias, and this realization resulted in increased awareness of the steps needed to be taken to counteract it. A daily research journal was used from the 1st of September to the 14th of December with the goal of achieving reflexive objectivity by gaining insight into unavoidable prejudices and assumptions. One to three-week-long email communication with the participants preceding the interviews enabled initial rapport to be established, which should have increased the credibility. Additionally, open online communication was being kept with several researchers in the field.

Transferability is provided through detailed descriptions offered by the interviewees. The participants gave rich, detailed answers to the questions. Many topics were discussed more than once during the interview, and a high inter- and intra- subjective consistency were observed. Member checking of the (1) transcript and the (2) initial themes were employed to further enhance consistency. The triangulation of information was ensured through the use of different data types (survey results and interview transcripts), diverse data sources (age, ethnicity, level of engagement with both sport & exercise, and the WHM), and consulting with other researchers in the field during data analysis.

Quantitative Results

Demographics

The sample was predominantly male (81%). The mean age of the participants was 38, and the majority were located in Western Europe and the USA. 59% of the sample learned the method through free content, while 25% purchased an online course. The rest were involved in a face-to-face activity with Wim Hof Instructors. It's important to notice the importance of online presence for the WHM.

Different sports that were perceived as primary athletic activity by the participants are listed in Table 1. Running was the most frequent sport in the survey, followed by martial arts (Brazilian Jiu-Jitsu, Kickboxing, Judo, Taekwondo, Karate) and strength training (weightlifting, body weight, HIIT, calisthenics, CrossFit). Notably, a low frequency of team sports (basketball, football/soccer, and ice hockey) was observed. Participants practiced their sports 7 hours per week and had 18 months of experience with the WHM on average. Most of the participants (64%) were not competing in their respective sports, while 19% were local, 9% national, 4% regional, and 4% international level competitors. It's important to notice that 86% of the participants were amateurs.

Table.1 Primary athletic activity

Running	28%
Martial arts	17,5%
Strength training	17%
Yoga	5%
Swimming	5%
Cycling	5%
Team sports	5%
Other	17%

Perceived performance improvements

The question "Do you believe WHM improves your athletic performance?" asked participants to rate perceived improvements caused by WHM on a scale from 1 to 10. 77% of the responses

were “7” or higher (M = 7.65, SD = 2). The most common responses were “8” with 24% and “10” with 23% of the sample.

Table 2. shows in what percentage participants choose each answer to the question “Main reasons for practicing the WHM”. The participants weren’t restricted to the number of options they can choose, and this resulted in 749 responses from 138 participants. General health was the most frequent answer with 62% of the sample, followed by psychological reasons (mood, arousal, and anxiety management, mental health, focus, confidence, dealing with adversity) which were all in the range from 42-49%.

Table 2. Perceived benefits

General Health	62%
It helps me wake up/energize	49%
Mood management	49%
It helps me relax	48.5%
Mental Health	48%
Focus	45%
Anxiety management	42%
It improves my breathing when I perform	39%
Cardio Endurance	31%
Recovery	30%
Fatigue management	22%
Pain management	20%
Confidence	19%
Dealing with adversity	17%
Muscle soreness	14%
Other	7%

Competition experiences

One of the open-ended questions of the survey asked participants to describe their experiences with practicing the WHM on a competition day. Thirty-three answers were provided and coded into two themes, named psychological and physical effects. The theme psychological effects had 14 answers, mainly revolving around decreasing pre-performance anxiety and improving focus. Physical effects related to cardio and muscle endurance were mentioned in 16 answers.

Breathing habits

Participants usually (74%) do 3-4 rounds of breathing, and they repeat the exercise 5 or more days per week (62%). The breathwork is commonly done in the morning (41%), before training (15%), or before sleep (13%). 65% of the sample relies on the audio-guided sessions available online.

Cold exposure habits

Cold showers are the most common way of exposing oneself to the cold, as this answer was chosen by 72% of the participants. Cold exposures are similar to breathing exercises in terms of frequency as 69% perform them 5 or more days per week, 5minutes on average. Usually after training (25%), in the morning (25%), after breathwork (20%). It's important to notice a mistake in survey design, as answers "in the morning" and "after breath" most likely overlap.

Meditation & Yoga

WHM practitioners' meditation (33% 5+ days per week) and yoga (18% 5+ dpw) habits shouldn't come as a surprise, as the WHM heavily draws inspiration from these methods.

Qualitative Results

Following the transcription of the interview and extensive reading of the transcript, initial notes were taken. In the next phase of the analysis, line-by-line coding was performed. These codes were merged into more inclusive codes and themes, and from these, three distinct categories emerged. Physical benefits, psychological benefits, and practical guidelines for practice. The author understands that divorcing physical and psychological benefits is unnatural and inaccurate. The separation has been made purely with the goal of easier comprehension of the results.

Physical benefits

Participants provided rich data regarding physical improvements experienced related to practicing the WHM. This category is divided into two higher-order themes. Endurance and Recovery.

Endurance

Every participant in this research emphasized the significant improvements in their cardio endurance, attributed to the practice of the WHM. Participants reported being able to perform longer, lower perceived effort, and using brief pauses in performance to recover quickly. Explanations of these improvements varied. Some participants explained how regular practice of the WHM breathing protocol made them more conscious of their breathing, enabled them to breathe deeper and faster while they perform. It is hypothesized that the resulting increase in O2 and CO2 ventilation is responsible for endurance improvements.

‘’I’ve noticed, you know, because I think I’m the oldest guy in the gym and hearing the young people even notice. They said, Boy, you can go for a long time, you really couldn’t do that before, and I was like, yeah”.

Others underlined the benefits of doing the breathing protocol as close as possible to performance, as it “primes the body”, oxygenating the blood. Doing the breathing protocol regularly is also said to expand the lungs and increase the strength of the diaphragmatic muscle.

Besides breathing, three participants partially attribute their endurance improvements to cold exposure. Prolonged cold exposures in particular are described as a “cardio exercise” because of the physiological processes that the body performs to produce heat, which results in burned calories.

“I’ll do an ice bath maybe for just a few minutes, and then I’ll sit outside in the cold. And, you know, extend that cold exposure to maybe 30, 45 minutes being cold and it’s a, it’s a great

workout because your body is burning a ton of calories, right, you're all the physiological things that your body has to do to create heat is, is, is an exercise literally so, and your body's becoming more efficient and using oxygen, you have to continue to breathe in order to generate that heat so I do feel like just from an exercise perspective, the ice bath in itself is a good workout for the body. And, and I feel like it's increasing your VO2 max right your ability to convert oxygen into energy. So, yeah."

An alternative explanation that was offered was that the cold conditions the cardiovascular system to be more efficient by consistent vasoconstriction and vasodilation.

Another important result from the study is the reported increase in anaerobic exercises, such as push-ups and pull-ups. The majority of the participants observed a significant and acute increase in the number of repetitions on these exercises when combined with the breathing protocol, specifically hyperventilating in between sets and staying in the retention phase while performing the exercise (push-up or pull-up). One participant reported that besides breathing, he performs intermittent cooling of his hands in between sets of exercises.

"And then, mainly hammering home the breathing technique plus the push ups. And so, again, knowing what we know about hyper oxygenating the blood, it's like, of course, your arms aren't going to get tired as fast because they have oxygen and fuel to actually use, so…"

Recovery

A common view among interviewees was that the WHM plays an important role in the recovery process. Managing pain and minor injuries were the most frequently mentioned themes in this category. Data shows participants find the method particularly useful in healing joint and back pain. Lowering pain was mostly attributed to cold exposure after training sessions. It is important to notice that the majority of participants are involved in combat sports, and managing pain is a significant part of their training process. Another theme that was mentioned in half of the interviews was the method's attenuating effect on delayed onset muscle soreness (DOMS). It was suggested that taking an ice bath or a cold shower after the training session significantly reduces the inflammation in the muscles.

“And I don’t find that… I just don’t have that soreness and that stiffness that I used to have. The ice just sort of eliminates and tremendously reduces that.”

While some participants use the breathing protocol to “calm the mind” and fall asleep faster, for others, breathing is so energizing that if they do it in the evening, severe difficulties in falling asleep are experienced. As for the cold exposure, there is a consensus that it negatively affects sleep if performed late in the evening.

“I sleep better whenever I’m doing, and I don’t know. Maybe it’s the pH balance. Maybe it’s the, you know, the extra oxygen we are expelling carbon, I don’t know what it is but I know that I sleep better whenever I’m doing it consistently”.

Psychological benefits

Participants also described how WHM practice aided them in the psychological domain. Psychological benefits are divided into two higher-order themes. Psychological states and mental techniques.

Psychological States

The most apparent psychological benefit of the method is achieving a state of calmness, experienced both as a result of the breathing protocol and cold exposure. The word calm specifically is repeatably used in all 8 interviews. Descriptions like “In those moments, there is tremendous calm.” are used to describe the everyday experiences of those athletes.

“When you are in the ice you want to slow down, to be calm, when your body wants to go fast”.

“I get in that first minute and a minute and a half, suck every time. And then I’m able to really relax and my breathing is slow and calm. But that first minute I’m very focused on staying alive”.

“I only did short cold exposures before that because I like the adrenaline kick; the rush, but now I found out if you stay a little bit longer, the effect will be much more and you find this peace of mind in this very stressful situation”.

Comparisons with mindfulness practice were ever-present throughout the research, and many participants had experience with mindfulness meditations before starting the WHM.

Notably, many participants preferred WHM because it is more “active”, “there is something to do, instead of just staying still”, “WHM breathing is way more exciting”. WHM was even described as a “Next-generation mindfulness” by two participants.

The majority of the participants could recognize with no probing questions how the skill of achieving calmness while practicing the WHM translates to their sports. Staying in control in a stressful situation is vital in both contexts. This is the reason many interviewees use the WHM as a mental preparation on competition day. It is described as a “method of choice” for tackling pre-performance anxiety, and “controlling the nerves”. This is how one participant described his experience before the match with the favored opponent.

“I was even though this is like a controlled fight, you know, you still get pretty nervous before the matches; I knew I was at a disadvantage and I did a bunch of breathing before and I went out there it’s like nothing. I mean I was just totally calm and even my coaches noticed”.

It’s important to mention that 3 participants perceived helpful effects of the WHM on Covid related anxiety.

Several participants are using WHM as an arousal management tool. The technique was described as a caffeine-like energy boost or a caffeine substitute. The effects are said to last for several hours. Interestingly, both cold exposure and breathing protocol are being practiced for this purpose. These participants rely on the energy increase before competitions and training sessions. Some of them recalled several situations in which they’ve experienced a “slow start” as a result of not performing the breathing exercises prior to a training session.

“I don’t necessarily start my workout as fast, because I have to get everything going and stuff like that and so it definitely makes a performance difference in practice. I always do it before competition. So, I’ve never tried it. I’ve never tried not doing it in competition.”

State of heightened awareness is another potential psychological benefit achieved after practicing the method. Several participants reported that cold exposure is viewed as a tool to improve focus. One participant, in particular, provided a detailed explanation.

“I’ve noticed that, after surviving the first 10-20 seconds in the water two different things can happen Either I remain completely focused on being in the moment, relaxed, breathing and I have an enjoyable experience, or I let my thoughts wander to what I am gonna do today and have a miserable, trembling experience. So sustaining your focus for 3-4 minutes is very desirable. And this translates to my sport perfectly, but also my relationship with my girlfriend”.

Body awareness was unsurprisingly mentioned several times in the interviews. In many audio-guided sessions available online, Wim Hof encourages practitioners to explore their bodily sensations while doing the breathing exercise. The majority of the participants were able to recognize the importance of body scans.

“What I noticed, though, in my retention, that I was holding more tension in my body than I needed to, to hold my breath. And it wasn’t a lot. But it was more than was necessary.”

Mental Techniques

Very detailed descriptions of imagery practice related to the method were provided.

“I spend like 5 or 10 minutes before. I’m sitting I close my eyes, and I try to visualize all the process I’m going to go outside I’m going to swim in the water I am going to breathe. Just focus on the breathing, how I am gonna feel, it will burn in my feet, my arms. My breath will go faster and faster, so I need to focus to slow it down. I try to visualize also when I am going to go out of the water. It’s going to be tough because I don’t feel my leg and my arms I have to warm up with horse stance for like 5 10 minutes. And how I prepare I’m going to take a towel, go back inside. I am going to get close to a fire and take a cup of tea. All of this I try to visualize in my mind to do

like a movie inside my head. This helped me not to get too much stress when I am going to water. And then I know the process I know I need to follow the process and then at the end of the process is going to be okay and is going to be warm".

Surprisingly, three participants reported using the WHM to teach sport-related imagery to their students. Similarities of physiological reactions before going into the cold and before competition are said to be of particular importance.

"And then when we do the ice bath training I asked everybody, you know, to step up next to the ice bath and look at the ice and visualize you're about to rock onto the mat, and you start to feel the same butterflies like when you're about to get an ice bath, you're a little nervous and like you know this is going to suck. And so if you can stay calm and maintain that focus you train that in the ice bath, exercise, and then when you get to the real competition. It happens automatically."

Interviewees also provided rich data about self-talk without being probed to do so.

"And it's exhilarating. But then once you say no, I'm, I'm intentionally putting myself in this position in this stressful place, and it's going to be okay, I'm going to gain the benefit from doing this."

Practical guidelines

This category focuses on practical information obtained from the interviews regarding the initiation and implementation of WHM practice. The first theme explores the initial phase of practicing the method. Participants shared their views on what attracted them to start and sustain their practice. Several interviewees talked about how reading scientific articles about the method helped in lowering their skepticism towards it. Unsurprisingly, for many of them, it was the push up exercise demonstration that provided instant positive feedback.

"The push-up exercise is great because it's very eye-opening. If you say hey, do these three rounds of breathing and then see how many push ups, you can do. And then if they do more push-ups than they thought they could do, they're gonna be like, what's going on here that's pretty cool."

Other ways of objectively measuring the acute and chronic effects of the method were also deemed important. It was reported that resting heart rate was significantly lowered after a couple of weeks of cold showers; pH strips were used to show an acute increase in alkalinity after the breathing protocol; using oximeters to measure acute changes in oxygen saturation. In general, participants agreed on the timeline for substantial effects of the method. Answers were ranging from 2 to 4 weeks of everyday practice. This relatively short time frame proved to be one of the most important factors in maintaining the habit. It's important to notice that most of the participants described having a pressing need to start practicing the method (an injury or a health condition). The opinion of these interviewees is that without these clear goals, their motivation for the WHM would be significantly lower.

The method owes its popularity to a substantial online presence and ease of access to educational materials. There is an abundance of free YouTube audio-guided breathing sessions, podcasts, documentaries, and explanatory videos. All of the participants spoke about utilizing these to gain knowledge about the method. Several participants enrolled in paid online courses, and two of them were involved in 7-day training camps with Wim Hof in Poland. Finding the time and maintaining consistency are the biggest challenges that were talked about in the interviews. Most participants prefer doing the breathing protocol and cold exposure as a part of their morning routines. There was a single case of performing the breathing exercise as a way of relaxing before sleep. All participants are mindful of the plasticity of the method and the need for adapting it to one's preferences. A slower breathing rate is generally used to relax, while faster breathing is perceived to be energizing. The majority of the interviewed athletes use the breathing protocol before and during their training sessions and are relying on them on the competition day.

"We say fight is on Sunday for example or Saturday so 2-3 days before we do a lot of breathing everyday in the morning. You wake up and you do breathing. Like 4 or 5 rounds of breathing when you wake up. So fight day you do the same. Let's say the fight is in the evening so you wake up in the morning and you do breathing. 5 rounds, and then you go for the press, weight in and all this stuff. Go back to your room you take a nap, wake up in the afternoon, go back to breathing, lot of breathing and it's like you are fully charging your body with a lot of good

oxygen during the day and I think last round of breathing should be at least 2-3 hours before the fight".

It is recommended to do 2-4 rounds of breathwork before training or competition. In addition, participants are using 1–2-minute breaks in their respective sports to significantly increase oxygen intake in order to recover.

Routines related to cold exposures provided more mixed results. While some participants use cold showers and baths as a recovery after physical exertion, others prefer doing them before with a goal of increasing arousal while preparing to perform. It's important to underline the importance of gradual exposure to cold.

"Everybody wants to do their full immersion immediately. I think that that's a turnoff for a lot of people, I think it's too shocking and too abrupt and too harsh for a lot of people. So, if somebody wants to really do this method, I think that they need to do it slowly. And progressively".

All participants agree that in order to obtain the best results, the synergistic effect of breathing protocol, cold exposure, and mind training is crucial. Interaction of the method with yoga and mindfulness meditation also seems important.

The social environment is a significant factor in practicing the method. Participants mostly describe positive aspects of practicing in a group of people; motivational support makes it easier to enter a cold bath and creates a bond in the group. Two participants described how their MMA team cohesion increased as a result of regular cold baths. Some athletes, on the other hand, prefer doing cold exposure alone, as it's more challenging and is considered as more of a "mental training".

"I think for people is really easier to go in a group because they feel stronger. They feel like it's kind of team building stuff. Because I say wow, we are together we do it together. Let's go together we are stronger we do it and there is some kind of emulation and it excitation shared with a group. So, there is more chance that you're going to do anything to succeed if you are not alone for sure. But for myself, when I want to do it and I want to face myself and my mind I like to do it alone. Because no support and I cannot rely on the support of other people to cheer me

up. So, for me, it's more like the truth. You can do it or you cannot but it just you and you so when I want to train for myself, not physically but mentally. I like to go alone because I have to deal with myself."

The negative influence of social environment is evident in some athletes' experiences of being self-conscious if other persons observe their breathing exercise. Pressure from significant others to stop exposure to extreme temperatures is also present in some cases.

Discussion

The aims of this study were a) to explore perceived benefits and underlying mechanisms of applying the WHM in sports context b) to give insight into how the method is being implemented and create guidelines of good practice accordingly. Congruence in results from both the screening survey and the interviews indicates that the WHM could be a useful tool for athletes. There are numerous physical and psychological benefits reported, including endurance, focus, anxiety, and arousal management. The method's ease of access, vivid body sensations, and the possibility of objective measurement are the reasons which make it an attractive proposition for athletes.

Physical benefits

Endurance

The data observed is in line with many athlete testimonials (Wim Hof, 2016) and previous literature on WHM. (Bahensky et al., 2020; Kox et al., 2014). Cardio endurance is one of the most frequently mentioned physical benefits in both parts of the study. Several possible pathways can explain the method's influence on endurance. Participants reported that the breathing exercises preceding training sessions condition the diaphragmatic muscle and primes the body by "oxygenating the blood". Those attributions, like many others, were quite speculative, using terms like "maybe" and "perhaps".Being more conscious of one's breath during a performance was also judged as vital for endurance improvements. According to Cohen

(2018), the WHM allows the practitioner to manipulate the levels of pH, CO2, and O2. The pH can be increased by hyperventilating, which decreases the levels of CO2. The opposite is true for breath holds, pH levels drop while the amount of CO2 rises (this effect can be enhanced by performing pushups during BH). To lower the amount of O2 the practitioner should do a BH after exhaling, which blows excess CO2, and removes the stimulus to breathe. This allows for a dramatic drop in oxygen saturation.

Observable anaerobic strength improvements in exercises such as push-ups and pull-ups were frequently reported. This is in line with numerous online testimonies and self-made experiments. Kox et al. (2014) reported drastically increased epinephrine levels, lowered secretion of TNF-α (protein secreted in states of fatigue), decreased inflammatory proteins, and higher pH values in the experimental group performing the WHM breathing exercise. Cold showers can also partially explain improvements in athletes' endurance as they are related to lower heart rate (Falls & Wibers, 1965; Michael Jr., 1957; Ajjimaporn et al., 2019), reduced sensation of fatigue after exercise (Cochrane, 2004; Bleakley et al., 2012; Higgins et al., 2016), and increased mitochondrial activity (Aguiar et al., 2016). Another potential pathway of endurance improvements might be an increase in HRV, as research suggests that regular deep diaphragmatic breathing (Prinsloo, Derman, Lambert, & Rauch, 2013) and cold exposures (Mäkinen et al., 2008; Mejía-Mejía et al., 2020) are related to an increase in chronic HRV. Reported intermittent cooling of one's hands between sets of exercises was informed by already mentioned work of researchers from Stanford University (Heller et al. 2015).

Recovery

Participants described using the WHM, and especially cold exposures (CS, CI) as a fundamental part of the recovery process. Literature suggests attenuating effects of cold on fatigue (Cochrane, 2004; Bleakley et al., 2012; Higgins et al., 2016). Due to cold being widely applied as a recovery method across sports, this result comes as no surprise. Breathing exercise also have a role in improving recovery according to some participants, which might be explained by an increase in pH value and sympathetic activation of the ANS (Kox et al., 2014, Muzik, Reilly & Diwadkar, 2018). Interview data is in line with the previous research regarding pain management (Knight, 2000) and delayed muscle soreness (DOMS) (Bleakley et al., 2012; Higgins et al., 2016),

although DOMS were mentioned in only four interviews. This might be due to participants implementing cold showers to energize the body before exercise, as opposed to being part of post-exercise recovery. The WHM effects on initiating sleep provided mixed results. Participants agreed that CS or CI at later hours leads to difficulties in falling asleep. In a survey performed by Allan (2018), 15% of participants reported the WHM's harmful effects on sleep. Increased amounts of cortisol caused by a cold shower (Leppäluoto et al., 2008; Kox et al., 2012) may be responsible as this hormone generally peaks in the morning and negatively affects sleep when secreted in the evening (Hirotsu et al., 2015). Breathing protocol activates the sympathetic system (Kox et al., 2014, Muzik et al., 2018), but some participants insist that slowing down the tempo of the breathing calms them down, and helps them fall asleep. There is some support for this notion in the literature as Cohen (2018) suggests that longer BH may lead to a parasympathetic response.

Psychological benefits

The participants were in complete unison regarding the calming/relaxing effect of both breathing and cold protocols. A significant body of research data supports this notion. Whereas retention of breath after inhalation creates tension and pressure in the respiratory muscles, creating temporary hyperinflation that prevents relaxation and proper emptying of the lungs, a hold after exhalation is more relaxing and may lead to an increase in CO2 tolerance (Chaitow, Bradley, &Gilbert, 2014; Courtney &Cohen, 2008). One study was able to identify specific neurons in the brain that control breathing and arousal states in mice (Yackle et al., 2017). Participants in this study provided rich descriptions of using WHM breathing on a competition day as a successful way of lowering precompetition anxiety. Athletes often make the mistake of taking shallow breaths when faced with the adversity of competition. Deep diaphragmatic breathing has a long history of serving as a stress-reduction tool in yogic practices (Bhavanani et al., 2012; Brown & Gerbarg, 2005; Harinath et al., 2004), CBT (Davis et al., 2008) and mindfulness therapy (Kabat-Zinn, 1990; Goodman et al., 2014). In the Radboud case study (2012), Hof significantly increased his cortisol level by breathing, followed by a decrease to levels below the initial measurement. Higher-order cortical areas associated with self-reflection (insula) that he activated in the Wayne University study (2018) might have a role in lowering anxiety. Data from both previous and recent studies suggest that WHM type of breathing can be used to activate the

sympathetic (Kox et al., 2012; Muzik et al., 2018) nervous system, but some of the participants of this study argue that by lowering breath rate parasympathetic response can be achieved. Based on the previous literature (Cohen, 2018) it seems that shorter breath retention leads to sympathetic, whereas prolonged retention results in parasympathetic innervation.

Cold exposures also provided similar psychological effects, but the descriptions leaned more towards heightened arousal, and improvements in focus and awareness. These improvements were attributed to intentionally staying calm and focused on something specific (usually breath, but also objects in the visual field) in the presence of an adverse stimulus (cold). Inhibiting the shivering reaction was an essential part of this process. Inhibitory control is an executive function fundamental to behavioral self-regulation. It has recently been shown to be of the utmost importance for athletic endurance because it prevents task disengagement in high-intensity physical tasks (Angius et al., 2019; Pageaux et al., 2014; Cona et al., 2015). Stimulating the dorsolateral prefrontal cortex (area of the brain crucial for inhibitory control) resulted in a significant reduction in perception of cold in several neuroscience articles (Mariano et al., 2016; Mylius et al., 2009). Vastly increased cold tolerance being the most frequently cited benefit of WHM, in the previous research (Allen, 2018), it is possible to suggest that CS or CI might be beneficial for the brain's inhibitory control system, as immersion in cold water requires an act of will to initiate and maintain.

Similarities of the WHM with mindfulness meditation were frequently mentioned in the research. The major difference between the two is that in order to achieve mindfulness relaxation, a WHM practitioner intentionally goes through substantial excitation (both breathing and cold). It might be hypothesized that WHM is more appealing to some athletes than traditional mindfulness meditations, as a result of more intense bodily sensations and increased activity of the practitioner.

Detailed descriptions of psychological techniques, such as imagery and self-talk, were of particular interest. Not only did the participants implement those techniques to help them tackle the unpleasantness of cold exposure; but also used the unpleasantness of cold exposure to teach their students how to use psychological techniques in sport-specific context. Participants believe that visualizing the competition while preparing to go into the cold is highly beneficial to their

students because of similarities in physiological reactions in both contexts. These notions came as a big surprise to the researcher.

This data suggests the WHM might be used in sport psychology consultations, as a tool for teaching the mechanisms and value of imagery and self-talk techniques.

Practical guidelines

A series of practical guidelines were obtained during the interviews.

The ones revolving around the initial phase of practicing the method are mainly oriented towards increasing motivation to start and lowering skepticism. Reading the scientific articles about the WHM and regularly measuring parameters such as heart rate, oxygen saturation, and pH value were frequent recommendations. Observing instant improvements on push-up exercise was unsurprisingly reported as the most potent way of creating buy-in. It is important to notice, however, that majority of the participants had a specific injury or health condition that motivated them to start practicing the WHM.

Interestingly, a relatively short time frame before significant improvements were observed was agreed upon between the participants and ranged between 2 and 4 weeks of consistent practice. Availability of learning materials online was another positively contributing factor. Regarding the implementation of the method, the possibilities of adaptation towards one's schedule and preferences were underlined. In general, it was judged to be important to develop some kind of consistent routine. Practicing the WHM in the morning and before the performance was favored by participants in the present study.

There is a social aspect of the method that requires serious consideration. If performed in a group setting, cold exposures are estimated to be easier due to the support of others and can have positive effects on the chemistry of the group. But according to some participants, if the goal is to increase “mental toughness” it’s more beneficial to practice alone. Breathing exercises can also be enhanced in a group if everyone is performing them, but some participants feel uncomfortable if other people are observing their practice.

Safety considerations deserve special attention because of the nature of the WHM. Participants identified several guidelines that are also present on various internet presentations of the method. Breathing exercises should only be performed in a safe space, not while driving, not while in the water. Cold exposure should be gradual, never longer than 10 minutes. If performed in nature, another person should always be present.

Limitations

Several limitations of this study should be mentioned, besides the inherent limitations of self-reported data.

Firstly, the lack of prior research studies on the topic caused exploratory rather than an explanatory research design to be adopted for this study. Secondly, only one interview was conducted with each participant. Considering the plurality of WHM components and potential areas of effect, several interviews with different topics might be more appropriate. Thirdly, participants in this research were asked to describe events that occurred in the past. Those recollections might have involved memory decay and reinterpretation of events. To reduce the risks associated with the retrospective recall, the interview questions encouraged participants to describe their experience with the WHM in chronological order. And lastly, participants' positive opinions of the method could be attributed to being exposed to the same online content (usually designed by the WHM organization).

Conclusions

In summary, both past and present research suggest potential psychophysiological benefits of the WHM appliance in sport, exercise, and broader context. This study aimed to address the gap in the literature regarding the appliance of the method in sport, and it provides encouragement for the appliance of the WHM as an arousal management tool, with the added benefits of endurance and recovery enhancement. However, it must be underlined that the science behind the method is in its initial stages. Additional investigations are necessary to validate these kinds of conclusions.

Future research should certainly aim to avoid the limitations of this study. An experimental design with participants who have no prior knowledge of the WHM to lower the placebo effect is needed. The author suggests a 4 weeks intervention (led by a certified WHM instructor), with regular interviews and measurement of physiological parameters of the participants before, during, and after sport or exercise activity.

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Appendix: Interview guide

1. General Questions.
    a. How are you doing now in general?
    b. How has it been since you started practicing the WHM?
    c. How did you get into the method?

2. Reasons:
    a. You have mentioned the following reasons for practice in the survey. Anything you would like to add?
    b. Have you noticed any improvements on any of those?
    c. How significant are they?
    d. How likely you think these improvements would have been if you hadn't been practicing the method

3. Negatives?

4. In general, what do you think has caused the changes you described?

    a. Can you provide a timeframe?

5. Resources:
    a. What personal strengths do you think have helped you make use of the method
    b. What things in your current life situation have helped you make use of the practice to deal with your problems and obstacles?
6. Limitations
    a. What things about you do you think have made it harder for you to use the method to deal with your problems? (things about you as a person)
    b. What things in your life situation have made it harder for you to use the method to deal with your problems? (family, job, relationships, living arrangements)

7. Examples of most pleasurable experiences with the method

8. Routines? Around training and comp?

9. If you were the coach how would you structure the training to implement WHM
    a. Any suggestions for fellow athlete practitioners of the WHM
    b. Any suggestions on how the method can be adapted to better serve athletes?