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Sea swimming as a novel intervention for depression and anxiety - A feasibility study exploring engagement and acceptability

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ABSTRACT

Background: Outdoor swimming is increasingly popular, with enthusiasts claiming benefits to mental health. However, there is limited research into its effectiveness as an intervention for people with depression and/or anxiety. We aimed to establish recruitment rates and explore potential benefits, for a sea swimming course offered to people with depression and/or anxiety.

Methods: This was a singlearm, unblinded feasibility study. 61 participants, were recruited to an eight-session sea-swimming course. Attendance rates were recorded. Self-administered questionnaires were completed at baseline, post-course and at three-month follow-up. Free-text descriptions of thoughts about the course were collected using surveys, and 14 participants kept a diary.

Results: 53 participants (47 female, 5 male, 1 non-binary) were included in the final analysis. Overall attendance was 90.1%. There were reductions showing large effect (between $d = 1.4$ to 1.7) in the severity scores of both depression and anxiety between the beginning and end of the course. While severity scores marginally increased at three-month follow-up, a reduction from baseline scores for depression, anxiety ($d = 1.2$ and 1.4, respectively) and functioning scores ($d = 0.8$) remained. The qualitative analysis identified that 'confronting challenges', 'becoming a community' and 'appreciating the moment' were key to the impact, or the 'mechanisms', that resulted in participants experiencing the 'outcomes' of 'immediate positive changes in mood', 'improved mental and physical health' and 'increased motivation to swim'.

Conclusions: This study provides preliminary support for the engagement and acceptability of sea swimming as a novel intervention for depression and/or anxiety. Participants reported positive changes in mental health, indicating the intervention's potential as a public health resource. There was a clear gender difference, which requires further exploration. Larger scale trials are warranted.

1. Introduction

The prevalence of depression and anxiety is high in the UK, a situation exacerbated by the SARS-CoV-2 pandemic. The proportion of adults experiencing depression doubled to nearly 1 in 5 between March and June 2020 (Office for National Statistics, 2020) and more than 76 million antidepressants were dispensed in the community in 2019–20, a 23% increase from the 2015–16 figures (NHS Business Services Authority [NHSBSA], 2021).

The National Institute of Health and Care Excellence (NICE) recommends a range of talking therapies, as well as antidepressants, for people experiencing depression (National Institute for Health and Care Excellence [NICE], 2018). These include low intensity psychosocial interventions for people with mild to moderate depression, such as supported self-help, and high intensity psychological interventions for those with moderate to severe depression, including Cognitive Behavioural Therapy (CBT). In the UK, high numbers of therapists have been appropriately trained and employed to provide these therapies, as a result of the Improving Access to Psychological Therapies (IAPT) program. Access is through self-referral, primary care or voluntary service referral. Many other countries are not in such a fortunate position (National Collaborating Centre for Mental Health, 2020). However,

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despite increased availability of NHS talking therapies, demand and waiting times continue to grow.

In addition to talking therapies and medication, the NICE guidelines for depression (National Institute for Health and Care Excellence [NICE], 2018) also recommend exercise. An in-depth systematic review (Cooney et al., 2013) to determine the effectiveness of exercise as a treatment for depression, concluded that exercise has a moderate effect compared to no exercise and is as effective as pharmacotherapies or psychological interventions. Exercise referral schemes (ERS), that aim to increase physical activity levels in those who lead a more sedentary lifestyle, also have added benefits such as helping people to socialise that can additionally support mental health. Guidance for these schemes have been developed (National Institute for Health and Care Excellence [NICE], 2014), however research suggests they are delivered inconsistently across the UK and there is limited research into their success in the 'real world' (Dugdill et al., 2005).

Being out in nature, in itself, has been shown to have a range of positive effects on mental health. Moving to live in greener urban areas was associated with sustained mental health improvements (Alcock et al., 2014). A qualitative evidence synthesis of socially prescribed nature-based activities showed broad and wide-reaching perceived impacts on wellbeing, mood and functioning from participants (Garside et al., 2020). Contact with nature, three times a week for 10 min or more was shown to significantly reduce salivary cortisol concentrations (Hunter et al., 2019) and green spaces have even been proposed as an effective way to reduce socio-economic differences in mental health (Mitchell et al., 2015). The positive effects of contact with nature were also demonstrated during the pandemic: a study based on 5218 responses from nine countries, found that lockdown severity significantly affected mental health, while contact with nature helped people to cope with these impacts, especially for those under strict lockdown (Pouso et al., 2021). While the evidence for the beneficial effects of exercise in depression is well established (Cooney et al., 2013), latterly there has been a focus on the additive impact of the environmental setting e.g. urban vs natural. A recent systematic review (Wicks et al., 2022) found large effect sizes in favour of the natural environment (e.g., green spaces) for anxiety, positive affect and a small effect size for depression. Positive affect was also increased in a group setting. This study focused on walking and running rather than swimming as an activity and results were subject to high risk of bias and heterogeneity. Physical activity in nature may be more 'sustainable' with future intent linked to the greater positive impact exercise has in these settings (Focht, 2009).

With a growing demand for NHS mental health services, there is an increasing emphasis on how preventative and community-asset based approaches to mental health can be introduced (NHS England, 2019). If successful, this would benefit individuals, communities and society (Pizzo, 2020) through achieving a sense of purpose, improving wellbeing and reducing loneliness. The demand for medical resources and the associated financial costs could also be reduced. NHS England has committed to increasing the number of workers that can support people to access community-based activities (NHS England, 2019). Varyingly called navigators, connectors, social prescribers and link workers, their role is to identify and match appropriate community resources with the people who would most benefit. However, the impact of any community-based activity and for whom it might help most should be ascertained before it is included as a signposting option (Garside et al., 2020).

As early as 1581, sea bathing was recommended for health and wellbeing in the UK. Its popularity grew during the 18th century and continued into the Victorian era. During the latter part of the 20th century the number of people sea swimming dropped (Parr, 2011), however, it has recently enjoyed a resurgence. The Active Lives survey found that 266,500 people went open water swimming in the 28 days preceding survey in 2017, rising to 504,800 in 2019 (Sport England, 2019). Further increases in outdoor swimming participation have occurred during the pandemic. A recent report indicated that there were more than one million regular outdoor swimmers in the UK in 2020, which is a 1.5-to-3-fold increase on the previous year (Outdoor Swimmer, 2021). Many enthusiasts report benefits to mental as well as physical health (Massey et al., 2022).

Whilst progress has been made in understanding the physiology and adverse effects of cold-water immersion, there has been less research into how it might be helpful for health and wellbeing (Tipton et al., 2017). Qualitative research exploring the experience of regular swimmers, to better understand the benefits they gain from the activity (Denton & Aranda, 2020; Foley, 2015), suggest restoration, challenge, social interaction, and connection with nature as contributing factors (Denton & Aranda, 2020; White et al., 2020). A case report documented the significant impact of open water swimming for a young woman with treatment-resistant depression (van Tulleken et al., 2018) and in a national survey respondents reported reduced symptoms of anxiety, depression, pain and migraine (Massey et al., 2022). The therapeutic potential of other 'blue space' interventions has also been investigated, and a recent systematic review found that blue care can have a direct benefit for health, especially mental health and psychosocial wellbeing (Britton et al., 2020).

Investigators have highlighted several physiological mechanisms that may support the use of cold-water immersion to promote health that suggest benefits beyond those of simply engaging in exercise (Harper, 2012; Tipton et al., 2017). Acute whole-body (head out) exposure to cold-water increased anti-inflammatory markers (Ullevig et al., 2018), with repeated immersions priming both immune and inflammatory responses (Janský et al., 1996). Additionally, vagal nerve stimulation, triggered by immersing the face in cold water, may reduce inflammation (Bonaz et al., 2016). As raised inflammatory status has been linked with depression (Canli, 2014), cold-water immersion may reduce the inflammatory status and therefore reduce symptoms of depression (Tipton et al., 2017). There are also risks associated with open-water swimming, which can include panic attacks, cardiac arrythmias, hypothermia and drowning (Tipton et al., 2017).

Despite a solid physiological basis and strong anecdotal evidence for the positive effect of outdoor swimming on mental health, to date, no clinical trials have studied its acceptability as a therapeutic intervention. Our aim was to assess the feasibility of conducting trials of outdoor swimming for participants living with symptoms of depression and anxiety. Primarily, we aimed to establish recruitment rates for a sea swimming course and follow up period. Secondly, to trial data collection methods for quantitative, qualitative data and biological markers of inflammation and finally to establish whether the sea swimming intervention study might be beneficial for participants and therefore worthy of further investigation.

2. Material and methods

2.1. Study design

Ethical approval was granted from the Health Research Authority (HRA) and the London-City & East Research Ethics Committee (REC) (REC reference: 20/LO/0725 IRAS project ID: 277692) and registered with clinicaltrials.gov (NCT04528485). Sponsorship was provided by the Devon Partnership NHS Trust (DPT). All participants provided written informed consent for their data to be used in the research.

This was a single-arm, unblinded feasibility study in patients with depression and/or anxiety. A total of eight groups ran in 2020: two in July and a further six between October and December. The number of groups was based on the availability of funding and safety cover. The maximum in each group was eight, in order to ensure safety and social distancing. Each course was at a fixed location (one of three beaches) in North Devon and consisted of eight sea swimming sessions that took place either over a period of four weeks (two/week) or eight weeks (one/week). An experienced coastguard and lifeguard ran the sessions and completed thorough risk assessments prior to each one. They were

supported by additional lifeguards and mental health support was available through the research team.

A typical session would last 40–50 min. It would start with 5 min of gentle stretching, followed by a small jog or walk depending on the participant. They would then enter the water and over the weeks engage in the following activities, depending on confidence and ability:

- The process of cold-water acclimatisation
- Running/walking into the water, out to a lifeguard, round the lifeguard and back (water up to the waist).
- Repeating the same exercise but introducing dolphin dives.
- Repeating the same exercise but now going deeper and possibly out over head height (depending on competence of swimmer and conditions).
- Teaching the technique of body surfing.
- Going for a short swim (with 2 lifeguards on rescue boards)

The time in the water was no more than 30 min.

2.2. Study population and recruitment

The initial protocol aimed to recruit participants over the age of 18 with mild to moderately severe depression through primary care and social prescribers. This was to be based on a Patient Health Questionnaire, 9-item version (PHQ-9) score of 5–19. However, amendments were necessary due to the impact of the SARS CoV-2 pandemic on access to services. Eligibility was therefore extended to anyone over the age of 18, who was subjectively experiencing or self-reporting symptoms of low mood and/or anxiety. Therefore, the PHQ-9 was no longer used for the initial screening, but we later excluded participants who had a combination of minimal to no symptoms for both depression (PHQ-9 <5) and anxiety (GAD-7 <5) from the data analysis (Fig. 1). Participants were recruited through primary care, including social prescribers, social media, Active Devon (a non-profit organization) and Devon Partnership NHS Trust for their Recovery College. Following approval, the recruitment process ran from July 2020 until October 2020.

Convenience sampling was used following registration, a participant information sheet was provided and telephone screening and informed consent was completed. Those deemed high risk of suicide, experiencing other mental health problems at a significant level or with significant physical health problems that would put them at risk in cold water, and those who were not confident to swim two lengths of a 25-m pool were excluded from the study. GPs were informed if participants were recruited.

2.3. Research measures and procedure

The primary outcome was the recruitment and retention of participants. Secondary outcomes looked at the feasibility of using the Patient Health Questionnaire, 9-item version (PHQ-9), Generalised Anxiety Disorder Assessment, 7-item version (GAD-7), The Work and Social Adjustment Scale (WSAS) and the role of the point-of-care (POC) C-reactive protein (CRP) device (Alere Afinion™ CRP) in measuring levels of inflammation. Finally, we wanted to determine if a sea swimming course was beneficial and therefore worthy of further study. A qualitative component was embedded into the feasibility study, with qualitative data collected through diaries and evaluation surveys (Appendices 1 and 2), alongside the standardized quantitative measures outlined above. The employment of this combined approach was necessary to gain a comprehensive understanding of the effects of the intervention and its underlying mechanisms.

Changes in mental health were ascertained using the self-administered, validated mental health questionnaires that are widely used in primary care in the UK. Depressive symptoms were measured using the PHQ-9. Scores of 5, 10, 15, and 20 represent mild, moderate, moderately severe, and severe depression respectively. It has a 61% sensitivity and 94% specificity in adults (Kroenke et al., 2001). Anxiety symptoms were measured with the GAD-7. The scores of 5,10, and 15 are the cut off points for mild, moderate and severe anxiety, respectively. A cut off score of 10 optimized sensitivity (89%) and specificity

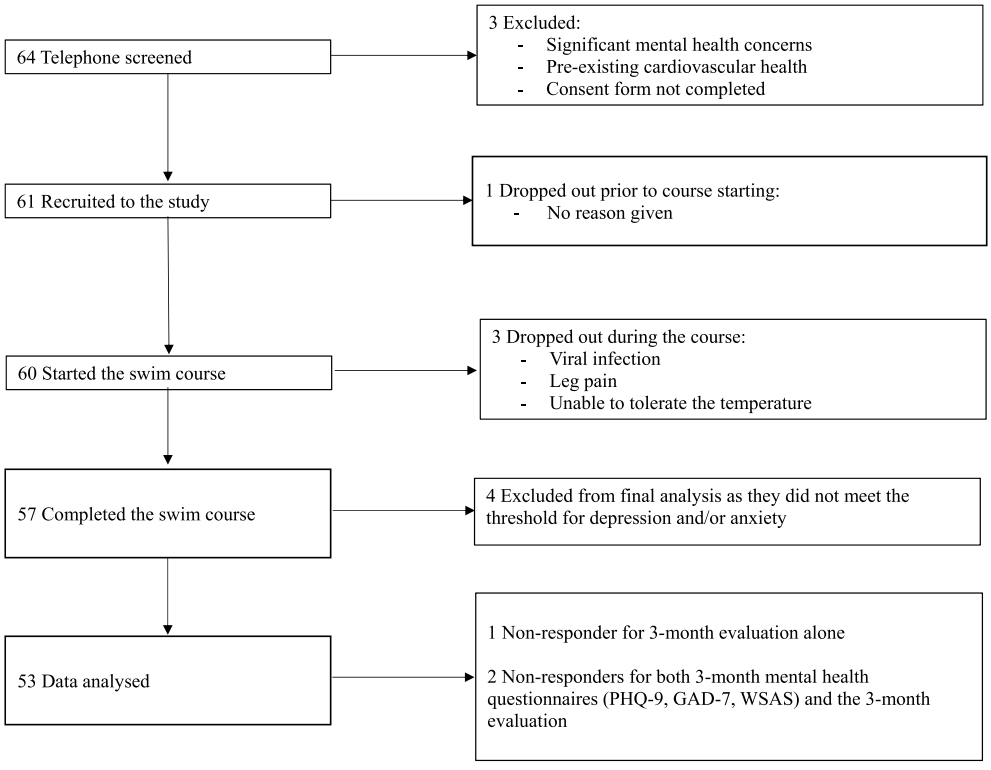

Fig. 1. Trial profile.

(82%) (Spitzer et al., 2006). The WSAS was used to assess functioning. Scores between 10 and 20 indicate significant functional impairment with less severe clinical symptomatology than scores above 20. Scores below 10 are associated with subclinical populations (Mundt et al., 2002).

While the study was primarily directed towards acceptability of the course, one of the proposed mechanisms by which sea swimming improves mental health is through a reduction in inflammation (Canli, 2014; Janský et al., 1996; Tipton et al., 2017). We therefore took the opportunity to investigate whether it was possible to measure and obtain meaningful results for levels of inflammation in this setting. To this end, levels of inflammation were monitored using a point-of-care (POC) C-reactive protein (CRP) device (Alere Afinion™ CRP). This was completed by a separate practitioner that was trained to use the device.

Prior to the intervention, the questionnaires were completed online. At the start of the first session a CRP sample was measured where possible. Eight sea swimming sessions then took place either over a period of four weeks (two/week) or eight weeks (one/week). A further CRP sample was completed immediately before the last session. The validated questionnaires were repeated following the end of the course and at three months. The evaluation surveys were also sent at the same time and included questions that explored the participants experience and feedback of the actual course, continued attendance or barriers to sea swimming, impact of the course with particular reference to mental health and a free text comment to expand on any further details.

Participants were also invited to complete a diary of their experiences for their own interest throughout. This was on a voluntary basis and these were only analysed if they agreed to share at the end. There was no specification of what content to include and how to complete. The majority of participants completed a reflective entry for each swim session.

All quantitative and qualitative data was collected remotely by electronic surveys due to Covid-19 limitations.

2.4. Data analysis

A formal power calculation was not used to determine sample size for this study. The data was organised using Excel.

Participants (n = 4) scoring below the thresholds for both mild depression (PHQ-9 score <5) and anxiety (GAD-7 score <5) were excluded from the data analysis. Descriptive statistics were used for baseline characteristics to check for any obvious selection biases, attendance and response rates. The normally distributed data (checked using Shapiro Wilkes tests) were compared pre-, post and in follow up using Cohen's *d*. In particular, $d = 0.2$ is interpreted as a small effect, 0.6 a moderate effect, 1.2 as a large effect and 2.0 or greater as a very large effect. 95% confidence intervals were calculated.

Outcome measures and recovery standards were used according to the Improving Access to Psychological Therapies (IAPT) service (National Collaborating Centre for Mental Health, 2020). 'Recovery' is a reduction in PHQ-9 and/or the GAD-7 below scores of 10 and 8 respectively (National Collaborating Centre for Mental Health, 2020). Reliable improvement was assessed using Jacobson and Truax's reliable change criteria (Jacobson & Truax, 1991). The measure of reliability used for the PHQ-9 and the GAD-7 was Cronbach's α (Kroenke et al., 2001; Spitzer et al., 2006). A reliable improvement was observed if PHQ-9 or GAD-7 score reliably decreased and in the PHQ-9 and GAD-7 combined if the score for the other scale either did the same or did not reliably deteriorate. Reliable deterioration occurred if participants scores on the relevant measures have either increased by a reliable amount and neither measure has shown a reliable decrease. Participants were deemed to have reliably recovered if they scored above the clinical cut-off on the PHQ-9 and/or the GAD-7 at initial assessment, they showed reliable improvement at the post intervention phase, and they scored below the clinical cut-offs post intervention. Those with 'mild PHQ-9 or GAD 7' scores pre-course were not included in the analysis.

The qualitative data, gathered through the evaluation forms and diaries, was subjected to a thematic analysis (Braun & Clarke, 2006). Although the evaluation forms were comprised of questions developed to gain insight into the experience, these questions were not used to inform the themes. An inductive analysis was undertaken, using the answers together with the free-text from the diaries, and with a (critical) realist stance. One author identified and coded extracts of the text, before categorising them into themes and analysed the data until saturation was reached. This author is a counselling psychologist with a Master of Research Degree who has worked clinically in adult mental health for many years and has experience of undertaking qualitative analyses. She is also a regular open water swimmer. Whilst this meant she had pre-existing insight into the area under investigation, all data was collected remotely and so she did not have a relationship with the participants. Two other authors acted as 'critical friends' to review and refine the themes (AB and HM) encouraging reflexivity and reducing personal bias. Finally, the themes were grouped into higher-order themes or 'clusters'. The final analysis was reviewed by a fourth author (MH).

3. Results

64 participants were initially considered for the study as described in Fig. 1.

Participant characteristics are in Table 1.

3.1. Attendance, retention and response rates

Attendance rates were high with a total of 382 sessions attended out of a possible 424 (90.1%) and with the median number attended being 8 (IQR = 7–8).

At the time of the three-month follow-up, 34 participants were still swimming at least once/week, 3 were swimming irregularly and 13 were no longer swimming.

Adverse events included suspected Raynaud's (n = 1), hyperventilation and exacerbation of panic attacks on entering water (n = 2), painful joints (n = 1), cramp (n = 1), feeling faint and dizzy on entering water (n = 1). Many of these were expected effects secondary to cold-water immersion. The Raynaud's was successfully addressed with neoprene gloves, the panic attacks with reassurance and repeated, controlled exposure. No events had lasting effects and participants completed the course. There were high response rates with all 53 participants completing both pre- and post-course questionnaires (100%) and only 2 non responders for the three-month follow-up. 14 participants completed a diary.

Table 1
Participant baseline characteristics.

Demographic characteristics	n (%)
Total	53
Gender identity	
Male	5 (9.4%)
Female	47 (88.7%)
Non-binary	1 (1.9%)
Age	
18–29	1 (1.9%)
30–49	23 (43.4%)
50–64	22 (41.5%)
65–84	7 (13.2%)
Ethnicity	
White background	52 (98.1%)
Mixed background	1 (1.9%)

3.2. Safety considerations

There were no serious adverse events, indicating that safety concerns were adequately managed.

3.3. Quantitative analysis related to potential effectiveness

There were reductions showing large effect (between $d = 1.4$ to 1.7) in the severity scores of both PHQ-9 and GAD -7 between the beginning and end of the course (Table 2). While severity scores marginally increased at three-month follow-up, a reduction from baseline scores for PHQ-9, GAD7 ($d = 1.2$ and 1.4, respectively) and WSAS scores ($d = 0.8$) remained (Table 2). Fig. 2 shows individual data during the study for PHQ-9, GAD-7 and WSAS scores.

CRP levels were measured using the POC CRP device. Of 27 participants offered the fingerpick test 25 (92.6%) participants consented. The number was limited as COVID-19 restrictions impacted the ability to take samples. Problems included too small sample size and an ambient operating temperature below that recommended by the manufacturer. Initial levels may have been biased by participants who had prepared for the course by taking repeated cold showers and swimming in the sea prior to its commencement. Therefore, these results were not analysed fully.

3.4. Qualitative analysis

The themes identified, whilst interconnected, fell broadly into two clusters. Aspects of swimming that the participants experienced as contributing to the impact of the intervention were grouped into a cluster entitled 'mechanisms'. Another cluster, 'outcomes', was comprised of themes describing the effects of the sea swimming course. (see Table 4 for specific, relevant quotes).

(1) Mechanisms

Confronting Challenges. Many participants described the experience of getting into the sea as challenging at times and reported some difficult experiences and fears that they needed to overcome. The challenges included worries about initially getting in, panicking whilst in the water and struggling with managing the cold both during and after swimming. The raw and harsh environment of the sea could also feel overwhelming. In addition, participants sometimes had to find the motivation and confidence to attend whilst struggling with mental health issues.

However, managing to overcome these challenges seemed to be key to the positive impact of the course. Participants reported learning new skills, gaining greater understanding of the water and developing strategies for managing cold. Many described moments where they felt proud of their achievements. Over the course they reported increased confidence and enjoyment of being in the water.

Becoming a Community. The impact of the course facilitators and other participants was highlighted by almost all respondents. Participants described feeling supported, encouraged and reassured by the coaches' professionalism and knowledge. They also valued finding like-minded people, who were supportive, and enjoyed the shared experience.

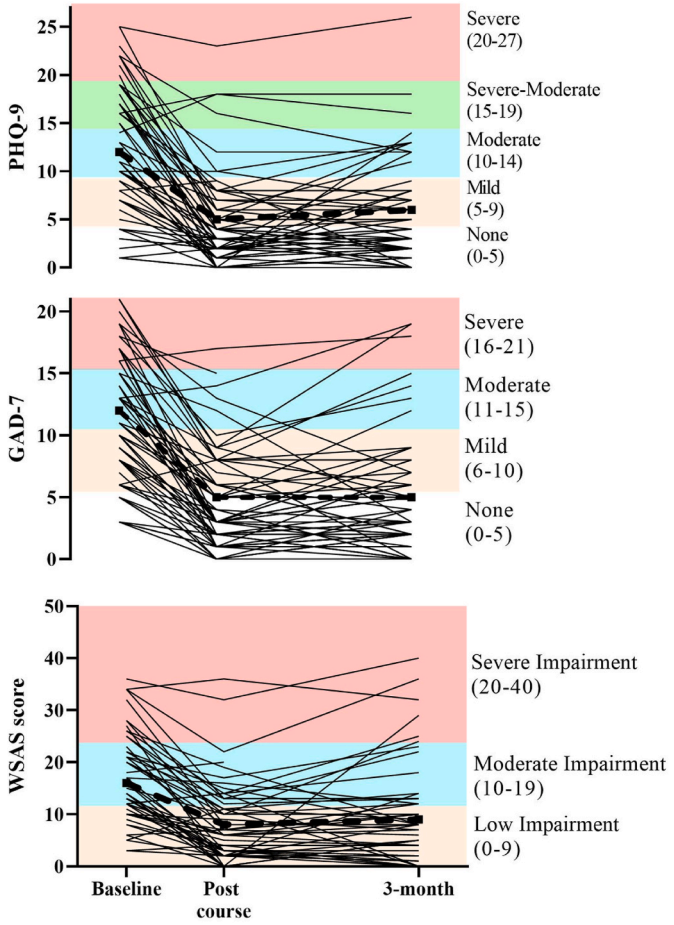

Fig. 2. Depression, Anxiety and functioning individual trends during the study. Bold dashed line indicates the mean scores. *(For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)*

There were some participants, however, who reported having anxiety about being part of a group, as a result of feeling nervous about meeting new people, discomfort of being in a swimming costume or fears of being less competent. These concerns seemed to diminish over the course of the sessions for those who felt able to join.

Appreciating the moment. A number of participants valued the breathing exercises introduced on the beach and highlighted the importance of getting into the water gradually and without feeling rushed. The course helped them develop a different connection to their surroundings and the changing sea conditions, allowing them to focus on simply being in the water.

Practical issues. Although the courses were based in a coastal area, proximity and accessibility of the course locations could be a challenge especially for people with mobility issues. Because of both physical and mental health issues, some relied on partners, relatives, or support

Table 2
Clinical ratings at baseline, post-intervention and 3-month follow-up.

	Mean (SD)			Baseline versus post-course			Baseline versus 3 months follow-up			Post-course versus 3 months follow-up		
	Before	After	3 month follow up	difference	$d =$	95% CI	difference	$d =$	95% CI	difference	$d =$	95% CI
	n = 53	n = 53	n = 51									
PHQ–9	13.0 (6.3)	5.1 (5.0)	7.0 (5.4)	−7.8	1.4	−10.0, −5.7	−6.0	1.2	−9.1, −2.8	1.9	0.2	−1.1, 4.9
GAD–7	12.2 (4.6)	5.0 (4.1)	5.6 (4.9)	−7.2	1.7	−8.8, −5.5	−6.6	1.4	−9.0, −4.2	0.6	0.1	−1.8, 2.9
WSAS	17.0 (8.3)	8.4 (7.8)	11.4 (9.8)	−8.6	1.1	−11.8, −5.5	−5.6	0.8	−11.2, 0.0	3.0	0.1	−2.5, 8.5

Mean (Standard Deviation) for self-administered questionnaires (PHQ-9, GAD-7, WSAS). These were completed pre-intervention, immediately post-intervention and at 3-month follow-up. PHQ-9 = Patient Health Questionnaire-9. GAD-7 = Generalised Anxiety Disorder Assessment-7. WSAS= Work and Social Adjustment Scale.

Table 3
Recovery, reliable improvement and reliably recovered percentage rates.

	Recovered [a]	Reliable improvement [b]	Not improved or deteriorated [b]	Reliably recovered [c]
Baseline-post course				
PHQ - 9	29/36 (80.6%)	33/53 (62.3%)	20/53 (37.7%)	25/36 (69.4%)
GAD - 7	31/44 (70.5%)	44/53 (83.0%)	9/53 (16.9%)	31/44 (70.5%)
combined	23/35 (65.7%)	30/53 (56.6%)	23/53 (43.4%)	19/35 (54.3%)
Baseline-follow up				
PHQ - 9	23/35 (65.7%)	31/51 (60.8%)	20/51 (39.2%)	18/35 (51.4%)
GAD - 7	29/43 (67.4%)	41/51 (80.4%)	10/51 (19.6%)	28/43 (65.1%)
combined	16/34 (47.1%)	27/51 (52.9%)	24/51 (47.1%)	14/34 (41.2%)

[a] Meet survey specific caseness criteria and recovered below PHQ-9 of 10 and GAD-7 of 8.
[b] All participants with greater reductions than the RCIs n = 53.
[c] Meet caseness, recovered and reliable improvement. PHQ-9 = Patient Health Questionnaire-9. GAD-7 = Generalised Anxiety Disorder Assessment-7. WSAS= Work and Social Adjustment Scale.

workers to take them to the sessions, which while could relieve some anxiety, also added pressure due to that need of extra support. This would be important to consider if this was developed as an intervention.

(2) Outcomes

Immediate positive changes in mood. Immediately after the swim participants described feeling both alive, energetic, and elated and feeling calm and relaxed. These changes in mood lasted for a few hours or into the next day(s).

Improved mental and physical health. Many participants reported a positive impact on their mental health, including improved confidence and increased motivation. Some even described it as life changing. They reported enjoying having a new purpose in their lives, connections with the other swimmers, and being more able to manage unexpected challenges as a result of new coping strategies and a greater self-confidence.

They also reported improvements to physical health which included reduced joint pain and improved sleep. Participants appreciated discovering an alternative way to manage their mental and physical health.

Increased motivation to swim. Whilst many described high levels of anxiety and trepidation at the thought of swimming before the course, by the end many were very disappointed if they had to miss a session or it was cancelled due to the weather. As a result of developing friendships and knowledge, many made plans to continue with people they had met. There was a plea for ongoing courses or drop-in sessions from others so they could continue with the activity.

4. Discussion

The primary objective of this feasibility study was to establish whether a sample of individuals with depression and anxiety could be recruited and supported to safely participate in a sea swimming course. All the courses were fully-subscribed, retention and attendance rates were high, and dropouts low. Due to the constraints of the pandemic, we were unable to obtain accurate data about rates of people recruited as a proportion of those approached. There were no serious adverse events (SAEs), so it can be concluded that the safety considerations were adequately addressed. Overall, our results support the view that, it is possible to recruit and retain participants to the intervention.

The secondary outcome was to establish the appropriateness of the data collection. High numbers completed the questionnaires and the level of detail in the course evaluation, in conjunction with the diaries,

Table 4
Quotations supporting themes.

Mechanisms	Example Quotes
Confronting Challenges.	
- Fears of getting in the water	Very nervous, had a moment before going, headache, not happy at all about going in the cold. Very unsure.. Bottom lip wobble (Participant 4, diary entry)
	I felt very nervous, I kept doubting myself as to if I could actually do this, would I be able to get into the sea? I can't stand the cold what if I can't do it? (Participant 19, diary entry)
- Finding motivation/confidence to attend whilst also struggling with mental health issues and life stressors	Against a background of general anxiety, which started following a traumatic repatriation to UK as lockdown was happening, shortly followed by family difficulties, there was the added high anxiety before going to the session around perceptions of: finding the venue, social distancing of public on the beach, coldness of water, unknowns, new challenge, not having swum in the sea for over 10 years, etc (Participant 3, diary entry).
	I felt anxious and overwhelmed when I arrived at this session, for personal reasons. It made the session more challenging and I didn't feel very strong, physically or mentally (Participant 12, diary entry)
- Raw and unpredictable environment	At one point as I was swimming a big wave came over me which I wasn't excepting and when I tried to stand I realised I was out of my depth I did panic for a bit but luckily (an instructor) was with me and able to help me and take me to the lifeboard when I was calmer he asked if I wanted to leave the water but I said no I was alright. I carried on swimming and when a few big waves came over I jump underneath them which I had done at lot of last time (Participant 7, diary entry)
	Sea definitely colder today but managed to get in ok. Large waves lots of ducking and diving tried to do it without holding nose but swallowed too much water! Kept getting knocked over by waves …. large waves (Participant 22, diary entry).
- The challenge of being cold	Hot shower at home …. shivering …. hot drink … sandwich … still cold …. even though wearing 3 layers and hat with gas fire on! (Participant 35, diary entry)
	It was hard getting in, and the cold was definitely a shock to the system (Participant 42, diary entry).
- Feeling proud of their achievements	I like myself more as a result because whenever I do it I feel a sense of achievement and really proud of myself. (Participant 54, 3mth f/u)
	I felt so proud of myself and I'm so happy I started this group because I feel like I've really accomplished something both physically emotionally and mentally (Participant 2, diary entry).
- Increased confidence in the water	This course has helped me with my confidence after a very difficult year, mentally and physically, it was really good to learn so much about the sea, tides, waves, and what your body can actually cope with (Participant 36, Eval).
	I have always been scared of going out beyond where my feet don't touch the

(*continued on next page*)

Table 4 (*continued*)

Mechanisms	Example Quotes
	ground but today I did it and I felt like I'd really accomplished something! My fear of the sea is definitely less severe now (Participant 2, diary entry)
	Getting in is no longer a challenge and I felt at one with the water. It was wonderful to properly swim, something I've only done in a pool before. Felt really exhilarated and excited to have achieved this, and felt confident about doing it in the future. (Participant 12, diary entry)
- Practical issues	Accessing the beach. Hard for me to walk on loose sand with my physical issues especially after swimming. (Participant 5, Eval)
	I do find it challenging to get there because I cannot drive due to my anxiety which means that I need to rely on my husband taking me (Participant 42, 3mth f/up)
Becoming a Community	
- Impact of the course facilitators	Friendly atmosphere, knowledgeable course leader and competent (and lovely) lifeguard. I truly looked forward to this every Sunday - I felt safe and most of all very welcome (Participant 3, Eval)
	The staff ooze positivity without being patronising. They have infectious enthusiasm and kindness; and are happy, self-assured people. Very pleasant to be in their company (Participant 13, diary entry)
- Feeling part of the wider group	I really loved coming together as a group and the feeling of inclusion and togetherness that gave. (Participant 47, Eval)
	After just one session felt I was part of the group – everyone very friendly and inclusive (Participant 12, diary entry)
- Anxieties about being part of the group	Was worrying about social aspects - analysing how I had been but then something clicked and I thought, 'no, I just went in the sea and faced loads of massive waves I am not weak and nobody will have paid attention to how I was or cared for that matter', and then the doubts seemed to wash away a bit.
	Panicked about making a fool of myself when changing in the rain (Participant 55, diary entry)
	Felt extremely anxious and self-conscious during the warm up but the instructors and friendliness of the other people put me at ease (Participant 42, diary entry)
Appreciating the moment	
- Taking time to get into the water	The warm up exercises provided a calming focus. I took a while to get into the water, focusing on the breathing as I experienced the change in depth and immersion (Participant 13, diary entry)
	Coldest yet and found it really hard getting in but it was really helpful to take my time, breathe and find support from the group and (instructor) - laughing through helped! (Participant 42, diary entry)
- Focus is on being in the water	When I am in the water I think of nothing but how beautiful it is to be immersed in the natural sea that nature has provided (Participant 2, diary entry).
	More diving, wave surfing, now I can't think about anything else but what I'm doing. Feel great getting out, I want to stay in. It just doesn't feel cold. (Participant 24, diary entry)
	I love the feeling of being so close to nature in a different way from anything I've experienced before, there is always something beautiful each time, whatever the weather! (Participant 34. Eval)
Outcomes	
Immediate positive changes in mood	
- Feeling alive, energetic, elated	I feel like I have a 'buzz' all day after some sessions (Participant 5, Eval).
	Felt exhilarated, motivated and purposeful for the rest of the day (Participant 13, diary entry)
- Feeling calm, relaxed and a moment of escape	It was incredible looking up at the blue sky. I felt an incredible sense of peace, being held and no worries or stress, an inner sense of sheer calm (Participant 4, diary entry)
	As I got into the sea all my anxieties/ worries disappeared I felt great sort of at peace (Participant 19, diary entry)
Improved mental and physical health	
- Improved confidence and motivation	It has been so helpful to me. I have changed so much. I am so much better. I feel I can cope better with unexcepted situations. I am going out more, and talking to people I meet more. I will be seeing my counsellor one a fortnight instead of once a week and hopefully, soon, I can talk to my doctor about started to lower the dosage of my anti-depressants. It's all been very positive (Participant 7, Eval)
	I feel that the swimming has a positive impact on my mood, definitely helping my confidence (I still compare myself to others and see myself lacking but I am challenging that). It gives me a great sense of achievement. (Participant 32, diary entry)
- Finding an alternative way to manage mental health	I don't want to stop going into the water, it almost feels like medicine for the body (Participant 32, diary entry)
	Sea swimming has been profound for me ….for a short while it takes away the internal fear I always feel …. (Participant 22, Eval)
Increased motivation to swim	
- Increasing motivation	Whilst it was daunting to start off with and I had a lot of fear, […] this is now diminishing. I can't say it is enjoyable going into cold water but I feel better for it (Participant 35, Eval)
	Today was the first time that I've actually started to really look forward to going to the class, because I feel so good afterwards it makes me want to do it. (Participant 2, diary entry)
- Disappointment about not going	An appointment I couldn't move meant I couldn't attend this session. I really missed it, and was frustrated (Participant 25, diary entry)
	Unable to attend due to caring duties. I missed it and felt really quite low as I am missing out on the activity I have found to be most beneficial in dealing with the anxiety that has come about, and been compounded, by the current Covid crisis (Participant 3, diary entry).
- Plans to continue	

(*continued on next page*)

Table 4 (*continued*)

Mechanisms	Example Quotes
	It's been life changing for me - I have made a new community of peers/ connections that enjoy the same thing and can meet randomly in groups to ensure safety when swimming, there are no demands on me from them, we just swim and go.. a great way to manage day to day stresses (Participant 4, Eval)
	Since it ended, we have done 3 solo swims and encouraged others to join us whilst we keep to Lockdown rules. We plan to swim twice a week … we have a WhatsApp group and continue to support each other (Participant 19, diary entry).
	I've been back swimming at least twice a week in the sea, and have also converted several friends locally. There are half a dozen of us who buddy up and it has become a really social physical activity. It's always a challenge but we egg each other on. We have managed to carry on during lockdown by being socially distanced and only swimming in 2s. (Participant 12, 3mth f/up)

enabled a comprehensive thematic analysis. This indicates a high degree of acceptability for both course and data collection methods. However further in-depth qualitative feedback, such as interviews or focus groups, would have allowed a greater understanding of who this intervention can most benefit and any barriers that may have prevented people from joining. The collection of biological markers of inflammation was not successful and other methods should be investigated.

Finally, we wanted to determine if a sea swimming course had a positive impact on mental health and therefore worthy of further study. Conclusive inferences cannot be made given this was a feasibility study, without a control group. However, the effect size was large in the reduction of severity scores of both PHQ-9 and GAD-7 pre- and immediately post-course. This reduction in symptoms was seen across the severity range. In the main, there was no return to pre-intervention severity levels three months after the end of the course, although this was seen in a small proportion of individuals. Similarly, WSAS scores were reduced post intervention and remained lower at three months.

The qualitative data provided some insight into how the sea-swimming courses were experienced. A key aspect of the intervention, that participants identified as helpful, seemed to be confronting the challenges of sea swimming. Although some of these might have acted as barriers that prevented some people from joining, for example proximity, access, needing additional support to attend, concerns about being part of a group, or fears of getting in the water, the fact that the sea can be a wild and unpredictable environment also appeared to be a factor in the impact of the intervention. This supports research into other adventurous activity that has argued that benefits may have been overlooked as a result of the focus of developed societies on keeping people safe (Clough et al., 2016). Meta-analyses of studies into adventure sports have indicated that they can offer significant positive health and wellbeing outcomes (Gass et al., 2012).

The sense of community that developed over the course also seemed key to a positive experience. The skill of the instructors in supporting the participants in undertaking a challenging activity safely was highlighted, and perhaps set the tone for the group. Participating in the sea swimming activity seemed to facilitate the bonding of the group, with some describing that they had met like-minded people. Social cohesion, including shared values, feelings and acceptance and belonging, can be positively influenced by natural environments (Hartig et al., 2014). There is also evidence that blue spaces in comparison to green spaces can be important in promoting positive social relationships (White et al., 2020). Furthermore, there is evidence that group-based physical activity protects against depression (Stevens et al., 2021). One in 20 adults reported feeling lonely in 2016–2017(Office for National Statistics, 2018). This will have been further exacerbated by the Covid-19 pandemic. Through the experience of sea swimming, and because of the potential to freely access the sea following the course, participants were able to form groups and many continued after the course finished. As well as reducing social isolation, this increased motivation to swim also means engaging in exercise which is likely to further ameliorate symptoms of depression (Cooney et al., 2013). There were, however, some people who did not find groups with whom they could swim and ideally an ongoing drop-in swim group would be provided to support them to continue.

The final beneficial mechanism identified from the qualitative responses, was an increased appreciation of the moment and in particular of being in nature. The intensity of the experience perhaps encourages people to become focused on the present moment, giving them a break from their day-to-day worries. There are many explanations as to why this might be helpful for mental health. Being totally absorbed in an activity has been described as 'flow' (Csikszentmihalyi, 1997) and has been shown to result in many psychological benefits (Seligman & Csikszentmihalyi, 2000). The attention restoration theory is a long-standing potential explanation for the benefits of being in nature and suggests that part of the positive impact comes from having a break from the focused attention that is required in our everyday lives (Kaplan, 1995; Kaplan & Kaplan, 1989). Finally, there may be an overlap with mindfulness research, that has shown that paying attention to the present moment can be beneficial for depression (Segal et al., 2018).

These factors accord with other research into the experience of activity in blue space and suggestions of how it might support mental health and wellbeing. Developing an attunement with the movement of water allows swimmers to feel 'at home' (Throsby, 2013), and the embodied sensory awareness of the water enables water users to turn a potentially risky activity into an enabling one (Britton & Foley, 2020). A number of studies exploring the impact of activity in blue space or blue therapy have highlighted the importance of social connectedness (Britton et al., 2020; Denton & Aranda, 2020; Thompson & Wilkie, 2021). Blue space can encourage 'undemanding' interactions focused on the experience of the water (Bell et al., 2015). Finally, the intense sensory experience of being in water brings attention into the moment and provides a respite from mental health difficulties (Caddick et al., 2015). There is also an overlap with the five ways to wellbeing identified by New Economic Foundation (Jody & Thompson, 2011). They suggested that to encourage wellbeing it is important to connect, be active, be curious, keep learning and give to your community. There has been a suggestion that the challenging nature of sea based activities appeal more to men or young people (Garside et al., 2020) and it has been suggested that there may be a 'masculinity' associated with some water-based activities that deters some women (Britton et al., 2018). However, in this study the population was predominately women with a mean age of 51, and this is an area that is worthy of further investigation.

Talking therapies and medication will remain the mainstay of treatment for mental health issues, but they could be complemented by preventative, community-based and nature-based approaches. However, to recommend these it is important that their potential impact is understood. For comparison, 54% of adults show some improvement with antidepressant medication (Cuijpers et al., 2020). However, medication is less effective with milder symptoms, some find the side effects intolerable and there are significant problems associated with withdrawal (Mahase, 2019). The national recovery rate standard for IAPT is that a minimum of 50% of eligible referrals should recover (National Collaborating Centre for Mental Health, 2020). For participants in this study these standards were met (Table 3).

However, as with other interventions, sea swimming is not helpful

for everyone. For example, from baseline to immediately after the course, around 17% and 38% of participants, in GAD-7 and PHQ-9 scores respectively, showed no reliable improvement or reliably deteriorated. To some extent this is to be expected, given the fluctuating nature of mental health problems and therefore there may not always be a clear cause. Furthermore, therapies have the potential to do harm as well as good (National Collaborating Centre for Mental Health, 2020), which may have been the case in this study. Reviewing the qualitative data for those that deteriorated gave some indications. One possible reason highlighted by participants was the increased psychological stress resulting from the ongoing pandemic in general and the second national lockdown enforced on the November 5, 2020 specifically. While the study was given permission to proceed, those in previous groups found it hard to continue swimming due to lockdown-related anxiety, physical health, and problems with transport. Others commented that while the sessions helped in the immediate short-term (e.g., the day of the session), they were unsure as to whether it helped their mental health in the longer term. Finally, a cause was not always highlighted and, indeed, the positive feedback provided did not mirror the increased scores. Overall, the qualitative data was useful, but in-depth interviews with participants who had deteriorated, as well as those that benefitted, would have enabled greater exploration and insight into the more unhelpful aspects of the intervention.

Although no formal health economics analysis was undertaken, the cost of the course compares very favorably with other non-medical interventions (note that there was no cost to the participants in the trial). The cost of each course was £11.72 per session or £93.75 for a full 8-week course. For comparison, group art therapy, offered at one centre, costs over twice as much at £25–45 per session, a total of £200–375 (London Art Therapy Centre, 2022) and, according to the NHS, CBT requires 5–20 sessions at around £40–100 per private session, a range of £200-£2000 (NHS, 2019). Additionally, we hypothesised that, once participants have gained the appropriate knowledge and skills from the course, they will be able to undertake the activity on their own initiative. This was borne out in our study as, three months following the end of the course, around 70% were still swimming regularly.

Participants were overwhelmingly positive about the structure of the course. We did not find it necessary to modify the course itself but have found that increasing experience allowed us to respond proactively to those whose anxiety required closer support.

The results of the feasibility study should also be considered in the context of several limitations. The study was restricted to a single supervising team and an area where the sea is reasonably accessible. Whilst it was advertised as a sea safety introductory course, people who were swimming prior to the course were not excluded. The COVID-related adjustments to the study meant recruitment was opened up to convenience sampling rather than specifically targeted which meant we were unable to estimate the rate of recruitment as a proportion of those reached out to. There was reduced access to primary care during the pandemic so fewer opportunities for GPs and social prescribers to promote the course. Consequently, there could have been a sampling bias in favour of those with internet access and active on social media. As mentioned the participants were predominately female, but it is unclear why there was such a gender difference, as this was not explored. Perhaps the barrier is related to the perceived stigma of depression with a disproportionate difference between the number of males with mental health disorders and those seeking treatment (Chatmon, 2020). This should be addressed in future studies.

There was also a possibility of response bias, as those that self-registered would have been relatively self-motivated or were participating because they had experienced improvements in their mood if they swam prior to the course. The impact of confounding variables, for example the use of antidepressants and talking therapies, could not be determined as there was no control group. The Hawthorne effect is also a potential bias, with participants responding favorably as they are aware they are being observed (Mayo, 1945). A control group in a future trial would help address this. Seasonality should be considered. While we don't have comprehensive data, follow-up suggested that a significant number of participants continued swimming through the winter. For safety reasons, however, it would not be possible to start courses between November and April when the water is at its coldest. It was restricted to people who could swim at least 50 m in a pool, we did not approach non-swimmers due to the safety aspect. However, this limits the population who would be able to attend and in particular those from more socially disadvantaged groups, who are less likely to swim (Pilgaard et al., 2019). Factors such as the geographical location and a narrow sociodemographic range, limit the generalizability of the study. With a continued expansion of social prescribing it may be possible to explore ways to include a more diverse population. However, such initiatives are subject to funding challenges and the political will for such public health approaches can fluctuate, which will affect the opportunities for this sort of community-based trial in the future.

This research has highlighted areas that would benefit from further study. As well as the psychosocial factors, there is evidence to suggest that cold water has a physiological impact that may help with depression. This study, however, was not able to find a methodology that would allow exploration into this. Further refinements to the equipment used and processes of data collection are required to identify methodologies that could investigate this impact. It would be useful to explore reasons why potential participants may have declined the course when offered. In particular, to establish if non-swimmers would have been interested if an introductory pool course could have been included prior to sea swimming. There are also populations that have previously had low participation rates in outdoor swimming. For example, this has been highlighted by the formation of the Black Swimming Association and further studies should collaborate with such groups in order to widen participation. Finally, not everyone has access to the sea, so studies should also be designed to evaluate whether similar effects are observed when swimming courses are held in inland bodies of water such as lakes, reservoirs and lidos.

5. Conclusion

While this is a simple, uncontrolled, feasibility study, its outcomes demonstrate that sea swimming can be employed safely and with a high level of acceptability, particularly for those identifying as female, as an intervention for clinically-relevant anxiety and depression. It also demonstrates the acceptability of a mixed-methods approach that employs both quantitative and qualitative evaluation. Finally, it illuminated the crucial components of the course and highlighted some of the barriers for participation and areas in which the research methodology could be improved.

There is an increasing demand from both commissioners and potential participants for therapeutic, nature-based interventions for mental health. There is, therefore a pressing need for research in this field. This study provides preliminary support for the employment and acceptability of sea swimming for depression and anxiety and justifies further clinical trials.

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CRediT authors contribution statement

Amy Burlingham: Conceptualization, Methodology, Investigation, Formal Analysis, Writing -original draft. Hannah Denton: Conceptualization, Methodology, Investigation, Formal Analysis, Writing -original draft. Heather Massey: Formal Analysis, Writing -original draft. Naomi Vides: Formal Analysis, Writing-review and editing. Mark Harper:

Conceptualization, Methodology, Writing-review and editing, Supervision.

Declaration of competing interest

Since the study, Amy Burlingham and C Mark Harper have had involvement with the Chill Therapy CIC in a voluntary and unpaid capacity. No potential conflict of interest was reported by the authors.

Data availability

Data will be made available on request.

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Appendix 1. End of Course Evaluation

Study Number

Participant Identification Number for this trial:

Sea Swimming for Depression.

Course Evaluation.

Thank you for taking part in the study. Please could you answer the following questions about your experience?

Can you describe anything you have particularly liked about the course?

Can you describe anything you have not liked about the course?

Has anything changed for you as a result of doing the sea swimming course?

Do you think it has an impact on your mental health? And if so in what ways?

Do you have any suggestions for us about the course?

Is there any other information you would like to share with us?

Appendix 2. 3-month follow-up evaluation

Study Number

Participant Identification Number for this trial:

Sea Swimming for Depression.

Follow up Evaluation.

Thank you once again for taking part in the study. Although it may feel long time ago it would be very helpful for us if you could answer the following questions about your experience?

Looking back how do you feel about the sea swimming course?

Have you been sea swimming since finishing the course? What has helped or stopped you from going?

Now there has been a gap since finishing do you think anything changed for you as a result of doing the sea swimming course?

Do you think it has had any ongoing impact on your mental health? And if so in what ways?

Do you have any further suggestions for us about the course?

Is there anything else you would like to share with us?

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