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An Interpretative Phenomenological Study of the Experiences and Value of Flow Transcranial Direct Current Stimulation (tDCS) and Behaviour Therapy Training Software Used at Home for Specialist Perinatal Mental Health Service and Maternal Loss Psychology Service Patients with Depression

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Abstract

Background: Flow FL-100 is a transcranial direct current stimulation (tDCS) device designed to alleviate symptoms of depression, offering an alternative to psychotherapy and pharmacological interventions. The Flow treatment also includes access to wellbeing behaviour therapy training delivered through a software application. This study examines the user experience and perceived value of Flow among individuals receiving care from a Specialist Perinatal Mental Health Service and the Maternal Loss Psychology Service. Methods: Qualitative methods, including semi-structured interviews, were employed to explore participants' experience over a six-week period. Interpretative Phenomenological Analysis (IPA) was utilised to analyse the data. The study recruited thirteen female participants aged between 29 and 40 all diagnosed with depression, with five having experienced maternal loss and eight reporting postpartum depression. Results: Participants reported positive experiences with Flow, highlighting its user-friendly interface, accessibility, and the availability of visual instructions. Most participants adhered to the treatment protocol, but challenges such as life-style restrictions were noted. Participants appreciated a non-medication treatment alternative and reported improvements in depressive symptoms, mood, sleep quality, and overall well-being. Discussion: The findings underscore the potential of Flow as a non-pharmacological intervention for depression. Individual variability in

treatment response and engagement with the app's training emphasise the need for personalised approaches. Further research is warranted to explore the long-term experience and value of Flow treatment.

Keywords

Transcranial Direct Current Stimulation (tDCS), Depression, Perinatal Mental Health, Maternal Loss, Qualitative Study

1. Introduction

Within the first three months postpartum, the frequency of depressive episodes can be twice as high as during other periods in a woman's life (O'Hara et al., 1984). Postnatal or postpartum depression presents similar symptoms to depression experienced outside the perinatal period (NHS, 2022); however, specific to postnatal depression are symptoms such as anxiety about the baby's well-being; reduced interest in or difficulty bonding with the baby; negative thoughts about maternal capability; and irritability towards their partner, baby, and/or other children (NHS, 2022). Recent research conducted by Wang et al. (2021) suggested global prevalence rate of postpartum depression at 17.22%. In England, postpartum depression affects 1 in 10 women (NHS, 2022). Postpartum depression can coexist with other mental health disorders such as anxiety disorders, obsessive-compulsive disorder (OCD), post-traumatic stress disorder (PTSD), tokophobia (an extreme fear of childbirth), and psychosis (National Institute for Health and Care Excellence, 2020).

Depression is also widespread among women who have encountered perinatal loss (Díaz-Pérez et al., 2023; Kukulskienė & Žemaitienė, 2022), between 8% and 20% of women experience symptoms exceeding the threshold for moderate depression within four to six weeks after a loss (Farren et al., 2018). The definitions of perinatal loss encompass miscarriage or stillbirth (Kolte et al., 2014). Stillbirth is defined by the NHS as the delivery of a deceased baby after 24 completed weeks of pregnancy; prior to this, it is termed a miscarriage or late foetal loss (NHS Choices, 2019b). According to WHO (2024), one in four pregnancies globally result in miscarriage (Everett, 1997). In England, stillbirth occurs in every 250 births (NHS Choices, 2019b), and approximately 1 in 8 known pregnancies ends in miscarriage (NHS Choices, 2019a). Recent reviews (Herbert et al., 2022; Mergl et al., 2023) highlight the link between significantly heightened levels of depression and any form of perinatal loss.

Postnatal depression and depression stemming from perinatal loss can result in enduring symptoms (Vliegen et al., 2014). About 30% to 50% of mothers experiencing postnatal depression continue to present with major depression throughout their child's first year and beyond (Vliegen et al., 2014). Symptoms of depression have been found to persist at clinically significant levels after miscarriage and ectopic pregnancy for a period of nine months (Farren et al., 2019;

Beutel et al., 1995).

Data from the Mental Health Services Time Series Dashboard illustrates increases in individuals seeking specialist perinatal mental health community services (NHS Digital, 2019). Various factors can heighten the risk of postpartum depression, including a prior history of mental health issues, mental health challenges during pregnancy, lack of support from family or friends, strained relationships, recent stressful life events, smoking or alcohol use, educational level of less than 12 years, and experiences of trauma such as domestic violence (NHS, 2022; Wang et al., 2021). Additionally, antenatal depression (which occurs during pregnancy) and postnatal have a linked relationship, where individuals who experience depression in pregnancy are more likely to experience this in the postpartum period (Underwood et al., 2016). Experiencing perinatal loss can also increase the likelihood of depression in mothers during subsequent pregnancies (Armstrong et al., 2009).

Perinatal depression can incur various costs, encompassing both economic and health-related impacts on mothers, children, and family, and has been linked to increased risks of emotional regulation and social behaviour difficulties in children (Stein et al., 2014). It correlates with various cognitive outcomes in early childhood, such as infants' learning abilities, achievement of developmental milestones, language, and general cognitive development. Maternal distress has significant implications for the development of school-aged children, affecting behaviour, cognitive, and socio-emotional development (Kingston & Tough, 2013). These effects can extend into adolescence, being associated with teacher-reported special educational needs, leaving school without qualifications, emotional problems, and conduct problems (Bauer et al., 2016).

The most common treatment for postnatal depression is pharmacological such as antidepressants or psychotherapy such as cognitive behaviour therapy (CBT), or a combination of both (NICE, 2014). Psychotherapies take time to take effect on depression symptoms and may be difficult to access (Baker & Kirk-Wade, 2024). Between 2000 and 2013, around one in eight women received antidepressant treatment for postpartum depression in the UK (Petersen et al., 2018). Serotonin reuptake inhibitors (SRIs) antidepressants have been the most prescribed antidepressants during pregnancy and the postnatal period and have a relatively favourable reproductive safety profile (McAllister-Williams et al., 2017). According to a review by Brown et al. (2021) SSRIs antidepressants offer only a slight advantage over placebo in treating postnatal depression. Furthermore, data on the safety for breastfeeding infants while taking antidepressants are scarce, although available studies show minimal adverse effects (Berle & Spigset, 2011).

A large-scale online survey indicated patients' preferences for novel non-invasive approaches (Atkinson-Clement et al., 2024). Transcranial direct current stimulation (tDCS) involves non-invasive brain stimulation using a portable device delivering weak electrical currents (0.5 - 2.5 mA) (Grycuk et al., 2021) to alleviate depression (Razza et al., 2020). Meta-analyses of randomised control trials indi-

cate significant improvement in depressive symptoms with tDCS compared to sham stimulation, suggesting its efficacy as a standalone or adjunct treatment (Mutz et al., 2018; Moffa et al., 2020). A randomised sham-controlled trial of Flow FL-100 found significant improvement in depression symptoms relative to sham (Woodham et al., 2023). Flow is a product combining tDCS (administered by Flow FL-100) with app-based wellbeing training. Qualitative studies indicate high acceptability, recommendation rates, and perceived positive effectiveness of tDCS sessions reported by participants with depression symptoms (Rimmer et al., 2022; Griffiths et al., 2023).

Studies of effectiveness and safety of tDCS during perinatal period show promising results (Kurzeck et al., 2018; Laurin et al., 2022). Reported minor and transient physical sensations, may include burning sensations (16.2%), skin redness (12.3%), scalp pain (10.1%), itching (6.7%), and tingling (6.3 %) (Chhabra et al., 2020). A study in pregnant women found higher rate of depression remission in the postpartum period in the tDCS group compared to the placebo group, views of treatment were positive with no serious adverse events (Vigod et al., 2019).

There is currently no qualitative research on the impact of Flow on individuals experiencing depressive symptoms who are patients of Specialist Perinatal Mental Health Services and Maternal Loss Psychology Services. This study is the first to explore the experiences and value of using Flow through in-depth interviews, aiming to understand its feasibility, acceptability, usability, and value among these patient groups.

2. Methods

2.1. Design

In a post-marketing patient informed consent study, participants were recruited from a UK NHS Specialist Perinatal Mental Health Service and a Maternal Loss Psychology Service. Flow was offered to patients diagnosed with depression to evaluate its feasibility and impact. This qualitative study employed a phenomenological analysis, as this was deemed the most appropriate qualitative method for understanding the lived experience of the participants, as it allows for an in-depth exploration of their subjective experiences (Smith & Osborn, 2014). Semi-structured interviews were conducted with participants following 6 weeks of Flow tDCS treatment. The 29 interview questions, informed by relevant research literature (Griffiths et al., 2024) and study objectives, aimed to assess the participants' experiences with Flow, including its usage, encountered issues or benefits, and its impact on various facets of their lives such as mood, sleep, motivation, socialisation, diet, exercise, and goal progress. All interviews were audio-recorded and transcribed verbatim. The interviewer remained independent from the treatment process to mitigate potential bias in the data collection and analysis process.

2.2. Ethical Approval

Approval for the study was granted by the NHS Trust 'Ideas Forum' reference number: IFFLOW3. All participants provided informed consent, and the study adhered to the principles outlined in the Declaration of Helsinki.

2.3. Inclusion and Exclusion Criteria

The inclusion criteria for participants in the study encompassed being aged 18 and over, having a diagnosis of depression, under the care of NHS services, and either experiencing maternal loss or having recently given birth.

Exclusion criteria:

1) Having a defect in neurocranium and/or an implant inside the skull.

2) Having an active, implanted medical device (e.g., cardiac pacemaker, spinal cord stimulator, vagal nerve stimulator, auricular stimulator, deep brain stimulating electrodes, cochlear implant, implanted hearing aid or defibrillator) or other implanted, metallic, or electronic device.

3) A history of hypomanic/manic episodes.

4) History of stroke, epilepsy and seizures, hydrocephalus, brain tumours, severe migraine, or other serious neurological condition.

5) Currently pregnant.

6) Open wound in area of pad contact on forehead.

2.4. Participants

Thirteen female participants were recruited for the study, five (38.46%) had experienced maternal loss and eight (61.54%) reported postpartum depression. All participants used Flow for a minimum of 5 weeks or completed at least 15 sessions. Their ages ranged from 29 to 40, ($M = 35.31$, $SD = 3.57$).

Among the thirteen participants, two (15.38%) used Flow as a standalone treatment, without concurrent antidepressant medication or psychotherapy. Ten (76.92%) used Flow alongside antidepressant medication (such as Sertraline, Aripiprazole, and Venlafaxine), while five (38.46%) of these participants combined Flow with psychotherapy (e.g., one-on-one compassion-focused therapy [CFT]; cognitive behavioural therapy [CBT]; or Eye Movement Desensitisation and Reprocessing [EDMR]). One (7.69%) participant combined Flow and psychotherapy.

Regarding adherence to the Flow protocol, five participants (38.46%) followed it precisely, using the device five times a week for three weeks, then three times a week for the subsequent three weeks. Three participants (23.08%) deviated slightly from the protocol but still completed all 24 sessions. Another two participants (16.67%) missed one session, while three (25%) missed more than one but still completed at least 15 sessions.

Twelve participants (92.31%) opted to continue using Flow. Among them, five (38.46%) were actively continuing with their usage, four (30.77%) expressed intentions to continue.

2.5. Settings

Flow was provided by professionals from the Specialist Perinatal Mental Health Service and Maternal Loss Psychology Service and Flow treatment was administered by the participants in their homes. All participants resided in the community in a single UK county.

2.6. Intervention

Flow FL-100, classified as a Class IIa medical device with Conformite Europeene (CE) marking for treating major depressive disorder (MDD), holds the 'Breakthrough Device' designation from the United States (US) Food and Drug Administration (FDA), indicating its potential for effective treatment. Available for direct purchase through the manufacturer's website in the European Union and other European nations, Flow has been utilised by over 15,000 users in the UK/EU and is offered by more than 70 private healthcare providers.

In adherence to the treatment protocol, patients are required to remain awake and self-administer five sessions weekly for the initial three weeks, followed by three sessions weekly for the subsequent three weeks, totalling 24 sessions with a maximum duration of one 30-minute session daily. Following the initial six-week period, patients have the option to self-administer up to three sessions weekly for as long as they desire.

Flow treatment is concurrent with ongoing treatments such as antidepressant medication, face-to-face psychotherapy, or online psychotherapy. The anode is positioned over the left dorsolateral prefrontal cortex (DLPFC) (F3 on the international 10/20 EEG system) and the cathode over the right DLPFC (F4), with stimulation set at 2 mA for 30 minutes. The Flow mobile phone software app offers seven optional brief healthy lifestyle behaviour therapy training sessions, approximately 20 minutes each, with the user choosing the pace of completion. These sessions, titled 'The basics', 'Choosing your actions', 'Mindfulness meditation', 'Exercise for your brain', 'The anti-depression diet', 'Therapeutic sleep', and 'Looking back and planning ahead', provide insights into the links between behaviour and wellbeing, offering strategies to enhance wellbeing and alleviate depressive symptoms.

The Flow mobile phone software app serves as the control interface for the Bluetooth-connected Flow FL-100 tDCS headset via the user's smartphone. In addition, Flow provides a means for users tracking depression symptom levels by weekly administering the nine-question Montgomery-Åsberg Depression Rating Scale Self-report (MADRS-S) (Fantino & Moore, 2009) via the user's smartphone prior to a tDCS session. Flow provides an integrated on-line platform for remote monitoring of patients and customisation of protocol by the patients' healthcare clinician.

2.7. Procedure

After diagnosing depression (utilising a PHQ-9), a healthcare professional evaluated their eligibility based on the study's inclusion and exclusion criteria. They

provided an overview of Flow and the study's requirements, gauging the patient's interest. The patient received a participant information sheet. An opportunity was provided for the patient to ask questions before choosing to consent to participate and completing the consent form, with all given the right to withdraw without reason throughout. The participant was then equipped with the Flow device, accompanied by instructions on its usage, guidance on accessing further instructional materials, and email support available on the Flow Neuroscience AB website. Subsequently, Participants received contact from the healthcare team to monitor usage and address any concerns. At the conclusion of the intervention period (between 6 to 8 weeks) eighteen participants were offered the opportunity to participate in a phone interview. Reasons for declining the interview included non-usage of Flow, delayed initiation, interruptions in usage, inability to participate in an interview, or non-response to the request. For those who agreed, interviews were undertaken over the phone, with audio recordings conducted using encrypted equipment. Upon transcription and anonymisation of the interviews, the audio recordings were deleted. The interview transcripts were securely stored within a password-protected drive. Following informed consent, demographic information, was extracted from clinical records containing routinely collected data.

2.8. Data Analysis

Interpretative Phenomenological Analysis (IPA) was used to investigate how participants derived meaning from their experiences with Flow (Smith et al., 2009); an inductive method, employed not to validate predetermined hypotheses but to uncover new concepts related to the topic being investigated. To ensure a comprehensive understanding of the data and a robust interpretation, initial analyses were conducted independently by a researcher and an individual with postpartum depression experience.

The analysis adhered to the IPA framework and encompassed four main stages (Pietkiewicz & Smith, 2014). Initially, audio recordings were listened to multiple times, followed by repeated readings of the transcripts until a deep familiarity with the data was achieved. At this juncture, the researcher made notes encompassing observations and comments regarding the interview experience, focusing on language use (metaphors, repetitions) by participants, their background/context (noting instances where participants were with their children during the interview), and any emotional responses elicited.

The second stage involved noting down the content of each verbatim sequence, leading to the third stage, where the researcher and the individual with lived experience synthesised these notes into emerging themes, subsequently refined into subordinate themes. Finally, the last step entailed identifying connections among subordinate themes, grouping them where feasible, and assigning them to overarching superordinate themes. Some subordinate themes were excluded at this point due to insufficient evidential support. The final step involved comparing and contrasting superordinate and subordinate themes across all in-

terviews. Additionally, this process was repeated to ascertain differences or similarities in themes between participants who had experienced maternal loss and those with postpartum depression.

3. Results

Two superordinate and ten subordinate themes were identified in the data (see Figure 1 for more details). The 'User experience with Flow' theme comprises six subordinate themes focusing on participants' Flow treatment experience. This included their acquisition of the device; ease of technology use; preference for non-medication options; ease and obstacles of new routine; management of practical issues; discomfort; and varied engagement with the training app. The 'efficacy and impact of Flow treatment' theme consists of four subordinate themes that delve into participants' experiences of improvement across various domains, including depressive symptoms, mood, sleep quality, and behavioural changes. Overall, this theme captures the value the Flow treatment had on participants' lives.

User experience with Flow

Effortless collection, setup & navigation

All thirteen participants highlighted the effectiveness and ease of the Flow collection process. They used language such as "*smooth*", "*fine*", "*quick*", "*easy*", and "*straightforward*" to depict the process. Additionally, seven participants specifically underscored the efficiency and helpfulness of the professionals providing Flow.

P18: *Yes, everything went really smoothly for me, everything was explained to me and I had leaflets and I the app and everything… it was brilliant…*

All thirteen participants found the device setup easy, guided by the app's visual instructions, including video demonstrations, making it straightforward to follow. The app's 'Basics Training' feature, with its step-by-step guidance and positioning checks via the camera, was praised for simplifying the process.

P9: *Yes, really helpful because not only did it tell you, it showed you… I also liked that after the few times of doing it initially, it then went to almost like a quick set-up.*

P12: *Yes, for the position of the headset. Because you've got the camera that every time you put it on… to check that it's all right.*

However, one participant (P22) offered suggestions for improvement, highlighting the difficulty comprehending the booklet found in the Flow package, suggesting that presenting the information in a more visually engaging format, such as using colour and pictures, could enhance comprehension.

Acknowledging the value of non-medication treatment options

Nine participants expressed gratitude for the opportunity of a treatment alternative to medication. Concerns about the long-term effects associated with antidepressants and previous negative experiences led them to non-pharmaceutical solution preferences, particularly important for those with childcare responsibilities.

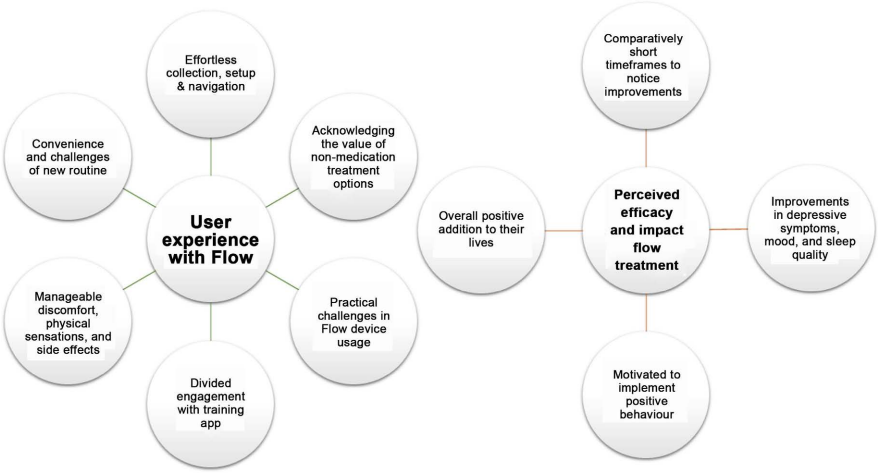

Figure 1. Superordinate and subordinate themes.

P7: *Just from people that I know that have taken antidepressants. Whilst they've said that they helped them, I know that it's a long-term thing that they have to take them, but also I've been told that you don't feel the highs as well as the lows. It just levels you out, is what I have been told. I've got two young children, I don't want to not be able to feel the highs.*

P8: *Because I wanted to try something without taking tablets… I've reacted* [*adversely*] *to the antidepressants before.*

For four participants, it was seen as a last resort after exhausting other treatment options, suggesting a desire for earlier access to Flow:

P10: *Yes. I had exhausted all my other options. I think it could have been offered sooner, to be honest. I'd taken lots of different medications. It hadn't really worked. I'm quite treatment-resistant, so I think it was offered to me for that.*

Manageable discomfort, physical sensations, and side effects

Two out of thirteen participants reported negative side effects. P5 stated: "*I started to get pain on my left temple. It made the skin come away*". Believing the pads caused a skin reaction after prolonged use, P5 paused the sessions but eventually completed all of them. P10 reported a possible side effect, mentioning, "*I think I had maybe one headache, but I don't know that I'd attribute it directly to the Flow device*".

All participants reported various physical sensations during and after using the Flow device, including tingling, burning sensation, and itching, primarily concentrated around the areas where the pads were placed. Some likened these sensations to pins and needles or small electric shocks, but for all but one, they did not find them severe enough to discontinue use.

P5: *So, I felt like a tingling. Then, the more I used it on the left side, the more that tingling started to become quite sharp. A little bit, like pins and needles type, like lots of little pins.*

P7: *Yes, a tingling where the pads sit. Like an itchy, burning sensation. Sometimes it's not for the whole* 30 *minutes, it kind of comes and goes. Sometimes it gives me pressure headaches, but not so much anymore that was more at the*

start. But only whilst using it.

P9: *So, it was more so on my left temple than my right, but tingly, burn-y and then itchy afterwards. I just used moisturiser and it relieved the symptoms. It wasn't enough for me to want to stop.*

Practical challenges in Flow device usage

Nine participants encountered practical challenges, such as wetness from the pads, lack of awareness regarding the availability of free pads, and a log into app issue.

Four participants reported wetness from the pads. "*When you've got the device on, the wet sponges… it drips all down your face because they're very wet*" [P8].

Five participants mentioned running out of pads for the Flow device after completing the recommended sessions, unaware that they could potentially receive additional pads from their healthcare provider if they wished to continue using the device. Consequently, they either intermittently used the device thereafter or discontinued sessions entirely. One participant highlighted financial constraints preventing her from purchasing more pads to continue the sessions:

P15: *I had it over Christmas, it was paying to get more pads if I wanted to continue. I just couldn't afford to do that at the time.*

Despite these challenges, the majority of participants persisted with the treatment, with only one participant discontinuing.

Convenience and challenges of new routine

All thirteen participants used the Flow device in the evenings, finding it convenient after their children had gone to bed, during moments of quiet solitude, or because Flow made them feel sleepy or tired.

P7: *I used it a nighttime, like in the evening when my children had gone to bed. Just because it's easier, I can sit down and be in one place, and not having to get up and do anything else for anybody.*

However, adherence to the recommended schedule varied, with seven participants not using it due to forgetfulness or other life commitments.

P9: *The times where I've either had to pause it—so, I've got baby twins and I've got a six-year-old, so there were times where I'd have to pause it or go back to it.*

P16: *Just because of life really. Yes, some nights I just forgot.*

Despite occasional missed sessions or deviations from the schedule, participants valued the opportunity that the new routine provided for relaxation. Six participants emphasised the benefits of having a period for themselves, which the sessions facilitated:

P14: *Maybe having the time to de-stress. It's giving me a bit more energy and motivation to do things maybe… One of the things I struggle with is having a highly stressful lifestyle, it would force me to sit and take the time out, and I think that's helpful.*

Divided engagement with training app

Participants provided general feedback on their engagement with the training

available on the software app. Six out of thirteen participants found the software beneficial, enhancing their knowledge:

P4: *Yes. That was the thing with the calendar, wasn't it, and filling in the days, things like that* [referring 'Looking back and planning ahead' training]. *That was quite helpful as well.*

P5: *The training on there was really helpful. It was almost like CBT training… It came up with some really good ideas and some really good tips.*

P9: *Having had psychotherapy previously it's almost like revision for me because it was going over things that I'd done before, and it was just making it fresh and relevant.*

However, one participant (P18) could not recall any of the available training. Both P12 and P22 acknowledged the helpfulness of the trainings, although P12 expressed that the software's design did not align with her learning style, stating, "*I think they're helpful, but the design of how you learn the information I didn't think was for me, it wasn't how I would like to learn*". P7 and P14 discussed a lack of time to engage in the training, with P7 admitting, "*Just finding the time, to be totally honest*", and P14 explaining, "*It's difficult because I've got two young children, but I also care for my mum who's got dementia.*" Participant P15 did not participate in any trainings due to an inability to focus, and P16 felt the content repeated information they already knew from previous CBT courses.

Perceived efficacy and impact of Flow treatment

Twelve out of thirteen participants highlighted an overall positive experience with Flow and some perceived positive outcomes. However, one participant, P15 (who had experienced maternal loss) after completing all recommended sessions chose not to continue with Flow, stating that it "*did not improve her mental health*" and that she still remained "*severely depressed*". Additionally, she stated that she did not engage in any of the training available on the app software due to her inability to focus, saying, "*I'm just not in the right headspace. I mean, at the moment, I can't even pick up a book and read it*". As participant P15 did not report any improvements or worsening of symptoms, her data will not be included in the further results section.

Comparatively short timeframes to notice improvements

Twelve participants reported noticing improvements in their symptoms after using Flow consistently for several weeks. The timeframe varied among individuals, with seven participants experiencing changes as early as two to three weeks.

P6: *I think like now, after starting using Flow and then after a couple of weeks I just feel a little bit more energised and more willing to do things.*

Three participants (P7 and P18) noted improvements after three to four weeks, and one participant (P4) experienced changes after 5 - 6 weeks. Despite individual differences, many participants observed feeling more energised, motivated, and mentally healthier after using Flow for a sustained period.

Improvements in depressive symptoms, mood, and sleep quality

The participants' accounts of using the Flow device revealed perceptions of a range of positive effects on depression, mood, and wellbeing. While not all par-

ticipants experienced improvements in sleep, the general consensus was that the Flow device had a beneficial impact on their mental health, enabling them to cope with daily challenges with increased resilience and optimism.

Ten participants reported improvements in mood and depressive symptoms. P4 and P6 suggested that using the device may have contributed to stabilising their mood: "*I think it probably made me feel a bit more stable. Just less all over the place*" [P4]. For P6 changes were also noticed by their family: "*My family says like basically there is a bit of difference in my moodiness and being able to do stuff… I think now I just feel a little bit more active and just willing to do more things, that would give me more trouble before*" [P6]. Participant P5 felt more equipped with better coping strategies: "*So, alongside the Flow and the training, I think I was equipped more with tips and things to deal with different things*". Participant P22 experienced a decrease in the tendency to dwell excessively on thoughts or worries and now possesses a more optimistic perspective in life: "*I've stopped ruminating over things as much*".

Participant P8 and P22 observed a reduction in anxiety, expressing, "*I'm not anxious on a day-to-day basis*" [P22]. Participant P18 articulated, "*Well, I don't have suicidal thoughts anymore*", indicating a marked improvement in depressive symptoms. Furthermore, Participant P22 described her depression as "*dissolved*", noting a subsequent positive impact on suicidal ideation: "*It completely changed… it got rid of it effectively*". In addition, two participants self-reduced their antidepressant medication due to improved well-being, "*Yes, I have to take them every day, but I was only taking them probably three or times a week*" [P18]; "*I've reduced my Sertraline from* 75 *milligrams down to* 50, *probably after about four weeks of using the device*" [P9]; while two participants had intentions of reducing it: "*My depression is a lot better now. I've actually spoken to my psychiatrist about reducing my medication, which is great*" [P10]. Participant P7 experienced a significant improvement in clarity and ability to handle symptoms:

P7: *I felt like I was walking around in a fog and that fog cleared, so whilst I still have issues, symptoms, and things I still need to deal with, I feel like I'm in a better position to deal with them. Whereas before I just couldn't face them.*

Six participants reported enhanced sleep quality, "*it did help me to sleep a bit better because it did make me tired*" [P4]; while participant P5, P9, P14, and P22 discussed how it was easier to fall asleep: "*To shut off quicker on an evening, so my brain isn't as racy before I go off to sleep*" [P5]; "*I've found it easier to settle at night*" [P14]; while P8 said "*I'm not as awake as many times*". One participant no longer had problems waking up and associated enhanced sleep quality with ability to cope:

P7: *I have a lot of issues with waking up. About four weeks into using Flow that stopped. My sleep is much better, which helps to deal with the other symptoms of depression and anxiety.*

Motivated to implement positive behaviour

Positive behavioural changes were reported by all twelve participants, encom-

passing various aspects of their lives: motivation, social interaction, achievement of life goals, diet, and exercise. Positive changes in diet were noted by five participants: "*My eating has gone back to normal now. Before I used the Flow I weren't really eating properly*" [P12]; "*I suppose, see I'd not had much of an appetite, and I suppose my appetite for my normal breakfast, lunch, dinner has improved slightly*" [P16]; "*I used to binge eat, but I've stopped*" [P18].

Three participants did not report changes in physical activity as they were already active with childcare or dog walking (P6, P7, P22). Five others (P9, P10, P12, P14, P16) did not notice changes. However, four participants reported positive changes: two began walking (P4 and P8), one started gentle exercise (P5), and one initiated exercise and felt motivated, "*I started exercising since starting Flow, and I've just got that motivation and that that drive. Which is something I've lacked a lot of*" [P18].

All twelve participants reported increased motivation, finding it easier to accomplish tasks. Three participants also noted improvements in achieving life goals: P7 "*managed anxiety better*", P18 "*lost weight*", and P14 felt more productive. The enhancement in motivation had broader implications for participants' lives. For example, P5 started a business, expressing improved motivation and confidence. P5 also looked forward to using the Flow headset for attending psychotherapy, whereas previously, she had "*dreaded it*". Participant P7 reported better planning for her business. In addition, the improvement in motivation had a broader impact on various aspects on life for participants. P9 noted improved libido and P16 resumed gardening, which she had enjoyed before depression. P22 observed an improvement in motivation which marked a return to self-care routines, such as getting dressed and maintaining body hygiene, signalling a revitalised engagement with daily life.

Four participants reported enhanced social interactions, "*Well, I'm a bit more sociable now. I don't feel as nervous talking to people*" [P8]. P22 reported a shift in mindset and behaviour, expressing her newfound willingness to engage socially compared to their previous reluctance and anxiety about leaving the house: "*…the thought of going anywhere just seems like an absolute mammoth task*". Five participants reported positive changes in their family lives, including enhanced relationships with their children, increased desire to spend time with them, and improved connections with their partners:

P8: *Well, I'm a bit more like my old self. I'm a bit more wanting to go out of the house and do things with my daughters.*

P18: *So I'm able to enjoy my children a lot more, which is really good for me and the kids.*

P22: *Once I hit like week four* [*of using Flow*] *I was interested in what my partner was doing at work, conversations even if it was about what were we having for dinner.*

Four participants mentioned work:

P16: *Well, it's much easier for me to go to work and do my work because at the end of last year, I was having massive problems because being motivated to*

do anything at work, and I had to sign myself off.

Overall positive addition to their lives

Overall, the participants expressed positive experiences with the Flow device. They described it as "*effective*" and "*easy to use*". Participant P4 stated, "*It's been a positive experience for me*", with P9 stating, "*Positive. Yes, it's easy and quite effective and it's something I would recommend*". Moreover, participants highlighted the device's ability to help them deal with challenging situations and improve their quality of life. Participant P7 remarked, "*It's got me to a place where I can deal with things that I didn't think I'd ever be able to deal with*"; P22 highlighted the value of Flow as a tool to rely on during difficult times and expressing gratitude for the opportunity to utilise it.

4. Discussion

The findings offer valuable insights into the user experience and perceived value of Flow. The user-friendly nature of the technology, coupled with the availability of visual instructions and app-based training, was perceived favourably, aligning with previous research emphasising the importance of intuitive design in promoting user engagement (Grycuk et al., 2021). All participants reported effortless Flow collection aided by supportive staff, these findings align with the previous qualitative tDCS study (Griffiths et al., 2024). Also, it shows similar results as previous research suggesting that the ease of use and accessibility of tDCS devices play a crucial role in promoting adherence to treatment protocols (Bikson et al., 2016).

Participants appreciated the opportunity for a non-medication treatment alternative, citing concerns about the long-term effects and previous negative experiences with antidepressants, echoing previous research (Gartlehner et al., 2017; Griffiths et al., 2024). This preference for non-pharmaceutical solutions underscores the importance of offering a range of treatment options tailored to individual needs and preferences, particularly among populations with childcare responsibilities.

While the majority of participants demonstrated adherence to the Flow treatment protocol, several practical challenges were reported, all which can be easily remedied. These challenges highlight the importance of providing adequate support and resources throughout the treatment process, as well as the need for clear communication regarding device maintenance and pad replenishment procedures. Although most participants reported tolerable discomfort and slight physical sensations during and after using the Flow device (as demonstrated by Chhabra et al., 2020 and Griffiths et al., 2023), the variability in experience underscores the diversity in how individuals respond to the treatment.

Several participants stated that the trainings available on the software app provided them with valuable insights and advice, resulting in positive changes in behaviour. For some participants, the training acted as a useful reinforcement of their existing knowledge, helping them maintain their well-being. This finding is in line with previous research demonstrating the benefits of combining Flow's

software app wellbeing behaviour training, covering areas such as physical exercise, nutrition, mindfulness, sleep, and behaviour activation (Griffiths et al., 2023; Rimmer et al., 2022; Sobral et al., 2022; Woodham et al., 2022). The reasons for not engaging with the available training varied among participants and included inability to recall the training; mismatch with learning style; lack of time; lack of engagement with content; inability to focus due to mental health issues; and perception of redundant information. To boost participant engagement with the app's training, it is important to offer content for different learning styles, ensure accessibility, incorporate feedback mechanisms, provide incentives for completion, and education on the importance of the training app in supporting wellbeing.

The theme 'Perceived Efficacy and Impact of Flow Treatment' showed significant improvements, reported by the participants, in depressive symptoms, mood, and sleep quality, with consistent use of the Flow device, which aligns with existing literature (Griffiths et al., 2023; Griffiths et al., 2024). Participants reported a positive impact on broader aspects of life, including increased motivation, social interaction, and achievement of life goals. These findings underscore the holistic impact of Flow on participants' overall well-being, highlighting its potential to promote resilience and improve quality of life beyond symptom reduction. Several participants expressed feeling more energised and willing to engage in activities they previously avoided, such as going for walks or doing household chores. Many reported increased motivation, productivity, and optimism, alongside a reduction in anxiety and depressive symptoms. Some noted positive changes in social interactions and a newfound ability to address personal challenges and responsibilities. Additionally, participants observed improvements in eating habits, weight management, and the establishment of healthier routines, including regular exercise. Participants experienced tangible benefits from using Flow, indicating its potential to enhance mental well-being and daily functioning. However, one participant did not report improvements in symptoms or engage with the training available. Their perspectives highlight the variability in treatment response and the need for personalised approaches and alternative treatments, emphasising the importance of ongoing monitoring and support to address individual needs and preferences.

Participants' accounts of increased motivation to spend quality time with their children underscore the wider impact of Flow treatment on family dynamics and functioning. Research suggests that positive parental involvement and family cohesion serve as protective factors against the adverse effects of parental mental health problems on children (Goodman, 2008). Thus, the observed improvements in parental engagement following Flow treatment have the potential to mitigate the negative consequences of maternal depression on children's emotional, social, educational, and behavioural outcomes.

In qualitative research, sample size determination lacks a fixed rule, but data collection typically ends upon achieving saturation and obtaining satisfactory information, with a minimum sample size of ten often considered sufficient

(Creswell, 2013; Polit & Beck, 2006). Following this approach, data collection for this study concluded after interviewing thirteen participants, however, sample size restricts generalisability. Due to recruitment through an NHS service in a single county of the UK, generalisability to other settings is reduced. However, these services across the NHS operate under the same requirements and delivery models. Participants in this study self-selected, which can introduce bias, as more people with a positive experience may be willing to be interviewed and their experiences and perceptions may differ from those who did not wish or felt unable to be interviewed.

This study represents the first qualitative exploration of Flow's impact on individuals with depressive symptoms under the care of a Specialist Perinatal Mental Health Service and Maternal Loss Psychology Service. It contributes to our understanding of the treatment's value in addressing depression symptoms. Longitudinal studies are essential to investigate the long-term effects of Flow treatment for depression. Moreover, Flow may offer a promising non-pharmacological intervention for pregnant women experiencing symptoms of depression. Untreated depression can lead to complications such as intrauterine growth retardation and disturbances in maternal-child relations (Dubovicky et al., 2017). However, treating depression with antidepressants like SSRIs may pose risks to the developing foetus, potentially affecting brain development and behaviour (Ogelman et al., 2024). Therefore, pregnant women could benefit from non-invasive alternatives like tDCS, which offer effective treatment options without the risks of antidepressants. tDCS has a favourable safety profile in pregnancy (McAllister-Williams et al., 2017; Laurin et al., 2022).

5. Conclusion

This study offers valuable insights into the feasibility, user experience, and perceived effectiveness of Flow tDCS treatment for depression in the context of perinatal and maternal loss of mental health. While additional longitudinal qualitative research is necessary to investigate the longer-term effect of Flow, the results suggest that Flow treatment is a valuable and acceptable intervention for individuals experiencing depression.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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