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Original Article

Enrollment-Cost and Recruitment Effectiveness in a dTMS Clinical Trial for Older Adults with Depression: A Mixed-Methods Analysis of Recruitment Strategies, Facilitators, and Barriers

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Enrollment-Cost and Recruitment Effectiveness in a dTMS Clinical Trial for Older Adults with Depression: A Mixed-Methods Analysis of Recruitment Strategies, Facilitators, and Barriers

Short Title: Recruitment Effectiveness in a dTMS Trial for Older Adults

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ABSTRACT

Objective: Recruitment challenges are inherent in clinical research, and are particularly pronounced in older adults with depression, who often face unique barriers such as medical comorbidities and infrequent help-seeking behaviour. Neurostimulation techniques, like deep transcranial magnetic stimulation (dTMS), are often unfamiliar to patients within the healthcare system. Existing literature offers limited insight into the costs and practical guidance associated with recruitment strategies in dTMS trials. This study aimed to address these gaps by investigating the cost-effectiveness of various

recruitment strategies for dTMS trials among older adults. Furthermore, we examined potential facilitators and barriers to recruitment.

Methods: This mixed-methods retrospective analysis examined recruitment data from our pilot study investigating the effects of dTMS in older adults with depression. We assessed diverse recruitment methods by analyzing enrollment rates and conducting an enrollment-cost analysis. Recruitment-related barriers and facilitators were identified using a theoretical thematic analysis.

Results: Over a 14-month period, we received 185 referrals, yielding 22 enrollments. Healthcare provider outreach to affiliated mental health clinics was the most effective recruitment method, with an enrollment-cost rate (ECR) of 0.00189 (\$537.63 CAD/person enrolled). The second most effective recruitment method was Facebook, producing an ECR of 0.00099 (\$925.93 CAD/person enrolled). Social support from research personnel was a potential facilitator of recruitment, while time-intensiveness and accessibility challenges were noted as potential barriers.

Conclusion: Our findings highlight both healthcare provider outreach within mental health clinics and Facebook advertising as effective recruitment strategies. Future research is warranted to evaluate recruitment-related facilitators and barriers to dTMS interventions for older adults with depression.

Keywords: Clinical trials, Deep transcranial magnetic stimulation, Geriatrics, Neurostimulation, Psychiatry

IRB Statement

The current manuscript's data was obtained from our clinical trial registered on Clinicaltrials.gov (ID: NCT05855850). This clinical trial received ethics approval from the Hamilton Integrated Research Ethics Board in Hamilton (HiREB) under project #15344. All participants provided written informed consent prior to enrollment.

1. INTRODUCTION

Recruitment is an ongoing challenge in clinical research. Low recruitment rates increase the likelihood of significant delays, prolonged expenses, insufficient sample sizes,¹⁻⁴ and early trial termination.^{5,6} A cross-sectional analysis of over 600 terminated

trials from ClinicalTrials.gov reported that 57% were ceased due to low recruitment rates.⁵ Moreover, in a review⁷ of 114 randomised controlled trials, only 31% of the trials met their recruitment goals, with 53% requiring an extension. Reasons for extension were related to recruitment delays caused by overestimating the number eligible participants, staffing issues, and a lower-than-expected willingness to participate.⁷

Special populations, such as older adults with depression, pose an added challenge for clinical trial recruitment. Older adults have higher rates of comorbidities,⁸⁻¹⁰ which may affect their eligibility to participate in clinical trials. Older adults are also more likely to have functional and mobility impairments,^{11,12} potentially affecting their ability to travel to in-person sessions. Transportation challenges may also affect an older individual's willingness to participate in research.¹³ A survey¹⁴ of 150 older adults revealed that only 44% were inclined to participate in a clinical trial, with the most common reasons for declining being (1) fear of harming their health and (2) believing they are too old. Older adults with psychiatric conditions are also less likely to seek professional help as compared to younger age groups,¹⁵⁻¹⁷ possibly due to negative perceptions towards mental health care, medical comorbidities, and limited access to geriatric healthcare providers.¹⁷ In older adults with anxiety and depression, these concerns may come hand in hand with additional worries, including apprehension about social stigma and skepticism toward mental health treatments and related costs, thus deterring them from seeking professional help.¹⁶

The current literature lacks in-depth information on recruitment strategies for clinical trials research in older adults with psychiatric conditions, such as major depressive disorder (MDD). Of the limited articles examining recruitment in older adults

with depression, the respective studies investigated psychotherapy¹⁸ and preventative wellness interventions.¹⁹ However, the effectiveness of recruitment methods used in neurostimulation interventions, such as deep transcranial magnetic stimulation (dTMS), for older adults with MDD remain unexamined. dTMS is a non-invasive brain stimulation technique often involving daily treatments over an acute period.^{20,21} Unlike psychotherapy and wellness interventions, which employ psychosocial approaches and are associated with minimal side effects, dTMS stimulates distinct brain regions and poses greater risks, including headaches, scalp discomfort, and a rare risk of seizure.²² These features may make dTMS sound intimidating or less familiar to potential participants, consequently posing a barrier to recruitment. Research is needed to provide insights into the effectiveness of recruitment methods for trials involving novel, and unfamiliar, neurostimulation interventions like dTMS. A pilot trial of our group aimed to examine the feasibility, tolerability, and clinical effects of dTMS in older adults with treatment-resistant MDD. However, insights into the effectiveness of various recruitment techniques in older adults are lacking and these insights are pivotal to advance dTMS trial recruitment in this population.

This retrospective mixed methods analysis addresses a critical gap in the literature on recruitment methods in dTMS trials in older adults with MDD. To our knowledge, no studies have been published to bridge this gap. We aimed to (1) analyze the effectiveness of the diverse recruitment methods — including online advertising, physician referrals, and community outreach — used in our pilot trial, and to (2) identify potential facilitators and barriers to recruitment in this population. We applied Braun and Clarke's (2006)²³ theoretical-thematic analysis model to evaluate participants' verbal

responses from semi-structured interview data. Understanding these factors is essential to overcome recruitment challenges and optimize accrual rates in older adults with MDD.

2. MATERIALS and METHODS

2.1 Study Overview

This retrospective mixed-methods analysis evaluated quantitative and qualitative recruitment data from our group's open-label clinical trial (Clinicaltrials.gov ID: NCT05855850) conducted at St. Joseph's Healthcare Hamilton, Ontario, Canada. The trial recruited older adults aged 60 to 85 with moderate-to-severe MDD as defined by *the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)*. Primary inclusion criteria included a score of ≥ 20 on the Hamilton Depression Rating Scale 24-Item (HDRS-24) and treatment resistance to antidepressant therapy. Exclusion criteria included diagnoses of Axis I disorders other than depression, contraindications to dTMS treatment, or a diagnosis of mild or major neurocognitive disorder. A complete list of inclusion and exclusion criteria is provided in Supplemental Methods. The study received ethics approval from the Hamilton Integrated Research Ethics Board (HiREB) on January 29, 2023 and began recruitment in April 2023 (Project ID # 15344).

Potentially eligible participants were assessed for eligibility via an online or telephone screening. If initially eligible, they were invited for an in-person screening to review medical history and identify contraindications to dTMS (i.e., seizures, pacemaker, etc.). After obtaining consent, participants received a brief adaptation

demonstration of the dTMS BrainsWay™ device to (1) ensure comfort with stimulation and to (2) assess whether 20 sessions of dTMS would be tolerable.

All participants provided written informed consent prior to enrollment. Enrolled participants received daily dTMS sessions, five days a week for four weeks, for a total of 20 treatments. Each session lasted approximately 30 minutes. Depressive symptoms and electroencephalography (EEG) were recorded at baseline and at every fifth visit. Side effects were routinely evaluated (Figure 1).

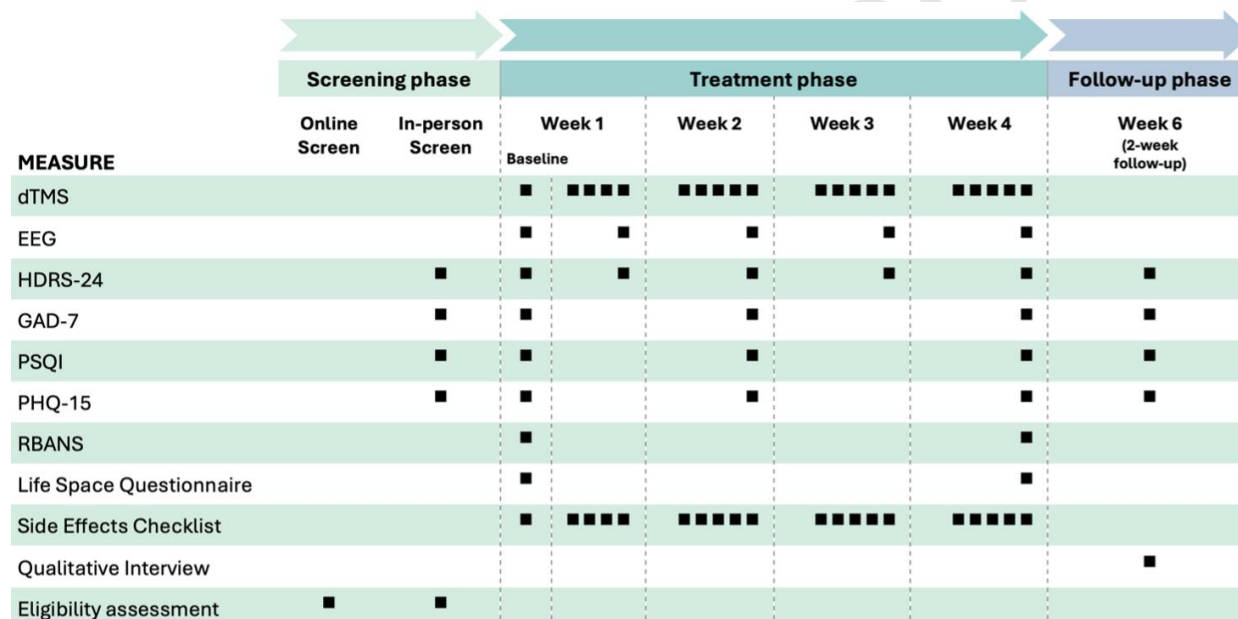


Figure 1. Study timeline and outcome measures.

Abbreviations: BL = baseline; dTMS = deep transcranial magnetic stimulation; EEG = electroencephalogram; GAD-7 = Generalized Anxiety Disorder 7; GDS-30 = Geriatric Depression 30-item Scale; HDRS-24 = Hamilton Depression Rating Scale 24-item; PHQ-15 = Patient Health Questionnaire; PSQI = Pittsburgh Sleeping Quality Index; RBANS = Repeatable Battery for the Assessment of Neuropsychological Status.

2.2 Recruitment strategies

To enhance recruitment rates, we employed various recruitment strategies from April 2023 to May 2024. Potential participants were asked how they heard about the study. Participants either self-referred in response to advertisements or were referred by a healthcare provider familiar with the study. Interested individuals could contact our research team to complete a telephone eligibility screening or submit an online screening form. Only those who were interested and met the initial eligibility criteria were invited to attend an in-person screening for a thorough eligibility assessment. Recruitment methods included community engagement and outreach, family medical clinics, healthcare provider outreach within affiliated mental health clinics, newspaper advertising, and online advertising (i.e., Craigslist, Facebook, etc.). For an exhaustive list of recruitment strategies and implementation timelines, see Table S1 and Figure S1.

2.3 Measures of recruitment method effectiveness

To evaluate the effectiveness of recruitment methods, we focused on two key indicators: enrollment rates and enrollment-cost rates. These metrics were selected because they capture the yield and resource-efficiency, which are critical for optimizing study feasibility and budget allocation during the recruitment phase. Consistent with previous research,^{24,25} cost analyses are a valuable tool for assessing and comparing the effectiveness of different recruitment strategies.

2.3.1. Enrollment rates. Enrollment rates were calculated by dividing the number of enrolled participants (N_E) by the number of referrals (N_R) for each recruitment source. Referrals (N_R) were defined as individuals who either completed the online screening

form or contacted the research team to express interest in study participation (e.g., via email or phone). For healthcare provider outreach, a referral was counted only if the patient expressed interest and consented to be contacted by the research team, either directly or through the provider. Incomplete screening forms or number of online advertisement views were not considered referrals.

Enrolled participants (N_E) were defined as individuals who met eligibility criteria, signed the informed consent form, and initiated treatment. Individuals who were excluded during screening or who declined to participate were not included in this number.

$$\text{Enrollment rate} = \frac{N_E}{N_R}$$

N_E = number of participants enrolled

N_R = number of referrals received

2.3.2. Enrollment-cost analysis. The enrollment-cost rate (ECR) was calculated by dividing the number of enrolled participants by the time and cost incurred per recruitment method. Higher ECR values indicated greater recruitment effectiveness. Research personnel estimated the number of hours spent and costs associated with each recruitment method. Time and cost estimation procedures are described in detail the Supplemental Methods. In this pilot trial, postsecondary research assistants were primarily responsible for recruitment. According to the Canadian Labour Force Survey of 2024,²⁶ the median hourly salary for post-secondary research assistants in Ontario from

2021 to 2022 was \$29 CAD.²⁷ This hourly wage was used as the variable w in ECR calculations.

$$\text{Enrollment-cost rate (ECR)} = \frac{N_E}{w t + c}$$

w = Median hourly wage of research personnel (\$CAD)

t = Time spent (in hours)

c = Cost of recruitment method (\$CAD)

N_E = Number of participants enrolled

2.4 Facilitators and Barriers to Recruitment

We analyzed qualitative interview data to identify facilitators and barriers affecting recruitment. A semi-structured qualitative interview was performed at the 2-week follow-up to assess participants' overall perceptions and attitudes towards the study components. For detailed information on the qualitative interview procedure, please refer to the Supplemental Methods. We conducted a verbal thematic analysis of participants' responses, whereby common themes were identified and manually coded to identify facilitators and barriers to recruitment (see section 2.5 for more details on the thematic analysis).

2.5 Statistical analysis

All statistical analyses were performed using R Studio (Version: 2023.09.1+494).

Enrollment rates across recruitment methods were compared using a two-tailed Fisher's exact test. A Bonferroni post-hoc test was used to adjust for multiple comparisons.

Ninety-five percent confidence intervals were calculated for enrollment rates using the

Agresti-Coull Method. A significance level of $\alpha = 0.05$ was applied for all statistical tests. As detailed in section 2.3.2, enrollment-cost rate analyses were descriptive and did not involve statistical hypothesis testing.

Qualitative interview data were analyzed using Braun and Clarke's (2006) theoretical thematic analysis model.²³ This model describes a six-step framework, whereby sentiments or "themes" are identified, coded for, and then tallied across the dataset. For additional information on how the thematic analysis was conducted, please refer to the Supplemental Methods.

3. RESULTS

3.1 Sample characteristics

This study retrospectively analyzed data collected over a 14-month period from our pilot trial. From April 1 2023 to May 27 2024 (i.e., the end of the recruitment period), a total of 22 participants with MDD were enrolled and 19 completed the study.

The intention-to-treat sample ($n = 22$) consisted of 13 females (59.09%) and 9 males (40.91%) with a mean age (SD) of 69.41 (6.0). All were of White/European ancestry. Regarding education level, 10 participants (45.45%) had a Bachelor's degree or higher (i.e., a Master's degree or a professional degree). Five participants (22.73%) reported having undergone some college or university and two (9.09%) had an associate's degree. Four participants (18.18%) had completed high school and one participant (4.55%) had less than a high school education. Nearly all participants were retired (19; 86.36%). Two participants (9.09%) were working full-time and part-time

hours, respectively. One participant (4.55%) was on disability. The mean HDRS score (SD) at baseline was 30.18 (4.94), with all participants having moderate-to-severe MDD.

3.2 Recruitment, referrals, and enrollment

From April 1 2023 to May 27 2024, we received 185 referrals (Figure 2). Of the 185 referrals, 138 (74.59%) were self-referrals from Facebook; 38 (20.54%) were referrals from inpatient and outpatient mental health clinics within the St. Joseph's Healthcare Hamilton hospital network; 5 (2.70%) were self-referrals from individuals who viewed our local newspaper advertisement; 2 (1.08%) derived from community engagement methods, specifically, the McMaster Institute for Research on Aging ($n = 1$) and the Centre for Medicinal Cannabis Research ($n = 1$); 1 (0.54%) was a self-referral from Craigslist; and 1 (0.54%) was a self-referral from Kijiji. No referrals were received via Google or family medical clinics.

After receiving 185 referrals, 45 participants did not show interest in enrolling and 92 participants were ineligible (Figure 2). Twenty-six referrals were excluded due to miscellaneous reasons, such as duplicate referrals (i.e., potential participants who mistakenly filled out a form twice). For more detailed information on the reasons for ineligibility, please refer to Supplementary Table S2.



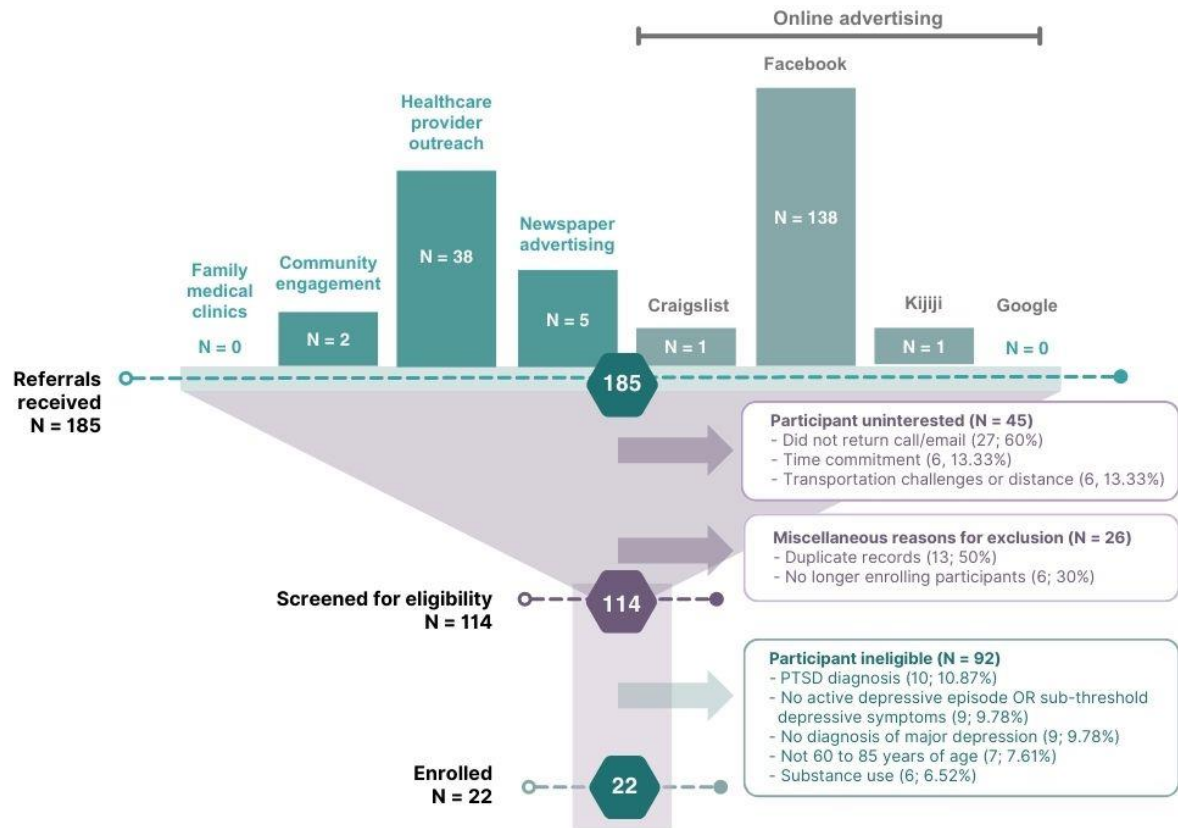


Figure 2. Recruitment flowchart.

Note. Please note that some potential participants had overlapping or multiple exclusion criteria; hence, reported percentages are noncumulative.

3.3 Recruitment method effectiveness

3.3.1 Enrollment rates

The most effective recruitment method regarding enrollment rates was healthcare provider outreach within inpatient and outpatient mental health clinics within the affiliated St. Joseph's Healthcare network (Table 1). This recruitment method produced the highest enrollment rate of 0.316 enrolled participants per referral received (95% CI:

0.190 – 0.475). Facebook was the second most effective recruitment method, with an enrollment rate of 0.072 enrolled participants per referral received (95% CI: 0.038 – 0.130). Following a two-tailed Fisher's exact test, we found a significant difference in enrollment rates between recruitment methods ($p = 0.028$). Following a post-hoc test for multiple comparisons, we noted a trend-level difference in enrollment rates between (1) healthcare provider outreach within inpatient and outpatient clinics and (2) Facebook recruitment methods ($p_{\text{adj}} = 0.079$). Other comparisons were nonsignificant. All other methods had enrollment rates of zero. Figure S2 provides a breakdown of total and cumulative number of enrollments per month by recruitment method.

Table 1. Enrollment rates across recruitment methods.

Recruitment method	N_R	N_E	Enrollment rate	95% CI ^b
Community engagement	2	0	0	n/a
Family medical clinics	0	0	0	n/a
Inpatient and outpatient mental health clinics ^a	38	12	0.316	0.190 – 0.475
Newspaper advertising	5	0	0	n/a
Online advertising				
Craigslist	1	0	0	n/a
Facebook	138	10	0.072	0.038 – 0.130
Google	0	0	0	n/a
Kijiji	1	0	0	n/a

^a Located within the St. Joseph's Healthcare Hamilton Network. ^bAgresti-Coull Method. Abbreviations: CI = Confidence interval. N_E = number of participants enrolled. N_R = number of referrals received. n/a = not applicable.

3.3.2 Enrollment-cost analysis

Following a comprehensive analysis of the estimated time spent (in hours), advertising costs, and labour costs, we calculated enrollment-cost rate (ECR) for each recruitment

method (Table 2). Healthcare provider outreach within inpatient and outpatient mental health clinics was the most effective recruitment method, with an ECR of 0.00186 persons enrolled per \$CAD, or an estimated \$537.63/enrolled participant. This recruitment method produced 12 enrollments (12/22; 54.55%) and incurred an estimated cost of \$6452.50. The second most effective recruitment method was Facebook with an ECR of 0.00108 persons enrolled per \$CAD, or approximately \$925.93/enrolled participant. Facebook yielded 10 enrollments (10/22; 45.45%) and emerged as the most expensive recruitment method, incurring an advertising cost of \$2,420.35 (Table S3) and an estimated final cost of \$9,235.35. The remaining recruitment methods generated an ECR of zero, as they produced no enrollments. Newspaper advertising, Google, Kijiji, and Craigslist recruitment methods were terminated due to producing no significant referrals.

Table 2. Enrollment-cost rates.

Recruitment method	N_R	N_E	Estimated time spent (hours)	Advertising cost (\$CAD)	Final estimated cost (\$CAD)	ECR	Estimated cost per enrollment (\$CAD)
Community engagement	1	0	17.5	0	507.50	0	n/a
Family medical clinics	0	0	12	0	348	0	n/a
Inpatient and outpatient mental health clinics ^a	38	12	222.5	0	6452.50	0.00186	537.63
Newspaper advertising	5	0	2	366.40	424.40	0	n/a
<i>Online advertising</i>							
Craigslist	1	0	1	0	29	0	n/a
Facebook	138	10	235	2,420.35	9235.35	0.00108	925.93
Google	0	0	6	30	204	0	n/a
Kijiji	1	0	2	0	58	0	n/a

^a Located within the St. Joseph's Healthcare Network. Abbreviations: ECR = enrollment cost rate. N_E = number of participants enrolled. N_R = number of referrals received. n/a = not applicable

3.4 Facilitators of and Barriers to Recruitment

Of the 19 participants who completed the trial, 18 (94.74%) participated in a semi-structured interview at the 2-week follow-up to explore their experiences participating in the clinical trial. One participant was lost to follow-up as they could not complete the questionnaire due to strong emotional reactions during the interview. Following a theoretical-thematic analysis of the qualitative interview data, we identified 10 facilitators and six barriers to recruitment (Table S4). The most common facilitators of recruitment were (1) perceived social support and positivity from research staff ($n = 16$; 88.89%); (2) endorsing a positive, rewarding, and/or worthwhile experience ($n = 14$; 77.78%); and (3) flexible scheduling and/or offering schedule accommodations ($n = 8$; 44.44%). The most common barriers to recruitment were (1) the significant time commitment ($n = 6$; 33.33%); (2) accessibility challenges in navigating the research facility ($n = 3$; 16.67%); (3) a considerable commute to the research center ($n = 2$; 11.11%); and (4) negative expectations or hesitancy towards enrolling in the dTMS study ($n = 2$; 11.11%).

4. DISCUSSION

We conducted a retrospective analysis exploring recruitment data, strategies, and costs from our dTMS trial in older adults with MDD. This analysis identified healthcare provider outreach within affiliated mental health clinics and Facebook advertising as the most effective recruitment methods, accounting for 20.54% and 74.59% of the 185 total referrals, and ECRs of 0.316 and 0.072, respectively. A thematic analysis of qualitative interview data revealed several important recruitment facilitators, including social support and positive interactions with research staff, perceptions of the experience as rewarding or worthwhile, and flexible scheduling and accommodation. Recruitment

barriers included the significant time commitment, accessibility challenges in navigating the research facility, long commute times, and negative expectations or hesitancy towards dTMS.

A key challenge of recruitment is effectively targeting the desired population. While traditional recruitment methods, such as patient referrals, flyers, and posted advertisements,^{28,29} have been commonly used, the post-COVID era has prompted a shift towards digital research designs.^{30–32} Accordingly, online recruitment modalities should be considered. Research suggests online recruitment can be faster and more effective than traditional methods.^{33,34} In the current analysis, Facebook advertising generated nearly 75% of all referrals, though it had a lower enrollment rate compared to recruitment from mental health clinics. This may reflect healthcare providers' ability to effectively identify eligible individuals, often having years of clinical experience. Successfully recruiting individuals who meet a study's eligibility criteria poses a significant barrier to recruitment.³⁵ The clinical expertise provided by healthcare providers may have further improved recruitment by effectively identifying eligible participants. Thus, targeting healthcare networks may be a valuable recruitment strategy.

Conversely, although Facebook yielded the highest number of referrals, these referrals were self-referrals, and less likely to lead to enrollment. Many individuals voluntarily completed the screening survey but were not eligible. Facebook was also the most expensive recruitment strategy. Nonetheless, Facebook accounted for 10 (45.45%) of total enrollments and proved worthwhile. Future researchers should

diversify recruitment methods to maximize enrollment, including recruitment methods such as Facebook, despite its lower referral-to-enrollment rate, as they can still lead to valuable enrollments.

Regarding the ECR analysis, Facebook produced an ECR of 0.00108 enrollments per \$CAD (~\$925.93 per enrolled participant), while recruitment through affiliated inpatient and outpatient mental health clinics yielded a higher ECR of 0.00186 (~\$537.63 per enrolled participant). A systematic review by Speich et al.³⁶ (2018) reported a median recruitment cost of \$409 USD (~\$530 CAD) across 56 trials, with a range of \$43 USD (~\$56 CAD) to \$103,254 USD (~\$133,869 CAD). The high volume of Facebook referrals required additional staff time for screening, calling potential participants, and booking in-person screening visits. Considering the fewer number of referrals from the affiliated mental health clinics, less time was spent screening, calling participants, and booking screening visits. However, research personnel spent a comparable amount of time meeting with healthcare professionals to encourage recruitment from clinics and to discuss referral strategies. Overall, our findings suggest greater investment of time and/or money in a recruitment strategy may generate more referrals, and in turn, more enrollments.

It is also important to consider the relatively high cost of Facebook advertising in addition to labour costs. The ECR for mental health clinic recruitment included only labour costs, as no advertising was required. In contrast, Facebook was a high-cost advertising method, with additional time spent screening a large number of referrals. Despite these costs, both recruitment strategies were valuable and highlight the need for diverse recruitment strategies to expedite enrollment. A recent analysis³⁸ found that

Facebook was the most cost-effective recruitment method for older adults with sedative use, outperforming TV advertisements, newspaper, Google, and healthcare provider referrals. Furthermore, older adults exhibit higher click-through rates on Facebook for clinical trial advertisements compared to younger age groups.³⁹ Consistent with these findings, we enrolled a significant number of participants from Facebook, highlighting its value in recruiting older adults.

A thematic analysis of interview data identified several recruitment facilitators: (1) perceived social support and positive interactions with research personnel, (2) having a positive, rewarding, or worthwhile experience, and (3) flexible scheduling and accommodation. A recent cardiovascular trial⁴⁰ found that social support from peers and health coaches significantly increased participation. Importantly, older adults with low social support are at an increased risk for depression.⁴¹ While social support is a known determinant of physical health and well-being,^{42,43} few studies have examined its importance in clinical trial participation. Considering the association between low social support and depression in older populations, future research should explore the impact of social support on clinical trial recruitment for older adults with depression.

The most common recruitment barriers were: (1) the significant time commitment, (2) accessibility challenges in navigating the research facility (3) lengthy commutes, and (4) negative expectations or hesitancy towards dTMS. Given that neuromodulation is an emerging area of research, there is a paucity of research exploring recruitment barriers in clinical trials involving brain stimulation interventions, such as dTMS. These interventions typically require a time-intensive acute treatment phase — for example, 20 sessions over four weeks, with daily appointments five days

per week.²² While each dTMS session is relatively brief (e.g., 30 minutes), the cumulative daily commitment can place a burden on participants. In contrast, wellness and psychotherapy interventions often allow for more flexible scheduling, which may better align with a person's daily activities and lifestyle. In line with our findings, flexible scheduling and accommodation from research staff were identified as key recruitment facilitators. Future researchers and clinicians should evaluate the time-intensiveness of dTMS interventions as a potential barrier to recruitment and consider this factor when designing effective recruitment strategies.

In a recent nationwide survey from the United States,⁴⁴ individuals with depression, caregivers, and community members identified “a lack of understanding of intervention” as a key barrier to accessing TMS treatment. This knowledge gap may contribute to negative expectations or hesitancy towards dTMS, particularly in older adults, and could impact willingness to participate in clinical trials. Notably, a review of several health trials⁷ identified lower-than-expected willingness to participate as a major contributing factor of recruitment delays. In contrast, our analysis identified perceived burden of dTMS treatment — particularly the significant time commitment — as a prominent barrier to recruitment. Researchers should explore both potential influences on willingness to participate, such as knowledge gaps or hesitancy, and the burdensome qualities of dTMS treatment that may impact recruitment.

Another important consideration concerns transportation coverage and accessibility. During our trial, several potential participants were discouraged by transportation challenges. Two participants who completed the trial voiced this challenge at the follow-up. Mobility impairments in older adults can disrupt travel to in-

person sessions^{11,12} and affect willingness to participate.¹³ Notably, some participants expressed appreciation for the transportation coverage provided. Regular transportation compensation should be provided to older adult participants to address accessibility barriers and support recruitment.

This retrospective analysis has several limitations. First, we could not fully evaluate the effectiveness of recruitment methods that were terminated early due to funding limitations or low referral numbers. Second, the ECR calculation was based on two estimates: (1) time spent on recruitment activities, and (2) the hourly wage of research staff. Though we aimed to measure the median hourly wage of research assistants in Ontario, research personnel differed in their hourly wage. Thus, this estimate may not precisely reflect the actual labour costs incurred. Third, recruitment data were collected retrospectively, which introduces the potential for recall bias and may limit the validity and reliability of the results. Fourth, the generalizability of this study's findings is limited by the single-site nature of the study and specific characteristics of the participant sample (e.g., seniors with depression). Nonetheless, this study offers valuable insights into effective recruitment strategies that can be implemented in clinical trial research among underrepresented senior populations. Lastly, selection bias is an important limitation to consider when recruiting participants from different sources. A systematic review of Facebook's utility in health research highlighted its benefits in recruiting hard-to-reach populations and improving sample representation.³⁷ However, Facebook recruitment may favour individuals who are more comfortable with technology and self-motivated to engage in research, while recruitment through healthcare professionals may reach participants who primarily seek clinical

care. These differences should be considered when examining recruitment outcomes and the generalizability of the sample.

In conclusion, we found evidence supporting the use of (1) healthcare provider outreach within affiliated mental health clinics and (2) Facebook advertising as effective recruitment methods to target older adults with depression for a dTMS trial. The impact of social support provided by research personnel and the time-intensive aspect of dTMS interventions should be further investigated as potential facilitators and barriers to recruitment, respectively.

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Disclosure of Interests

Dr. James MacKillop is supported by the Peter Boris Chair in Addictions Research and a Tier 1 Canada Research Chair in Translational Addiction Research. The remaining authors have no conflicts of interest to disclose at this time.

Data Availability

The data set generated and analyzed during this study will be made available by the corresponding author upon reasonable request. The data has not been previously presented orally or by poster at scientific meetings.

Author Contributions

AD and DD are credited with conceptualizing the main objectives of the manuscript. AD produced the manuscript in its entirety, including data collection, formal analysis, and writing. The other authors (AF, CMW, EM, EV, HY, JM, SPM) provided written feedback and revisions to the final version of the manuscript. All authors have read and approved the final version submitted and take public responsibility for all aspects of the work.

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References

1. Gul RB, Ali PA. Clinical trials: the challenge of recruitment and retention of participants. *J Clin Nurs*. 2010;19(1-2):227-233. doi:10.1111/j.1365-2702.2009.03041.x
2. Bower P, Wallace P, Ward E, et al. Improving recruitment to health research in primary care. *Fam Pract*. 2009;26(5):391-397. doi:10.1093/fampra/cmp037
3. Chaudhari N, Ravi R, Gogtay NJ, Thatte UM. Recruitment and retention of the participants in clinical trials: Challenges and solutions. *Perspect Clin Res*. 2020;11(2):64-69. doi:10.4103/picr.PICR_206_19
4. Caldwell PHY, Hamilton S, Tan A, Craig JC. Strategies for increasing recruitment to randomised controlled trials: systematic review. *PLoS Med*. 2010;7(11):e1000368. doi:10.1371/journal.pmed.1000368

5. Williams RJ, Tse T, DiPiazza K, Zarin DA. Terminated Trials in the ClinicalTrials.gov Results Database: Evaluation of Availability of Primary Outcome Data and Reasons for Termination. *PLoS One*. 2015;10(5):e0127242. doi:10.1371/journal.pone.0127242
6. Bernardez-Pereira S, Lopes RD, Carrion MJM, et al. Prevalence, characteristics, and predictors of early termination of cardiovascular clinical trials due to low recruitment: insights from the ClinicalTrials.gov registry. *Am Heart J*. 2014;168(2):213-219.e1. doi:10.1016/j.ahj.2014.04.013
7. McDonald AM, Knight RC, Campbell MK, et al. What influences recruitment to randomised controlled trials? A review of trials funded by two UK funding agencies. *Trials*. 2006;7:9. doi:10.1186/1745-6215-7-9
8. Salive ME. Multimorbidity in older adults. *Epidemiol Rev*. 2013;35:75-83. doi:10.1093/epirev/mxs009
9. Divo MJ, Martinez CH, Mannino DM. Ageing and the epidemiology of multimorbidity. *Eur Respir J*. 2014;44(4):1055-1068. doi:10.1183/09031936.00059814
10. Ho VP, Schiltz NK, Reimer AP, Madigan EA, Koroukian SM. High-Risk Comorbidity Combinations in Older Patients Undergoing Emergency General Surgery. *J Am Geriatr Soc*. 2019;67(3):503-510. doi:10.1111/jgs.15682
11. Gray-Miceli D. Impaired Mobility and Functional Decline in Older Adults: Evidence to Facilitate a Practice Change. *Nurs Clin North Am*. 2017;52(3):469-487. doi:10.1016/j.cnur.2017.05.002
12. Jia H, Lubetkin EI, DeMichele K, Stark DS, Zack MM, Thompson WW. Prevalence, risk factors, and burden of disease for falls and balance or walking problems among older adults in the U.S. *Prev Med*. 2019;126:105737. doi:10.1016/j.ypmed.2019.05.025
13. Rigatti M, DeGurian A, Albert SM. "Getting There": Transportation as a Barrier to Research Participation among Older Adults. *J Appl Gerontol*. 2022;41(5):1321-1328. doi:10.1177/07334648211072537
14. Bloch F, Charasz N. Attitudes of older adults to their participation in clinical trials: a pilot study. *Drugs Aging*. 2014;31(5):373-377. doi:10.1007/s40266-014-0168-2
15. Karlin BE, Duffy M, Gleaves DH. Patterns and predictors of mental health service use and mental illness among older and younger adults in the United States. *Psychological Services*. 2008;5(3):275-294. doi:10.1037/1541-1559.5.3.275
16. Elshaikh U, Sheik R, Saeed RKM, Chivese T, Alsayed Hassan D. Barriers and facilitators of older adults for professional mental health help-seeking: a systematic review. *BMC Geriatr*. 2023;23:516. doi:10.1186/s12877-023-04229-x

17. Lavingia R, Jones K, Asghar-Ali AA. A Systematic Review of Barriers Faced by Older Adults in Seeking and Accessing Mental Health Care. *J Psychiatr Pract*. 2020;26(5):367-382. doi:10.1097/PRA.0000000000000491
18. Tegeler C, Hoppmann F, Gellert P, O'Sullivan JL, Kessler EM. Evaluation of Recruitment Strategies for Home-Living Vulnerable Older Adults With Depression: Findings From a Randomized Controlled Psychotherapy Trial. *Am J Geriatr Psychiatry*. 2022;30(4):462-474. doi:10.1016/j.jagp.2021.07.020
19. Albert SM, King J, Dew MA, et al. Design and Recruitment for a Randomized Controlled Trial of Problem-Solving Therapy to Prevent Depression among Older Adults with Need for Supportive Services. *Am J Geriatr Psychiatry*. 2016;24(1):94-102. doi:10.1016/j.jagp.2015.11.003
20. Roth Y, Amir A, Levkovitz Y, Zangen A. Three-dimensional distribution of the electric field induced in the brain by transcranial magnetic stimulation using figure-8 and deep H-coils. *J Clin Neurophysiol*. 2007;24(1):31-38. doi:10.1097/WNP.0b013e31802fa393
21. Roth Y, Zangen A, Hallett M. A coil design for transcranial magnetic stimulation of deep brain regions. *J Clin Neurophysiol*. 2002;19(4):361-370. doi:10.1097/00004691-200208000-00008
22. Di Passa AM, Prokop-Millar S, Yaya H, et al. Clinical efficacy of deep transcranial magnetic stimulation (dTMS) in psychiatric and cognitive disorders: A systematic review. *J Psychiatr Res*. 2024;175:287-315. doi:10.1016/j.jpsychires.2024.05.011
23. Braun V, Clarke V. Using thematic analysis in psychology. *Qualitative Research in Psychology*. 2006;3(2):77-101. doi:10.1191/1478088706qp063oa
24. Huynh L, Johns B, Liu SH, Vedula SS, Li T, Puhan MA. Cost-effectiveness of health research study participant recruitment strategies: a systematic review. *Clin Trials*. 2014;11(5):576-583. doi:10.1177/1740774514540371
25. Kakumanu S, Manns BJ, Tran S, et al. Cost analysis and efficacy of recruitment strategies used in a large pragmatic community-based clinical trial targeting low-income seniors: a comparative descriptive analysis. *Trials*. 2019;20(1):577. doi:10.1186/s13063-019-3652-5
26. Government of Canada SC. Labour Force Survey (LFS). April 4, 2024. Accessed May 2, 2024. <https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=3701&lang=f&r&db=imdb&adm=8&dis=2>
27. Canada E and SD. Post-secondary Research Assistant in Canada | Wages - Job Bank. Accessed May 1, 2024. http://www.jobbank.gc.ca/explore_career/job_market_report/wage_occupation_report.xhtml

28. Feman SPC, Nguyen LT, Quilty MT, et al. Effectiveness of Recruitment in Clinical Trials: An Analysis of Methods Used in a Trial for Irritable Bowel Syndrome Patients. *Contemp Clin Trials*. 2008;29(2):241-251. doi:10.1016/j.cct.2007.08.004
29. Adams J, Silverman M, Musa D, Peele P. Recruiting older adults for clinical trials. *Control Clin Trials*. 1997;18(1):14-26. doi:10.1016/s0197-2456(96)00132-8
30. Steinhilber KM, Chabria RS, Clara A, et al. Shifting behavioral intervention research to virtual methods: Challenges and solutions in practice, during and after the COVID-19 pandemic. *J Telemed Telecare*. Published online April 26, 2023:1357633X231167899. doi:10.1177/1357633X231167899
31. McGregor G, Sandhu H, Bruce J, et al. Clinical effectiveness of an online supervised group physical and mental health rehabilitation programme for adults with post-covid-19 condition (REGAIN study): multicentre randomised controlled trial. *BMJ*. 2024;384:e076506. doi:10.1136/bmj-2023-076506
32. Mahoney ME, Sridhar SS. Clinical trial reform in the post-COVID era. *Ther Adv Med Oncol*. 2023;15:17588359231183676. doi:10.1177/17588359231183676
33. Reuter K, Liu C, Le N, Angyan P, Finley JM. General Practice and Digital Methods to Recruit Stroke Survivors to a Clinical Mobility Study: Comparative Analysis. *J Med Internet Res*. 2021;23(10):e28923. doi:10.2196/28923
34. Moseson H, Kumar S, Juusola JL. Comparison of study samples recruited with virtual versus traditional recruitment methods. *Contemp Clin Trials Commun*. 2020;19:100590. doi:10.1016/j.conctc.2020.100590
35. Institute of Medicine (US) Forum on Drug Discovery D. Challenges in Clinical Research. In: *Transforming Clinical Research in the United States: Challenges and Opportunities: Workshop Summary*. National Academies Press (US); 2010. Accessed February 12, 2024. <https://www.ncbi.nlm.nih.gov/books/NBK50888/>
36. Speich B, von Niederhäusern B, Schur N, et al. Systematic review on costs and resource use of randomized clinical trials shows a lack of transparent and comprehensive data. *J Clin Epidemiol*. 2018;96:1-11. doi:10.1016/j.jclinepi.2017.12.018
37. Whitaker C, Stevelink S, Fear N. The Use of Facebook in Recruiting Participants for Health Research Purposes: A Systematic Review. *J Med Internet Res*. 2017;19(8):e290. doi:10.2196/jmir.7071
38. Murphy AL, Turner JP, Rajda M, Allen KG, Pinter K, Gardner DM. Effectiveness and cost analysis of methods used to recruit older adult sedative users to a deprescribing randomized controlled trial during the COVID-19 pandemic. *Explor Res Clin Soc Pharm*. 2022;9:100214. doi:10.1016/j.rcsop.2022.100214

39. Cowie JM, Gurney ME. The Use of Facebook Advertising to Recruit Healthy Elderly People for a Clinical Trial: Baseline Metrics. *JMIR Res Protoc*. 2018;7(1):e20. doi:10.2196/resprot.7918
40. Addison S, Yang Y, Metlock F, et al. The Role of Social Support in Cardiovascular Clinical Trial Participation among Black Men: Black Impact. *Int J Environ Res Public Health*. 2022;19(19):12041. doi:10.3390/ijerph191912041
41. Ng CWL, Tan WS, Gunapal PPG, Wong LY, Heng BH. Association of Socioeconomic Status (SES) and Social Support with Depressive Symptoms among the Elderly in Singapore. *Ann Acad Med Singap*. 2014;43(12):576-587.
42. Reblin M, Uchino BN. Social and Emotional Support and its Implication for Health. *Curr Opin Psychiatry*. 2008;21(2):201-205. doi:10.1097/YCO.0b013e3282f3ad89
43. Chollou KM, Shirzadi S, Pourrazavi S, Babazadeh T, Ranjbaran S. The Role of Perceived Social Support on Quality of Life in People with Cardiovascular Diseases. *Ethiop J Health Sci*. 2022;32(5):1019-1026. doi:10.4314/ejhs.v32i5.17
44. Cortright MK, Bluhm R, Achtyes ED, McCright AM, Cabrera LY. Perceived Barriers to Using Neurostimulation: A National Survey of Psychiatrists, Patients, Caregivers, and the General Public. *J ECT*. Published online January 25, 2024. doi:10.1097/YCT.0000000000000990

Supplementary Material

Supplementary data for: Enrollment-Cost and Recruitment Effectiveness in a dTMS Clinical Trial for Older Adults with Depression: A Mixed-Methods Analysis of Recruitment Strategies, Facilitators, and Barriers.

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Supplemental Methods

Participant Inclusion and Exclusion Criteria

Older adults with major depressive disorder were recruited for enrollment. The main inclusion criteria were individuals aged 60 to 85, a diagnosis of major depressive disorder (DSM-5 criteria), a score of ≥ 20 on the Hamilton Depression Rating 24-item Scale (HDRS-24), and treatment resistance to antidepressant pharmacotherapy during the current episode. Specifically, eligible participants were required to have ≥ 1 failed antidepressant trial(s) or an inadequate trial (e.g., intolerance) to ≥ 2 antidepressants during the current episode.

Key exclusion criteria included diagnosis of Axis I disorders, other than depression; however, individuals with anxiety disorders or Axis II disorders were eligible if these were not their primary diagnosis. We excluded individuals with active suicidal behavior, substance use, possible signs of dementia or mild/major neurocognitive disorder (a score of < 24 on the Mini Mental Status Exam [MMSE]), prior unsuccessful ECT treatment(s), and contraindications to rTMS. Contraindications to rTMS include pacemakers, a history of epilepsy or seizures, brain tumors or surgery, metal implants in or around the head, brain trauma, neurological disorders (i.e., multiple sclerosis [MS], ALS, or Parkinson's disease), stroke, encephalitis, spinal cord injury, and significant brain injury.

Table S1. Detailed Account of Recruitment Strategies

Recruitment strategy	Account of methods implemented
Community engagement	- Starting in November 2023, we emailed various groups and organizations with a request to help spread awareness of our study, including the McMaster Institute for Research on Aging, McMaster Alumni, McMaster's Student Wellness Centre, and the senior citizen center Shalom Village. - We spread awareness of our study by incorporating study information in the Centre for Medicinal Cannabis Research newsletter. - In January 2024, we decided to enhance recruitment by broadening our outreach methods to eight local psychiatrists within the Greater Hamilton community who were contacted by the PI via email. These organizations and local psychiatrists were provided with a digital copy of our recruitment flyer and patient information sheet. - The recruitment flyer contained basic information regarding participant eligibility (i.e., 60 to 85 years old with a diagnosis of depression) and the contact information of our research centre. The patient information sheet was designed to explain the study intervention in lay terms, aiming to increase accessibility for non-scientific audiences. The information sheet also provided contact information for potential participants to inquire about the study.
Providing information to family medical clinics	- Research assistants were responsible for handing out recruitment flyers, patient info-sheets, and physician info-sheets to family medical clinics. These clinics were visited in November 2023. Flyers and information sheets were posted or placed on walls and tables within patient waiting areas after receiving consent from the medical staff. - The recruitment flyer contained basic information regarding participant eligibility (i.e., 60 to 85 years old with a diagnosis of depression) and the contact information of our research centre. - The patient information sheet was designed to explain the study intervention in lay terms, aiming to increase accessibility for non-scientific audiences. The information sheet also provided contact information for potential participants to inquire about the study. - The physician info-sheet provided a more thorough explanation of the dTMS intervention from a scientific

	and medical perspective.
Healthcare provider outreach within the affiliated inpatient and outpatient mental health clinics^a	• During the onset of the study (April 2023), we connected with several inpatient and outpatient clinics within St. Joseph's Healthcare Hamilton, including the Mood Disorders Clinic, Seniors Mental Health Outpatient Clinic, and the ECT/TMS Service. • We targeted case managers, nurses, psychiatrists, geriatricians, psychologists, and research coordinators within the St. Joseph's inpatient and outpatient networks. Healthcare providers and research personnel were invited to refer eligible candidates to our study. • During early recruitment stages, an email was sent to a large directory of physicians on May 5 2023, containing information about the study's objectives, eligibility criteria, and contact information. • The PI regularly checked in with physician colleagues to inquire if they had potentially eligible participants. • Research assistants were responsible for regularly communicating with outpatient clinics to remind them of our ongoing study. We provided these outpatient clinics with a basic description of our study, the main inclusion and exclusion criteria, as well as our recruitment flyer and info-sheets. • Two research assistants attended a staff meeting on January 15, 2024 at the Seniors Mental Health Outpatient Clinic to inform case workers of how they could share our study with patients whom they believed would be ideal candidates. • Research assistants and the principal investigator (PI) met with the Community Outpatient and Outreach Programs manager at Seniors Mental Health Outpatient Clinic on multiple occasions to develop an effective strategy for collaborating and collectively referring potential candidates to our study. • Research assistants were responsible for meeting with the manager at the Mood Disorders Clinic to discuss the referral process and how they could direct older patients to our research facility to inquire more about the study. • Two research assistants and the PI collaborated with staff members at the ECT/TMS Service to inform them of our study's aims and participant eligibility.
Newspaper advertising	• We advertised in the local newspaper Coffee News® which targeted residents of Hamilton, Ontario, Canada. Coffee News® reports an estimated reach of approximately ten million readers per week, identifying the newspaper as a potential recruitment platform to broadly target Hamilton residents. • The advertisement contained key information regarding participant eligibility (i.e., 60 to 85 years old with a diagnosis of depression) and the contact information of our research coordinator. • The advertisement was published on December 25th 2023 and ran for four weeks, costing a total of \$366.40 CAD. However, considering the high cost and the low number of referrals generated, this method was terminated after four-week period.
Online advertising	• We created online advertisements using several platforms: Craigslist, Facebook, Google, and Kijiji. Individuals from the community were able to self-refer by completing an online screening questionnaire assessing their eligibility, which was linked to the advertisements. • For all online advertising platforms, geographical settings were enabled to selectively target individuals within the Greater Hamilton Area (Ontario, Canada). • Paid Facebook advertisements were intermittently posted beginning July 2023 until the end of the study (May 2024). For a detailed list of the specific periods during which Facebook advertisements were posted, please refer to the Supplementary Table S3. Advertisements posted online contained an image of the study flyer, with a brief description of eligible candidates (i.e., 60 to 85 years old with a diagnosis of depression). Research personnel screened each entry and contacted individuals who appeared to be eligible and interested in participating. • Due to low recruitment rates from December 2023 to January 2024, additional online recruitment measures were implemented. Our first strategy was to launch a Google advertisement in addition to Facebook advertising. The Google ad was posted for four weeks beginning November 22 2024 and cost \$30 CAD. However, this advertisement was terminated after the four-week period due to an absence of referrals. • We further introduced unpaid Craigslist and Kijiji advertisements on January 9 2024 to examine whether these additional sources could gather a considerable volume of referrals. Due to a lack of referrals, the Craigslist advertisement was terminated after the 30-day period. • Kijiji advertisements were posted for 30 days at a time beginning January 9 2024 and were terminated

on April 3 2024 due to low recruitment.

^a Located within the St. Joseph's Healthcare Hamilton Network.

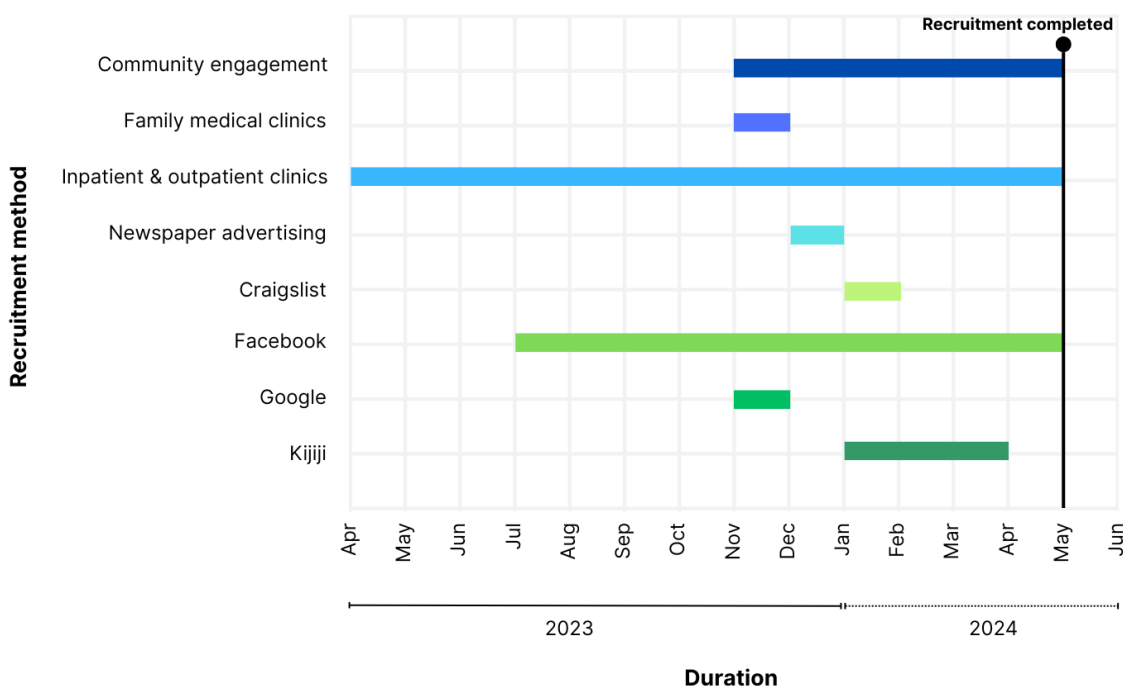


Figure S1. Duration of Recruitment Methods.

Various recruitment methods were employed from the beginning of the study, in April 2023, to the end of the recruitment period, in May 2024.

Detailed Recruitment Cost and Time Estimation

Recruitment time was estimated based on self-reports provided by all research personnel involved in the study. Given the retrospective nature of this analysis, research staff were asked after the study concluded to provide detailed estimates of the time (in hours) spent on each recruitment method (e.g., Facebook, Craigslist, healthcare provider outreach). This included activities such as telephone screenings, in-person screening, scheduling, emailing potential participants, and the time devoted to establishing recruitment methods (e.g., creating Facebook advertisements). The hours reported by each staff member were summed to calculate the total time spent per recruitment source.

Cost components accounted for included online advertising fees (e.g., Facebook ad budget) and newspaper advertisement charges. Furthermore, research assistants involved in recruitment from the start of the recruitment phase contributed to the enrollment-cost analyses. The median hourly wage of research assistants in Ontario was used to estimate labor costs, as detailed in the Methods section of the main manuscript.

Qualitative Semi-Structured Interview Procedure

The qualitative interview was a semi-structured, verbal interview designed to ask participants about their experience before, during, and after participating in the study. The interview was conducted at the 2-week follow-up and lasted approximately 15 minutes. A research assistant asked participants the following open-end questions and responses were documented in detailed notes. Participants were encouraged to be as honest and transparent in their responses as possible. Of note, qualitative interview questions were designed to assess participants' experiences before, during, and after the study. These data were retrospectively analyzed to explore recruitment outcomes, and verbal themes were manually identified to highlight potential facilitators and barriers to recruitment.

- What was your overall experience participating in this study?
- What were your expectations before entering the study?
- How was your experience during the study?
- How have these past 2 weeks been after the study?
- What are some things you may have liked or disliked? (Think about the schedules, staff, the dTMS treatments, other research components of the study, length of sessions, etc.)
- Was this treatment comfortable and tolerable for you?
- What are some things you would change to make it more tolerable and better suited to your needs?
- Did the frequency of treatment (5 days a week for 4 weeks) suit your lifestyle? What were some of the challenges, if any, that you faced?
- Overall, do you think that participating in 20 sessions of dTMS treatment benefited you in terms of your mood and well-being?
- Any other thoughts you would like to share with us regarding your experience?
- Would you recommend participating in this study to someone with a similar condition? Why or why not?

Verbal Theoretical Thematic Analysis

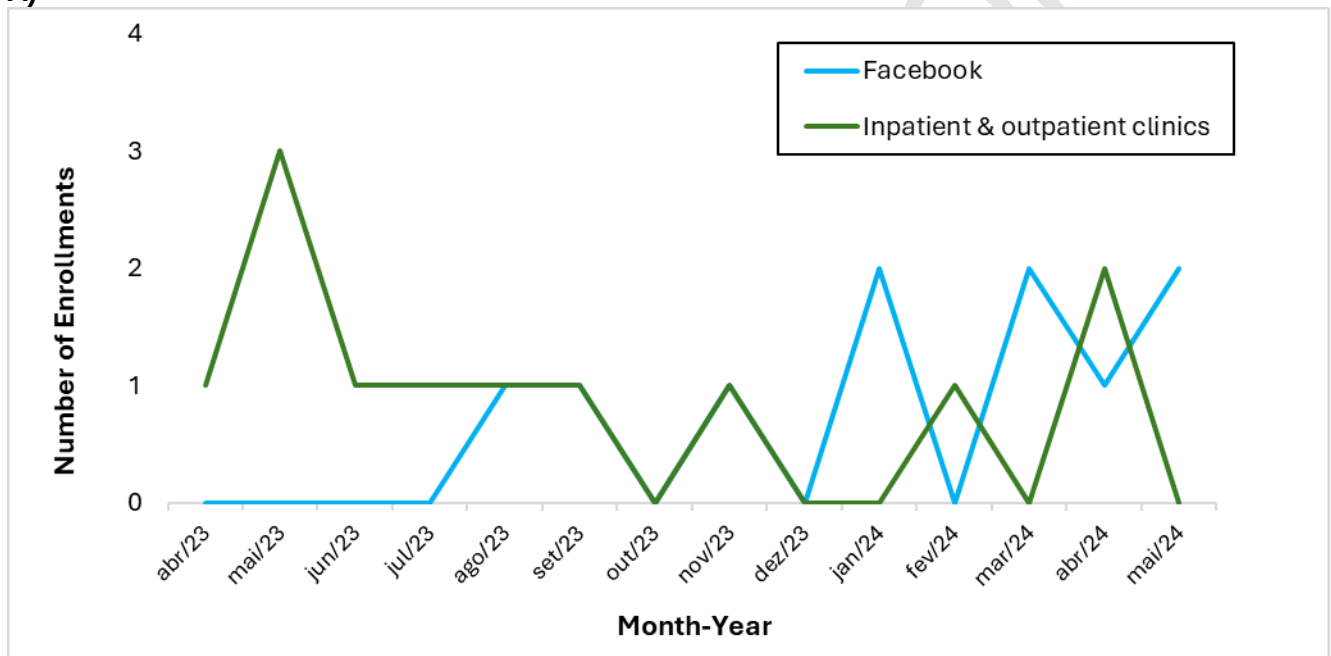
We conducted a verbal thematic analysis of qualitative interview data following Braun and Clarke's (2006) theoretical thematic analysis model.¹ Verbal responses from the qualitative interview were exported into an excel document and sentiments, or "themes," were identified across participants' (N = 18). The verbal themes were manually identified, assigned a code, and then tallied across the dataset. Importantly, the identification of recruitment-related facilitators and barriers was conducted retrospectively. The interview questions were not designed to assess recruitment outcomes, but rather, to evaluate participants' experiences in the study. Considering the retrospective nature of this analysis, we felt that Braun and Clarke's theoretical thematic model was most appropriate to evaluate recruitment outcomes, as this form of analysis is guided by the research question of interest — in this case, recruitment outcomes. The verbal themes are displayed in Table S4 for data transparency.

Supplemental Results

Figure S2. Enrollments Over Time.

(A) Enrollments per month by recruitment strategy. Please note only two recruitment methods yielded enrollments: Facebook and inpatient/outpatient clinics. **(B) Cumulative enrollments per month by recruitment strategy.** Facebook and inpatient/outpatient clinics produced 10 and 12 enrollments, respectively, over a 14-month period. In total, 22 participants were enrolled in the study. Inpatient/outpatient clinics recruitment began in April 2023, whereas Facebook recruitment began in July 2023. Both recruitment strategies when the recruitment phase concluded (May 2024)

A)



B)

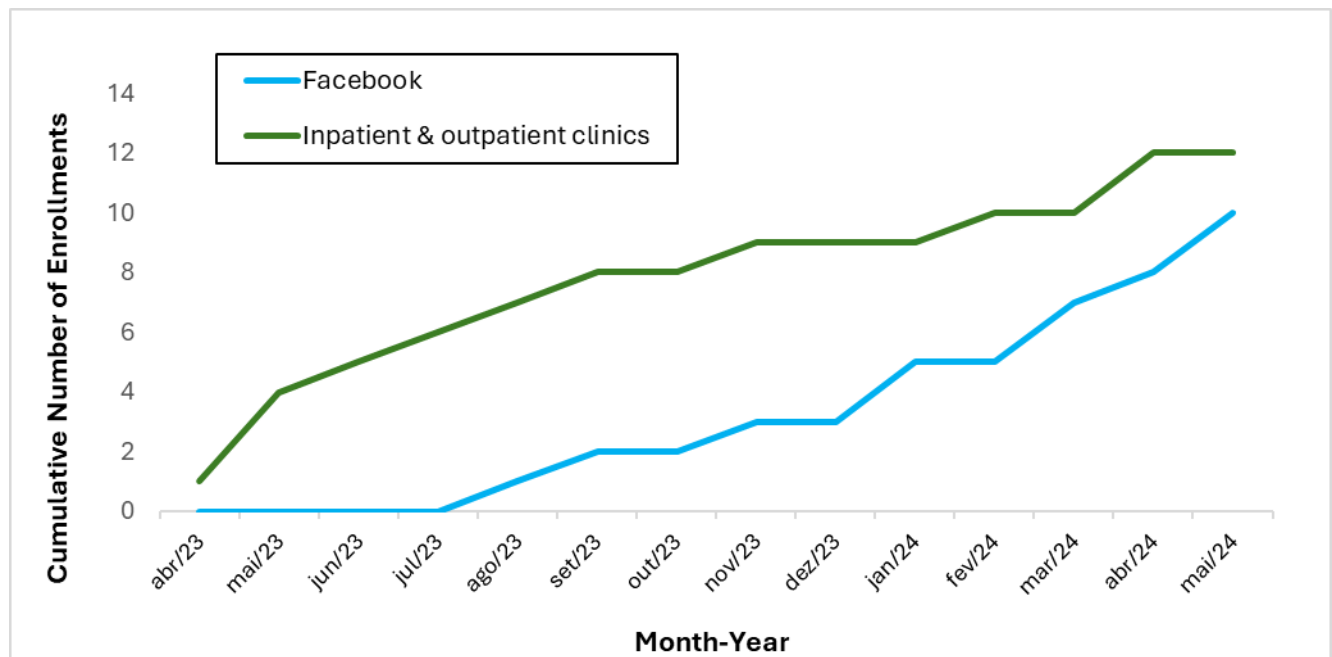


Table S2. Breakdown of Referrals Received

Source of referral: Community Engagement		
Category	Reason for exclusion	No. of individuals
Participant Uninterested	Not interested due to time commitment	1
Miscellaneous Reasons for Exclusion	No longer enrolling (Maximum females reached)	1
Referral Breakdown	2 referrals – (2 uninterested + 2 max enrollment)	0 enrollments
Source of referral: Affiliated Inpatient & Outpatient Mental Health Clinics		
Participant Uninterested	Not interested due to transportation challenges or long distance	2
	Not interested due to time commitment	1
	Cannot commit due to ongoing health problems (stomach issues)	1
	Not interested (reason not provided)	2
Participant Ineligible	Unstable medical condition (e.g., severe vertigo)	1
	History of acute neurological events (intracranial hemorrhage or stroke)	1
	Alzheimer's disease or dementia	1
	Bipolar disorder	1
	Borderline personality disorder	1
	Persistent depressive disorder	1
	Posttraumatic stress disorder	2
	Moderate-to-severe anxiety	1
	Substance dependence	2
	No active depressive episodes or below threshold symptoms	1
	No diagnosis of major depressive disorder + No history of treatment resistance	1
	Moderate-to-severe anxiety + No active depressive episodes or below threshold symptoms	1

	No active depressive episodes or below threshold symptoms + Not 60 to 85 years old	1
	Bipolar disorder + Borderline personality disorder	1
	Not 60 to 85 years old	4
Referral Breakdown	38 referrals – (20 excluded + 6 uninterested)	12 enrollments
Source Of Referral: Newspaper Advertising		
Participant Uninterested	Not interested due to time commitment	1
Participant Ineligible	Failed ECT trial	1
	Pacemaker	1
	Previous brain tumour	1
	Persistent depressive disorder	1
Referral Breakdown	5 referrals – (4 excluded + 1 uninterested)	0 enrollments
Source Of Referral: Craigslist Advertising		
Participant Uninterested	Reason not provided	1
Referral Breakdown	1 referral – (1 uninterested)	0 enrollments
Source Of Referral: Facebook Advertising		
Participant Uninterested	Did not return call/email	27
	Not interested due to transportation challenges/long distance	2
	Not interested due to time commitment	2
	No longer available	2
	No reason provided	1
	Not interested due to transportation challenges/long distance + time commitment	2
Miscellaneous reasons for exclusion	Duplicate record	13
	Incorrect phone number/email provided	2
	No longer enrolling (Maximum females reached for enrollment/ final participant enrolled)	5
	Form filled out by mistake	1
	Partially complete form before November 1 st 2023	4
	Note.* Partially complete forms submitted prior to November 2023 were regarded as indicative of disinterest from potential participants. As such, no contact was made with these individuals due to the enrollment capacity being reached at that time.	
Participant Ineligible	Living outside of the Greater Hamilton area	4
	Unstable medical condition (e.g., cancer, tinnitus, multiple sclerosis, etc.)	3
	Chronic headaches or migraines (weekly or more)	5
	History of acute neurological events (intracranial hemorrhage or stroke)	4
	Failed ECT trial	3
	History of epilepsy or seizure	1
	Pacemaker	1
	Taking bupropion (Wellbutrin) 300 mg or more	1
	Alzheimer's disease or dementia	2
	Bipolar disorder	5
	Borderline personality disorder	2
	Obsessive-compulsive disorder	1
	Posttraumatic stress disorder	7
	Moderate-to-severe anxiety	1

	Substance dependence	2
	No diagnosis of major depressive disorder	6
	No active depressive episodes OR below threshold symptoms	6
	No history of antidepressant treatment resistance	2
	Unstable medical condition + headaches/migraines	2
	History of acute neurological events + headaches/migraines	1
	Failed ECT trial + headaches/migraines	1
	Substance dependence + No diagnosis of major depressive disorder	1
	No active depressive episodes OR below threshold symptoms + No history of treatment resistance + Substance dependence	1
	Moderate-to-severe anxiety + No diagnosis of major depressive disorder	1
	Moderate-to-severe anxiety + No history of treatment resistance	1
	Failed ECT trial + bipolar disorder + posttraumatic stress disorder	1
	Not 60 to 85 years old	2
Referral Breakdown	138 referrals – [36 (participant uninterested) + 25 (miscellaneous reasons for exclusion) + 67 (participant ineligible)]	10 enrollments
Source Of Referral: Google Advertising		
Participant Ineligible	Not 60 to 85 years old	1
Referral Breakdown	1 referral – 1 participant ineligible	0 enrollments
Total Enrollments		12

Note. No referrals were obtained from Google advertising or community engagement methods.

Table S3. Facebook Advertising Costs.

Ad start date	Ad end date	Money spent (CAD\$)
Jul 27, 2023	August 3, 2023	51.67
Oct 23, 2023	Oct 30, 2023	83.98
Nov 21, 2023	Nov 28, 2023	181.98
Jan 9, 2024	Jan 16, 2024	181.99
Jan 18, 2024	Jan 25, 2024	69.95
Jan 26, 2024	Feb 2, 2024	181.97
Jan 26, 2024	Feb 2, 2024	83.91
Feb 5, 2024	Feb 12, 2024	181.93
Feb 12, 2024	Feb 19, 2024	181.96
Feb 23, 2024	Mar 1, 2024	181.92
Mar 5, 2024	Mar 12, 2024	182.39
Mar 12, 2024	Mar 19, 2024	84.31
Mar 25, 2024	Apr 1, 2024	83.99

Apr 2, 2024	Apr 9, 2024	265.97
Apr 9, 2024	Apr 16, 2024	167.99
Apr 17, 2024	Apr 24, 2024	167.97
Apr 29, 2024	May 6, 2024	86.47
TOTAL		\$ 2,420.35

Table S4. Potential Facilitators and Barriers to Recruitment

Theme identified across N = 18 participants	Frequency of theme	% of participants reporting theme
<i>Facilitators</i>		
Perceived social support and positivity from research staff	16	88.89
Positive/rewarding/worthwhile experience	14	77.78
Flexible scheduling / accommodation	8	44.44
Promoting autonomy/self-reflection/ self-esteem	3	16.67
Transportation coverage and/or parking vouchers	3	16.67
Incorporating a daily routine/structure	3	16.67
Making positive impact participating in research	2	11.11
Monetary incentives (i.e., gift cards)	2	11.11
Receiving support from loved ones	2	11.11
Abstaining from maladaptive habits during treatment	1	5.56
<i>Barriers</i>		
Significant time commitment	6	33.33
Accessibility challenges (e.g., entering & exiting research facility)	3	16.67
Far distance/long commute to research center	2	11.11
Hesitant to enroll in study and/or negative expectations	2	11.11
Daily sessions felt overly routine/monotonous	1	5.56
Not a replacement of medical care	1	5.56

References

1. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol.* 2006;3(2):77-101. doi:10.1191/1478088706qp063oa