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Transcranial Direct Current Stimulation in Treating Postpartum Depression

An acceptability study with health care professionals

Dissertação no âmbito do Mestrado Integrado em Psicologia, Área de Psicologia Clínica e Saúde, Área de Especialização em Intervenções Cognitivo-Comportamentais em Perturbações Psicológicas e Saúde orientada pela Doutora Ana Ganho Ávila e Professora Doutora Maria Cristina Canavarro apresentada à Faculdade de Psicologia e de Ciências da Educação.

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Orientação: Dr.ª Ana Ganho Ávila e Prof.ª Dr.ª Maria Cristina Canavarro

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Estimulação Elétrica por Corrente Contínua no Tratamento da Depressão Pós-parto:

Estudo de aceitabilidade dos profissionais de saúde

Resumo

Os estudos de investigação em implementação pretendem preencher a lacuna existente entre a investigação científica e a prática clínica. Para o concretizar, procuram estudar os comportamentos, perceções e atitudes dos profissionais de saúde que facilitam ou bloqueiam a implementação de novas práticas em saúde ou estudar estratégias que promovam a adoção de comportamentos com demonstrada eficácia científica (Bhattacharyya & Zwarenstein, 2009). Esta linha de investigação tem tornado evidente a importância da avaliação da aceitabilidade no desenvolvimento, avaliação e implementação de intervenções nos cuidados de saúde (Sekhon et al., 2017).

A presente dissertação é composta por dois artigos. Numa primeira fase, tivemos como objetivo desenvolver e investigar as propriedades psicométricas de um instrumento que avalia a aceitabilidade dos profissionais de saúde em relação à estimulação transcraniana por corrente contínua (ETCC) no tratamento da depressão pós-parto. Numa segunda fase, aplicámos este instrumento a uma amostra de profissionais de saúde e avaliamos a sua aceitabilidade pré e pós visualização de um vídeo psicoeducativo sobre ETCC. Além disso, explorámos a influência de diversas variáveis sociodemográficas na aceitabilidade, nomeadamente, informação acerca da situação profissional, história clínica, conhecimento/experiência prévia com a ETCC e preferência de tratamento dos participantes.

O ACCEPTpro-ETCC mostrou ser um instrumento válido e fiável para a avaliação da aceitabilidade. Prevemos futuras adaptações para outras línguas, outras perturbações psiquiátricas ou outras terapêuticas inovadoras. O estudo de aceitabilidade com profissionais de saúde revelou que aumentar o conhecimento sobre a ETCC aumentou a sua aceitabilidade como opção de tratamento para a depressão pós-parto. Os nossos resultados têm implicações relevantes na avaliação de tratamentos inovadores e fornecem orientações para estudos futuros sobre implementação da ETCC.

Transcranial Direct Current Stimulation in Treating Postpartum Depression:

An acceptability study with health care professionals

Summary

Implementation research intends to bridge the existing gap between research and clinical practice. It does so by studying the behaviours, perceptions and attitudes of health professionals that facilitate or hinder the implementation of new practices in health or by studying strategies that promote the adoption of behaviours that have been tested and shown to be effective (Bhattacharyya & Zwarenstein, 2009). Implementation research helped become recognized that acceptability should be highly considered when designing, evaluating and implementing healthcare interventions (Sekhon et al., 2017).

This dissertation is organized by two articles. On a first phase, the aim was to develop and investigate the psychometric properties of a measure that assesses acceptability of health professionals to transcranial direct current stimulation (tDCS) in treating postpartum depression. On a second phase, we applied this instrument to a sample of health professionals and evaluated their acceptability pre and post-intervention, in which the intervention consisted of a psychoeducational video about tDCS. Also, we explored how diverse sociodemographic variables, including information about the professional status, clinical history, previous knowledge and experience with tDCS, and treatment preference of participants would influence their acceptability.

The ACCEPTpro-tDCS revealed to be a valid and reliable instrument of acceptability measurement. We designed it foreseeing future adaptations to other languages, other psychiatric disorders, and other innovative treatments. The acceptability study with health professionals revealed that increasing knowledge on tDCS increased acceptability towards it as a treatment option for postpartum depression. Our findings have important implications to the assessment of innovative treatments in health and provide orientations for future studies about tDCS' implementation.

Content

Introduction

It is always a great challenge to establish a new program, practice or intervention in the health community. For that matter, there has been an increasing interest in what is called *Implementation Research*. Implementation research, concerns studies that aim to understand the *what*, *why* and *how* health interventions work in real life situations. Ultimately implementation research studies will improve interventions' effectiveness, efficiency, quality and equity within the health care system (Proctor et al., 2010), informing decisions on health and establishing new polices, programmes or practices (Peters et al., 2013).

The main goal of this thesis is to contribute to a series of implementation research studies about the use of Transcranial Direct Current Stimulation (tDCS). tDCS is a non-invasive brain stimulation technique aimed at modulating neural excitability, altering malfunctioning brain networks (Moffa, Brunoni, Nikolin, & Loo, 2018). In the recent years, tDCS has been presented as an alternative treatment (either augmentative or stand-alone to pharmacotherapy and psychotherapy) in several neuropsychiatric conditions (Temel et al., 2012; Hescham, Tonge, Jahanshahi, & Temel, 2017; Moffa et al., 2018). Due to its low cost, high portability and recent investment from several companies in developing user-friendly home-based versions, tDCS has an enormous potential to be scaled up. However, little is known about health professionals' acceptability of tDCS.

From the implementation research perspective, health decision makers, health managers, health providers, and citizens equally constitute the surrounding context. Additionally, the success of health interventions depends on the commitment and collaborative effort between practitioners and researchers from distinctive fields (Peters, Tran, & Adam, 2014). As further matter, implementation research does not try to modify the conditions of the current settings but rather work within the existing ones in finding the best solutions for an effective intervention (Peters et al., 2013).

Effectiveness concerning the implementation of a particular health intervention has a distinctive meaning from *treatment efficacy* and *treatment effectiveness*. Treatment

efficacy is tested by controlling the environment to assess whether a certain therapeutic approach produces the expected results. On this matter, the randomized controlled trial (RCT) is the gold standard design because it guarantees standardization of the intervention, manipulation and control for confounding variables, as well as selection and randomization of subjects. However, it says nothing about the real world. Once treatment efficacy is established, it needs to be tested in everyday practice in RCTs later phases – this is known as treatment effectiveness (Hemmings, 2000). In an ideal scenario, studies on a treatment that showed efficacy and effectiveness should be complemented by implementation effectiveness studies aimed at investigating the leverages and obstacles for the uptake of the intervention into real life situations (Sharma, Ghai, & Grover, 2017).

Many studies reflect on the existing gap between what treatments are known to have efficacy and to be effective and which are successfully bridged and finally provided to end-users in community practice (cf. Sekhon et al., 2017; Diepeveen, Ling, Suhrcke, Roland, & Marteau, 2013). This constitutes a particularly critical issue in mental health services (Proctor et al., 2008). However, despite its importance, implementation research continues to be a neglected field of study, due to both lack of funding and time and shortage of understanding of its purposes and relevance (Proctor et al., 2010).

Measuring implementation outcomes has the potential to enhance efficiency in implementation research and to enable other studies that compare effectiveness of implementation strategies. The main outcomes of implementation research inform about the success of the intervention and concern the implementation itself (acceptability, adoption, appropriateness, feasibility, fidelity, implementation cost and sustainability; Peters et al., 2013), the service (efficiency, safety, effectiveness, equity, patient-centeredness and timeliness) or the end-user (satisfaction, function and symptomatology; Proctor et al., 2010).

The main aim of this thesis was to develop and investigate the psychometric proprieties of a new measure that assesses acceptability as one fundamental implementation research outcome: the ACCEPTpro_ETCC. Moreover, we intended to explore how psychoeducation impacts health professionals' acceptability of tDCS and to what extend sociodemographic variables are associated to its effect.

Table of articles

This dissertation includes the following articles:

I. Saraiva-Martins, A., Caria-Rodrigues, I., Canavarro, M. C., & Ganho-Ávila, A. (2019). *ACCEPTpro-tDCS: A new measure to access the acceptability of health care professionals to transcranial direct current stimulation (tDCS).* Manuscript in preparation.

II. Saraiva-Martins, A., Canavarro, M. C., & Ganho-Ávila, A. (2019). *Impact of a psychoeducational video on the acceptability of health care professionals to transcranial Direct Current Stimulation in postpartum depression disorder*. Manuscript in preparation.

I.

Saraiva-Martins, A., Caria-Rodrigues, I., Canavarro, M. C., & Ganho-Ávila, A. (2019). *ACCEPTpro-tDCS: A new measure to access the acceptability of health care professionals to transcranial direct current stimulation (tDCS)*. Manuscript in preparation.

ACCEPTpro-tDCS: A new measure to access the acceptability of health care professionals to transcranial direct current stimulation (tDCS)

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Resumo

Objetivo: Desenvolver e estudar as propriedades psicométricas do ACCEPTpro-ETCC, um instrumento que avalia a aceitabilidade dos profissionais de saúde em relação ao uso da estimulação transcraniana por corrente contínua (ETCC) na depressão pós-parto.

Metodologia: Uma revisão da literatura incidida na definição de aceitabilidade e nos instrumentos disponíveis para medir a aceitabilidade de intervenções em saúde, providenciou a base para a identificação dos seus domínios e para o desenvolvimento dos itens e do instrumento como um todo. Realizámos um teste-piloto da primeira versão do questionário com um grupo de clínicos (N = 10, metade conhecedores e metade leigos em ETCC). Aplicámos a versão experimental final para testar a validade e confiabilidade do instrumento através de uma análise fatorial confirmatória e do alfa de Cronbach.

Resultados: A análise fatorial confirmatória conduziu à versão final do ACCEPTpro-ETCC composta por 15 itens que medem o construto global de aceitabilidade. O instrumento revelou uma consistência interna (α = .93) e uma validade de construto muito satisfatórias.

Conclusões: O ACCEPTpro-ETCC constitui-se como um método fiável e válido de avaliação da aceitabilidade da ETCC em profissionais de saúde. Um próximo passo será traduzir o questionário para outras línguas. Ademais, o ACCEPTpro-ETCC poderá ser adaptado para outras perturbações psiquiátricas e outros tratamentos inovadores, tais como métodos de estimulação cerebral não-invasiva que procuram implementação nos serviços de saúde mental.

Palavras-chave: desenvolvimento de instrumento; validade; confiabilidade; investigação de implementação; aceitabilidade; enquadramento teórico de aceitabilidade; estimulação transcraniana por corrente contínua; depressão pós-parto.

Abstract

Purpose: Here we aimed to develop and study the psychometric properties of ACCEPTpro-tDCS, an instrument that assesses health professionals' acceptability towards the use of transcranial direct current stimulation (tDCS) in postpartum depression disorder.

Methods: A literature review on the definition of acceptability and on the available instruments to measure acceptability of interventions in health provided the basis for domain identification, item and instrument development. We pilot-tested a first version among a group of clinicians (N = 10; half experts and half naive to tDCS). The final experimental version was surveyed to test the questionnaire validity and reliability using confirmatory factor analysis and Cronbach's alpha.

Results: The confirmatory factor analysis lead to the final version of ACCEPTpro-tDCS, composed by 15 items that measure a global construct of acceptability. The instrument showed very good internal consistency (α = .93) and construct validity.

Conclusions: The ACCEPTpro-tDCS provides a reliable and valid method for assessing acceptability to tDCS on health care professionals. The next step is to translate ACCEPTpro-tDCS to other languages. Furthermore, the ACCEPTpro-tDCS can be adapted to other psychiatric disorders and other innovative treatments such as former non-invasive brain-stimulation methods endeavouring to achieve full implementation in mental health services.

Keywords: instrument development; validity; reliability; implementation research; acceptability; theoretical framework of acceptability; transcranial Direct Current Stimulation; postpartum depression disorder.

1. Introduction

Acceptability of innovative healthcare interventions is a necessary condition for its effectiveness (Sekhon, Cartwright, & Francis, 2017) as it entails the likelihood of adherence, delivery or recommendation of a treatment (Proctor et al., 2008). Within neuromodulation techniques, transcranial Direct Current Stimulation (tDCS) is a novel intervention that has been suggested to be used in postpartum depression disorder (PPD) either as augmentative or stand-alone intervention (Padberg et al., 2017). PPD is a debilitating disorder that affects about 10-15% of women after delivery (Darcy et al., 2011); however, there are no alternative treatment strategies in public health services to psychotherapy or pharmacotherapy (Kim, Snell, Ewing & O'Reardon, 2015; Wisner et al., 2013), a breach that tDCS may supress. To establish a new treatment it is necessary for health professionals to convey acceptability towards novelty, and hence the emphasis on the need to develop acceptability measures. The growing interest on the role of tDCS for the treatment of psychiatric disorders such as PPD, motivated the current study aiming at developing a new measure to access health professionals' acceptability of innovative health interventions - the ACCEPTpro-tDCS.

Acceptability is more than satisfaction with a service or treatment – it is dynamic and changes with experience (Proctor et al., 2010). Upon an extensive literature review, several approaches on acceptability were found. Proctor et al. (2010) define acceptability as the perception among stakeholders (e.g. consumers, providers, managers, policy-makers) that an intervention is agreeable, and related acceptability to other factors such as comfort, relative advantage and credibility. Peters et al. (2013) presented acceptability as the degree of adoption of the intervention, taking into consideration several acceptability outcomes such as appropriateness, feasibility, fidelity, implementation cost, coverage and sustainability.

A study by Wilhelmy et al. (2017) about knowledge and attitudes concerning electroconvulsive therapy (ECT) in Germany suggests that acceptability is the synonym of acceptance. In their study, the authors assessed the acceptability rate relying on participants' answers on whether they would accept a personal treatment with ECT if they were suffering from depression. However, no structured supporting theoretical model was suggested.

From our literature review, the Theoretical Framework of Acceptability (TFA) suggested by Sekhon et al. (2017), showed to be the most coherent and embodied theory on acceptability. According to the TFA, acceptability reflects the extent to which people delivering or receiving a health care intervention regard it as appropriate. Acceptability of an intervention is then based on individual cognitive and emotional responses to the intervention. Additionally, the authors consider that the probability of those responses modulate the individual commitment to the intervention. Finally, within the TFA, individual responses to measure acceptability can be collected either before, during or after the intervention itself.

The TFA proposes a structured and operationalised definition of acceptability that combines seven components: affective attitude, burden, perceived effectiveness, ethicality, intervention coherence, opportunity costs and self-efficacy. *Affective attitude* concerns how a person feels about engaging an intervention; *burden* is defined as the personal effort required to participate in the intervention; *perceived effectiveness* is related to the likelihood of the intervention to achieve its purpose; *ethicality* concerns the fit of the intervention with the person's system of values; *intervention coherence* is defined as the person's understanding of the intervention and how it works; *opportunity costs* concerns the benefits or profits a person has to give up to when taking part of the intervention; and, finally, *self-efficacy* is related to a person's confidence that he/she is capable of performing the required behaviours to engage in the intervention (Sekhon et al., 2017). Together these seven components are presumed to provide the clearest vision of end-users' acceptability towards a new therapeutic protocol and support the development of strategies aimed to support its implementation (Sekhon et al., 2017).

Taken its complexity, completeness and strong theoretical basis, we consider that TFA provides a well-fitted foundation for implementation research enabling to progress from investigation to intervention, with a good coverage of the potential problems in different phases of the process (Atkins et al., 2017; Peters et al., 2013).

In recent years, there has been an augmented interest on the effectiveness of non-invasive brain stimulation techniques such as transcranial direct current stimulation (tDCS) for the treatment of several mental health conditions. TDCS induces changes in neuronal networks while electrical current flows from the anode electrode to the cathode

electrode (Woods et al., 2016). The current flow changes the polarity of neurons, and the susceptibility of neurons to fire. Whereas anodal stimulation is broadly assumed to increase cortical excitability, enhancing the probability of action potentials, cathodal stimulation is assumed to decrease cortical excitability, thus reducing the likelihood of action potentials (Moffa, Brunoni, Nikolin & Loo, 2018; Stagg, & Nitsche, 2011).

Postpartum depression is a very debilitating diagnosis to mothers and families (Pereira et al., 2014; Malus et al., 2016), negatively impacting the new-born neurodevelopment (Stein et al., 2014) and to which non-invasive brain stimulation techniques have been suggested has an alternative or complementary treatment to pharmacotherapy and psychotherapy (Baeken, Brunelin, Duprat, & Vanderhasselt, 2016). tDCS in particular, benefits of a level B recommendation for major depression disorder (MDD; Lefaucheur et al., 2017) and due to its portability, low cost, minor side effects, non-invasive nature and easy-to-use devices (Brunoni et al., 2012; Moffa et al., 2018; Woods et al., 2016) it has a great implementation potential.

Despite tDCS potential to be broadly adopted by health services, previous studies on the use of tDCS in several neuropsychiatric disorders mainly assess its efficacy (cf. Kekic et al., 2016; Shiozawa et al., 2014) overlooking end-users' acceptability. As previously highlighted, the study of the acceptability factors that may contribute to patients' and professionals' thoughts, attitudes and acceptance or reluctance towards innovative health treatments is central to its successful implementation. Such is the case of tDCS in PPD, leading to the importance of combining treatment efficacy and treatment effectiveness studies with implementation effectiveness studies (Sharma, Ghai, & Grover, 2017) to define the future of tDCS within research and health care services provision.

The present study aims to develop and validate a self-report TFA-based questionnaire on the acceptability of health professionals on using tDCS: the ACCEPTpro-tDCS. This instrument was developed such that it is adaptable to other non-invasive brain stimulation techniques, granting a valid method to access acceptability of health professionals.

The study of the acceptability factors that may contribute to patients' and professionals' attitudes towards innovative treatments such as tDCS is critical to health

intervention implementation (Sharma et al., 2017) and the most straightforward way to assess these factors is using self-report measures. If assessed prior to the intervention, patients and healthcare professionals can provide their anticipated perception about the intervention's acceptability, (Sekhon et al., 2017). This allows collecting information other than the exclusive assessment of drop-out rates (cf. Moffa et al., 2017) or reported side effects of the intervention (cf. Peters et al., 2013; Sekhon et al., 2017), a practice that is insufficient according to implementation research principles.

2. Material and Methods

2.1. Measures

Participants provided information on sociodemographic data, including age, gender, marital status, area of residence, profession, level of education, years of clinical experience, if he/she is currently providing health care services, if he/she ever consulted a psychologist or psychiatrist, and if he/she has any previous knowledge on tDCS and has ever recommended/administered/prescribed tDCS to his/her own patients.

Participants completed the experimental version of the ACCEPTpro-tDCS, a questionnaire consisting of twenty-one items to assess acceptability to tDCS (e.g., item 10 - *"tDCS has a strong clinical applicability"*), using a 6-point Likert scale (1 – *Completely disagree*, 2 – V*ery much disagree*, 3 – *Moderately disagree*, 4 – *Agree moderately*, 5 – *Very much agree*, 6 – *Completely agree*) in which a higher point is equivalent to higher acceptability, with exception for the inverted items, namely items two, six, nine, 13, 19 and 21.

2.2. Participants

Two hundred and eight Portuguese health care professionals (74.5% women) were surveyed in person (pilot phase) or through web-based social media (e.g. e-mail, LinkedIn, Facebook), using a convenience sampling method. Inclusion criteria included (1) being at least 21 years old, (2) having professional practice as health care provider

and being effectively or hypothetically directly or indirectly involved on treatment decision in PPD, and (3) having the ability to read and understand Portuguese.

The mean age of the participants was 40 years (*SD* = 11.84). Most participants were married/cohabitating (n = 129, 62%), living in urban areas (n = 186, 8.8%) with a bachelor's degree (n = 101, 48.6%), followed by master's degree (n = 82, 39.4%). Nurses were the most represented professional group (n = 74, 35.6%), followed by psychologists (n = 72, 34.6%) and medical doctors (n = 62, 29.8%). Most participants were currently providing health care services (n= 197, 94.7%) and the mean years of clinical practice was 15.24 (*SD* = 11.53). The majority had never been in Psychology/Psychiatry consultations; 84 (4.4%), reported previous knowledge about tDCS (n = 157, 75.7%) but only a minority had ever recommended/administered/prescribed tDCS before (n = 8, 3.8%).

Table 1

Participants characteristics regarding clinical practice, history and knowledge (N = 208)

		Frequency (%)
Currently providing health care services	Yes	197 (94.7)
	No	11 (5.3)
Past history of Psychiatric/Psychological consultations	Yes	51 (24.5)
	No	157 (75.5)
Previous knowledge on tDCS	Yes	84 (4.4)
	No	124 (59.6)
Previous recommendation/administration/prescription of tDCS	Yes	8 (3.8)
	No	200 (96.2)

2.3. Procedures

For instrument development, we have followed five stages: (i) literature review on acceptability measures in health, definition of acceptability and tDCS; (ii) item development according to the components of the Theoretical Framework of Acceptability

(content validity); (iii) questionnaire development including instructions, response scale format and scoring; (iv) evaluation by experts for content validity and (v) pre-testing questions phase of questionnaire-items, through rounds of cognitive interviews to 10 end-users ensuring feasibility (Figure 1).

Table 2

Sociodemographic characteristics (N = 208)

	Participants *Frequency (%)*
Gender	
Male	53 (25.5)
Female	155 (74.5)
Area of residence	
Rural	40 (19.2)
Urban	168 (8.8)
Marital status	
Single	54 (26)
Married/cohabiting	129 (62)
Divorced	19 (9.1)
Widowed	6 (2.9)
Profession	
Doctor	62 (29.8)
Nurse	74 (35.6)
Psychologist	72 (34.6)
Level of education	
Bachelor	101 (48.6)
Master	82 (39.4)
PhD	25 (12)
	M (SD)
Age (years)	40 (11.84)
Years of clinical experience	15.24 (11.53)

For instrument evaluation, we aimed at refining the items of the experimental version and at confirming the factorial structure of the ACCEPTpro-tDCS and its preliminary psychometric properties. Instrument evaluation included survey administration and data collection, testing for reliability, construct validity, and factorial structure including model fit assessment of two different models, model modification and model comparison with consequential choice of the best fitting model.

The Ethics Committee from the Faculty of Psychology and Educational Sciences of the University of Coimbra approved the current study. After full description of the study, a consent paragraph with information about the voluntary nature of participation, confidentiality of responses and benefits for participants was added to the online survey protocol. Following the current European Union General Data Protection Regulation (GDPR, 2016), a consent answer was required to access and complete the survey.

All data collection, including pilot-study phase, occurred between November 2018 and June 2019. Data collection for instrument testing occurred between February 2019 and June 2019. Data was collected through e-mail and phone contacts from maternity hospitals, general hospitals, primary health care units, private health units, physicians, psychologists and nursing forums and blogs, nursing schools, and private offices. Phone contacts aimed to ask for collaborating professionals and to pre-notice health services that an e-mail was going to be sent. The e-mail included a link to the survey website. The link was also posted on Facebook and LinkedIn's personal pages of the researchers and sent individually to professional inboxes for eligible participants via Facebook and LinkedIn. The contacted professionals were asked to share the protocol to other colleagues.

2.3.1. Data analysis

Data analysis were conducted using the Statistical Package for Social Sciences (SPSS 22.0). Confirmatory factor analysis (CFA) was performed using Analysis of Moment Structures (AMOS 22.0).

A probability of a type I error of .05 was considered for all analysis. Exploratory data analysis was conducted to test assumptions of normality. The Kolmogorov-Smirnov test of normality (Marôco, 2018) showed non-normal distribution of the individual items and totals of the acceptability components ($p < .001$). However, because skewness (Sk)

and kurtosis (Ku) values did not reveal serious biases (-1.30 < Sk < -.20, -.65 < Ku < 1.88; Kline, 2011) we followed a parametric testing strategy. The acceptability global score presented a normal distribution ($p > .05$) and standard deviation was below 1.5 for all items. We detected a ceiling effect on the inverted items (i.e. items in which higher score indicates lower acceptability), and also on items 4 and 11, according to Terwee et al. (2007) criteria of > 15% of respondents achieving the highest possible score.

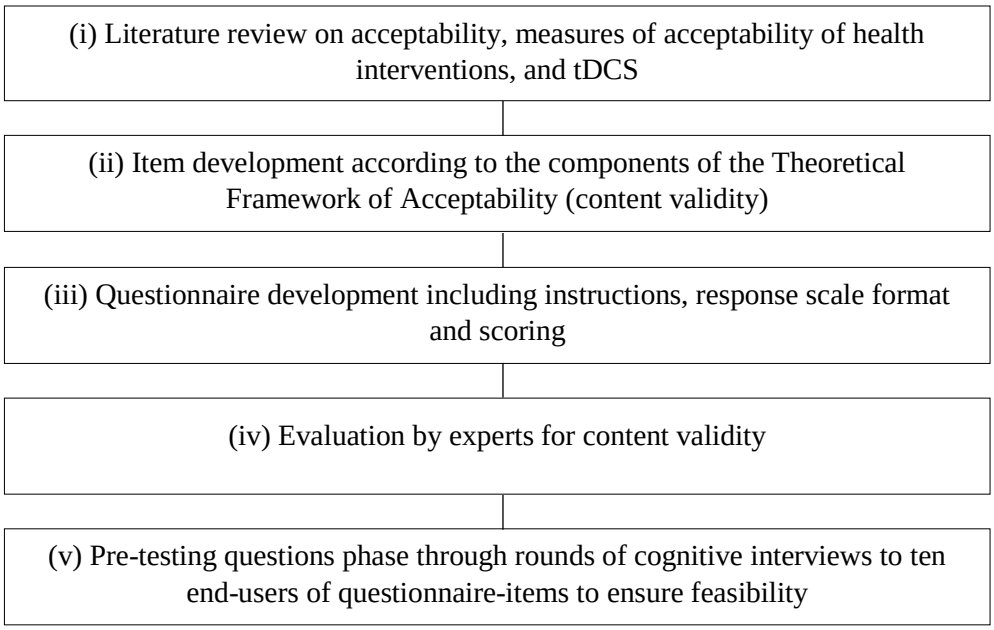

Figure 1. *Flowchart of the five stages of ACCEPTpro-tDCS development*

Data analysis was organized into three stages: 1) Descriptive statistics and analysis of reliability, 2) Test of dimensionality: Confirmatory Factor Analysis, inspecting factorial structure and 3) Test of reliability using Cronbach's α.

We used descriptive statistics to summarize participants' age, gender, marital status, area of residence, profession, level of education and years of clinical experience. Descriptive analysis was also carried out for individual items, totals of acceptability by factors (components), and the acceptability global score. Pearson's correlations were calculated between the factors of the questionnaire, between the items within each factor and between each item regardless of factors. According to Cohen, Cohen, West, & Aiken (2003), correlation coefficients between .10 and .30 were considered low, between .30 and .50 were moderate and above .50 were considered high.

For internal reliability analysis of the ACCEPTpro-tDCS we calculated Cronbach's alpha coefficient, taking into consideration the criteria suggested by George & Mallery (2003). According to these authors, internal consistency is considered to be high for reliability coefficients above .9, good for coefficients between .8 and .9, and acceptable for coefficients between .7 and .8.

Furthermore, we assessed construct validity using the CFA to examine the factor structure of the ACCEPTpro-tDCS and test whether data from the items fitted in the components to which they had been categorized. We overcame the required minimum sample of 105 participants for the 21 items (Tabachnick & Fidell, 2007). Two models were estimated: a second-order model where the questionnaire items were loading into the first-order factors (affective attitude, burden, perceived effectiveness, ethicality, intervention coherence, opportunity costs and self-efficacy), which in turn loaded into a global second-order factor (acceptability global score); and a first-order model in which all items were loading into one global factor (acceptability global score). The two designed models were compared in terms of model fit indices: the Comparative Fit Index (CFI) and Tucker and Lewis Index (TLI), both with values of good fit ranging from .90 to .95 (Brown, 2006); the Goodness of Fit Index (GFI), and the normed chi-square (χ^2/df) indicating the suitability of the questionnaire's structure with values between 2 to 5 indicating a good global adjustment; and the Root Mean Square Error of Approximation (RMSEA) ranging from .05 and .08 with a 95% confidence interval (Tabachnick & Fidell, 2013), or up to .10 (Hu & Bentler, 1995).

3. Results

Stage 1: Descriptive statistics and analysis of reliability

The mean, standard deviation, minimum, maximum, skewness and kurtosis for all seven factors of acceptability are presented in Table 3. All of them presented relatively high mean values, with *ethicality* and *burden* presenting the highest mean values (13.77 and 13.50, respectively) and *intervention coherence* and *perceived effectiveness* presenting the lowest (11.45 and 11.53, respectively).

Correlations between the acceptability factors are presented in Table 4. All correlations were significant at $p < .05$, except between *intervention coherence* and

burden, *perceived effectiveness* and *burden* and *affective attitude* and *burden*. These results seem to indicate issues with the factor *burden*, which is constituted only by inverted items. Correlations between *burden* and e*thicality*, *burden* and *opportunity costs*, *burden* and *self-efficacy*, *ethicality* and *intervention coherence,* and *ethicality* and *self-efficacy* were low ($.16 \leq r \geq .35$) , and all the remaining were moderate to high ($.41 \leq r \geq .89$).

Table 3

Mean (M), standard-deviation (SD), minimum (Min), maximus (Max), skewness (Sk) and kurtosis (Ku) of the acceptability factors (N=208)

Factors	*M*	*SD*	*Min*	*Max*	*Sk*	*Ku*
Affective attitude	12.14	3.28	3	18	-.70	.90
Burden	13.50	2.91	3	18	-.37	.17
Perceived effectiveness	11.53	3.07	3	18	-.73	1.14
Ethicality	13.77	2.70	6	18	-.53	.12
Intervention coherence	11.45	3.50	3	18	-.57	.09
Opportunity costs	12.37	2.35	3	18	-.43	.98
Self-efficacy	12.04	3.01	3	18	-.22	-.05

Table 4

Inter-correlations between acceptability factors

Factors	Affective attitude	Burden	Perceived effectiveness	Ethicality	Intervention coherence	Opportunity costs	Self-efficacy
Affective attitude	1	-	-	-	-	-	-
Burden	.09	1	-	-	-	-	-
Perceived effectiveness	.89**	.08	1	-	-	-	-
Ethicality	.63**	.35**	.59**	1	-	-	-
Intervention coherence	.58**	.12	.60**	.28**	1	-	-
Opportunity costs	.72**	.22**	.68**	.65**	.41**	1	-
Self-efficacy	.54**	.16*	.54**	.34**	.58**	.53**	1

Note. * $p < .05$. ** $p < .01$

The instrument, including all 21 items, tested well for reliability (Cronbach's α = .91) with high internal consistency, assuming that the sum of scores measure acceptability (Prous, Salvanés, & Ortells, 2009).

Stage 2: Test of dimensionality: Confirmatory factor analysis (construct validity)

We conducted a confirmatory factor analysis for two different models: a second-order or hierarchical model and a first-order or unifatorial model. Table 6 presents the goodness-of-fit of both, for a straightforward comparison. Although the second-order model apparently showed the most adequate fit (χ^2/df = 3.20; p < .001; CFI = .85, TLI = .83 and RMSEA = .10, 90% confidence interval [CI; .09, .11]), it presented two negative error variances, what resulted in factor loadings above one. Theoretically, negative variances and factor loadings above one are impossible, and when this occurs we are in the presence of a Heywood case (McDonald, 1985). According to Joreskog and Sorbom (1984), a negative variance may indicate that the sample size is too small for the model; McDonald considers a common cause the insufficient number of variables within each factor, suggesting preferably four variables for each (our model has three). Also, some solutions suggested in literature (Kolenikov & Bollen, 2012; McDonald, 1985) include combining the most related factors and constraining estimates to be equal within factors. Nonetheless, the first solution would turn the model inconsistent with our base-theory and the second solution did not correct the issue. As we were unable to overcome this problem, regardless the applied solution to correct it, the second-order model was disregarded.

In contrast, the first-order model presented the following values of goodness-of-fit: χ^2/df = 4.84; p < .001; CFI = .73, TLI = .70 and RMSEA = .14, 90% CI [.13, .15]. In order to improve the model fit, we operated a series of modifications which are specified on Table 5. The first modification related to the poor loadings (≤ .3; Boateng, Neilands, Frongillo, Melgar-Quiñonez, & Young, 2018) and ceiling effects of the inverted items, which support the need for their removal. All the following modifications concerned the correlation between errors of different items.

Table 5

Applied modifications on the CFA first-order model

Model	Modification	M.I.
M1	M0 excluding inverted items	-
M2	M1 + correlated errors of items 8 and 14	62.03
M3	M2 + correlated errors of items 4 and 11	38.96
M4	M3 + correlated errors of items 5 and 8	35.15

Note. M0 = original model; M.I. = modification indice.

In order to correlate errors, we verified the items theoretical association (content) as well as similarities concerning wording and sentence construction (structure). Items 8 and 14 share similar phrasing and content about how much professionals understand the technique (item 8: *"I understand how to administer tDCS"*; item 14: *"I understand the mechanism of action of tDCS"*). Besides sharing similar phrasing, both items 4 and 11 refer to the ability to learn about the technique, alluding to the perceived self-efficacy (item 4: *"I am capable of learning how to administer tDCS"*; item 11: *"I am capable of learning about tDCS"*). Also, items 5 and 8 shared similar sentence construction and both related to the coherence of the intervention (item 5: *"I understand tDCS' side effects"*; item 8: *"I understand how to administer tDCS"*). By correlating the errors of those items we were able to improve the model up to the advised values achieving satisfactory fitness.

Table 6

Main goodness-of-fit indices of the two CFA models

	χ^2	*df*	χ^2/df	CFI	TLI	NFI	RMSEA
M0: Second-order Model	583	182	3.20	.85	.83	.80	.10
M0: First-order Model	916	189	4.84	.73	.70	.69	.14
M1	420	90	4.67	.85	.83	.82	.13
M2	348	89	3.91	.88	.86	.85	.12
M3	305	88	3.46	.90	.88	.87	.11
M4	260	87	2.99	.92	.91	.89	.09
Criteria for goodness of fit	-	-	≥ .90	≥ .90	≥ .90	≥ .90	≤ .10

Note. CFI = comparative fit index; TLI = Tucker and Lewis' index of fit; NFI = normed fit index; RMSEA = root mean square error of approximation.

Figure 2 shows the final factor structure of the ACCEPTpro-tDCS, squares representing the questionnaire items and the first-order factor circle representing the theoretical global domain where they fit: acceptability. Factor loadings ranged between .47 and .92 and were statistically significant at $p < .001$. The 15 items structure is represented in Figure 3. Furthermore, all items revealed adequate standardized regression weights (SRW), which varied from .47 to .92, confirming the instrument's reliability (Tabachnick & Fidell, 2013). Composite reliability (CR) value was .92, and the average variance extracted (AVE) was .60, all of them representing good reliability and validity (Hair, Black, Babin, & Anderson, 2010).

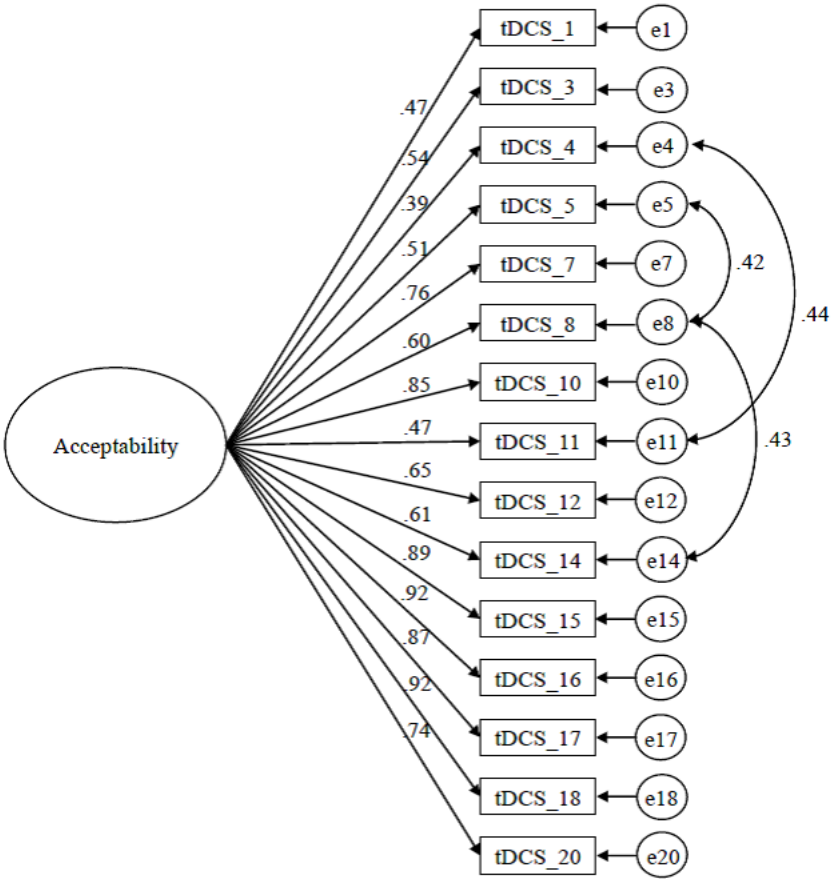

Figure 2. *Final structure of the ACCEPTpro-tDCS*

Stage 3: Test of reliability: Cronbach's α

By the end of the process of construct validity, we reached a 15-item instrument to measure acceptability as a global score. The instrument tested well for reliability,

revealing high internal consistency (George & Mallery, 2003), with a Cronbach's α of .93, which is an improvement concerning the original 21-item questionnaire (α = .91) and a preferred value for the psychometric quality of the instrument (Boateng et al., 2018; Cronbach, 1951). Furthermore, all items presented item-total correlation values superior to .30, which demonstrates that they represent the same general construct of acceptability (Field, 2009). Moreover, values of Cronbach's α if item deleted (see Table 7) were close or equal to the value of the instrument itself, thus confirming items contribution to its internal consistency.

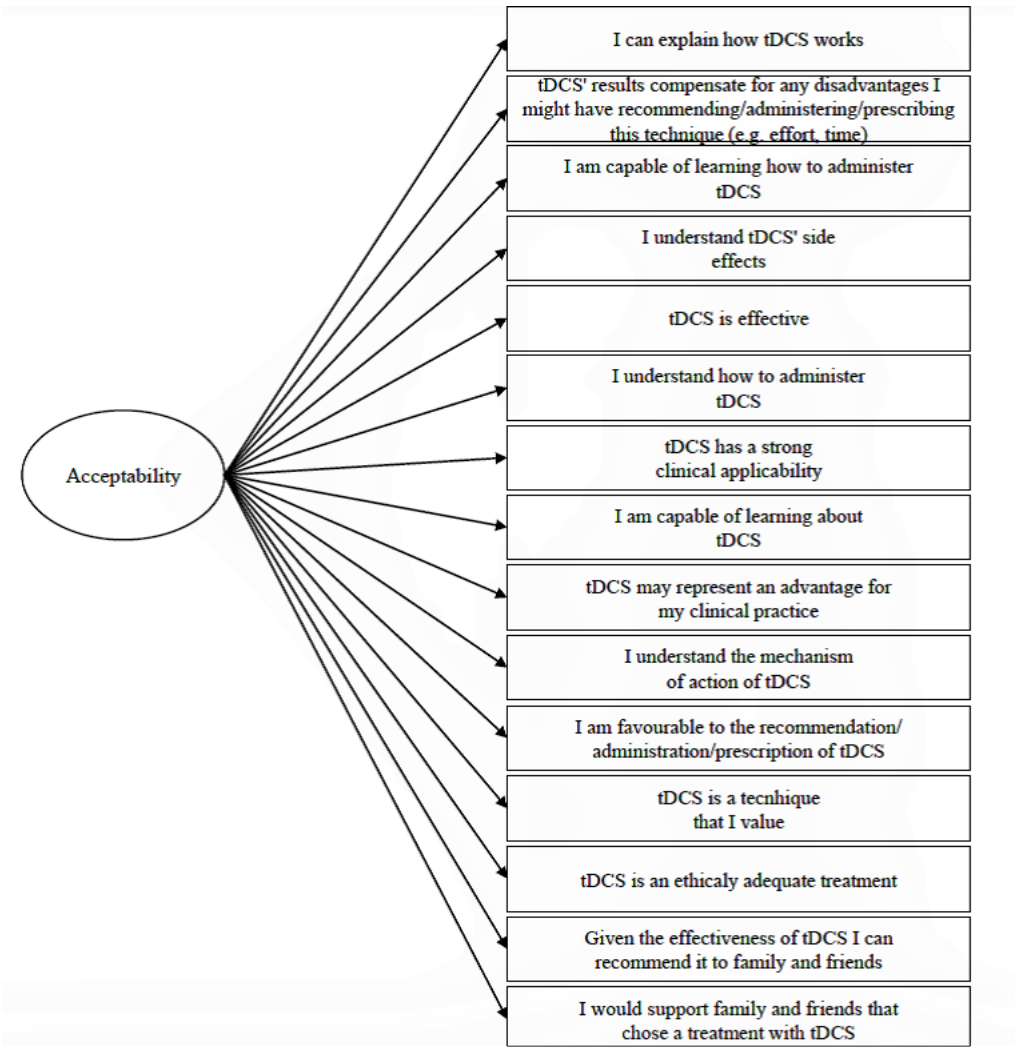

Figure 3. *Items of the final version of the ACCEPTpro-tDCS*

Stage 3: Test of reliability: Split-half method

We also tested for reliability using the slip-half method, dividing the 15 items of the questionnaire in unequal halves. The first half was constituted by the items one, three, four, five, seven, eight, 10 and 11 and the second half by items 12, 14, 15, 16, 17, 18 and 20 as numbered on the original questionnaire. The Spearman-Brown Coefficient achieved was .90 which is close to the Cronbach's α of .93, once again showing the reliability of the instrument.

Table 7

Reliability

Item	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's α if Item Deleted
1	.53	.47	.93
3	.50	.44	.93
4	.43	.37	.93
5	.58	.52	.93
7	.71	.62	.92
8	.66	.66	.92
10	.80	.73	.92
11	.52	.44	.93
12	.62	.47	.93
14	.67	.61	.92
15	.81	.79	.92
16	.86	.82	.92
17	.79	.77	.92
18	.86	.82	.92
20	.68	.61	.92

4. Discussion

NIBS interventions have been described as exceptionally advantageous treatment options because of their mild side effects and lack of absolute contraindications (Brunoni et al., 2018). Among those, tDCS shows excellent tolerability, safety, and clinical efficacy in reducing depressive symptoms (Brunoni et al., 2016; Nikolin & Loo, 2018).

In this study, our aim was to develop and test a theory-driven instrument to assess the acceptability of health professionals to tDCS as an alternative treatment to postpartum depression disorder. The ACCEPTpro-tDCS fills an important gap in the literature as it focuses the professionals' perspective towards an innovative therapy for a psychiatric condition that urgently needs alternative non-pharmacological interventions. To our knowledge, this is the first instrument assessing professionals' acceptability to tDCS (behavioural and emotional responses) from a multidimensional approach and overcoming dropout rates and adverse effects assessment. Due to its broader nature, ACCEPTpro may better inform future implementation research studies aiming for the uptake of tDCS to the clinical practice.

tDCS has been extensively studied and there is strong evidence regarding its efficacy on several psychiatric disorders, particularly major depression disorder. Notwithstanding, tDCS has not yet fully achieved the clinical pipeline as it has been limited by the "promising intervention" narrative (Brunoni, 2019). Fortunately, recent research has been grounding tDCS' full potential, and its home-based versions in particular caught stakeholder's attention. For example, a recent pilot-trial for home-based tDCS to treat depression (Alonzo et al., 2019) used a portable device, independently operated by participants and remotely supervised by clinicians. The study concluded that participants experienced significant reductions in their depressive symptoms sustained beyond acute treatment phase, thus ascertaining its efficacy. Overall, within NIBS techniques, home-based solutions may become the most efficient strategy for both patients and health care professionals, allowing time and cost savings and increasing accessibility to tDCS treatments (Alonzo et al., 2019). But then again, tDCS will only see its place as a treatment option after having health professionals acknowledging on its advantages and after their acceptability of tDCS as a treatment option is fully confirmed.

Acceptability is a construct that needs to be considered when designing, evaluating and implementing healthcare interventions. Previous attempts to define acceptability suggest a diversity of definitions showing the lack of consensus in the field (cf. Peters et al., 2013; Proctor et al., 2010; Wilhelmy et al., 2017). With the TFA, Sekhon et al. (2017) aimed at offering an extensive, dynamic and multidimensional framework to adequately access acceptability, enabling its monitoring over time and allowing for comparative studies between alternative interventions (Sekhon, Cartwright, & Francis, 2018).

Notwithstanding TFA's advantages, in our study we were not able to find the correct formulae for a self-report questionnaire - ACCEPT-pro-tDCS -, such that its factorial structure would match the definition of acceptability proposed. The hierarchical model, in which all seven components of acceptability suggested by TFA were included to assess the general construct, was not statistically appropriate to the nature of our instrument and sample. This may be due to several reasons. Firstly, the static nature of self-reported measures (Demetriou, Ozer, & Essau, 2015), may not comply with the dynamic nature of acceptability as defined by TFA. Secondly, the contiguity between acceptability dimensions that constitute acceptability lead to the construction of items that were too close in wording and meaning making it hard for responders to understand their distinctiveness in a self-reported questionnaire format.

In fact, TFA's authors developed a semi-structured interview (Sekhon, Cartwright, & Francis, 2016) that besides its self-reported format, included not only the collection of feedback on global acceptability, affective attitude, burden and anticipated effectiveness, but also suggestions on possible improvements and a direct discussion about personal issues within the health service. This approach could represent the most adequate method allowing for a thorough understanding of health professionals' individual perspectives.

Nevertheless, self-report questionnaires present many advantages as they allow for an easy and inexpensive process of data collection, surveying a high number of participants anonymously, protecting for sensitive information to be shared and promoting truthful responses (Demetriou, Ozer, & Essau, 2015; Northrup, 1997).

For the development of ACCEPTpro-tDCS, we followed Boateng et al. (2018) best practices for developing and validating questionnaires in health research, through a series

of suggested steps on item and instrument development and instrument evaluation. Furthermore, experts revised the experimental version ensuring content validity and a series of cognitive interviews of the pilot-study assessed the extent to which items reflected the domains of interest.

Two structural models were tested: a second-order model and a first-order model. Considering the statistical issues of the second-order model and the impracticality to correct them without undermining the theoretical base, we choose the first-order model. After improving the fitness of the model by applying modifications over the initial structure, the psychometric analysis showed ACCEPTpro-tDCS to perform well. Items that were compromising reliability were removed and we correlated item errors associated to phrasing (leading participants' responses), either by sharing method variance or specific item content (Brown, 2006). The final structure comprised 15 items to assess acceptability global score, regardless of specific components. The 15 items version of ACCEPTpro-tDCS revealed high values of internal consistency, reliability and construct validity in a sample of 208 Portuguese health professionals (nurses, psychologists and medical doctors), experienced in infant-maternal, obstetrician or gynaecology fields.

This study has four limitations that are worth mentioning. The first concerns the constraint underlying online surveys, in which the respondents tend to be highly motivated or interested on the study's topic (Remillard, Mazor, Cutrona, Gurwitz, & Tjia, 2014). Secondly, due to time constrains we were unable to perform test-retest reliability by surveying a group of participants in two distinctive time points. Thirdly, there is not firm agreement on the best indices of model fit, as distinctive cut-off points and guidelines can be found in literature (e.g. the use of RMSEA, cf. Hair et al., 2010; Hu & Bentler, 1995; and Tabachnick & Fidell, 2013). Finally, ACCEPTpro-tDCS was developed and tested for European Portuguese, and future research should investigate its structure invariance to other languages. Further research should also investigate the influence of individual variables on acceptability, such as sociodemographic characteristics, education level and profession, previous contact/familiarity and previous knowledge about tDCS.

Overall, the ACCEPTpro-tDCS is a short, easy to administer and reliable measure to assess acceptability of health care professionals towards tDCS, which has important

implications for research and clinical health services, providing the perspective of health professionals about this treatment option. Furthermost, ACCEPTpro-tDCS can be adapted to further non-invasive brain stimulation techniques such rTMS and distinctive psychiatric conditions within treatment efficacy and treatment acceptability studies.

Contributors

Authors ASM, AGA and MCC designed the study, prepared the measures and wrote the protocol. ASM and AGA recruited and assessed the participants. ASM and ICR conducted literature research and provided summaries of previous research studies. ASM conducted the statistical analysis and wrote the manuscript throughout its development stages. AGA and MCC supervised and contributed throughout the conduction of these tasks. All authors approved the final manuscript.

Conflict of interest

The authors declare no conflicts of interest.

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6. Appendices

Appendix A

ACCEPTpro-ETCC
(EXPERIMENTAL VERSION)
(Saraiva-Martins, Caria-Rodrigues, Canavarro, & Ganho-Ávila, 2019)

A Estimulação Transcraniana por Corrente Contínua (ETCC) é uma técnica de estimulação cerebral não-invasiva que tem demonstrado ser eficaz em pacientes com perturbação depressiva major e que tem sido sugerida como abordagem alternativa para o tratamento da depressão pós-parto. A ETCC envolve a aplicação de uma corrente elétrica de baixa intensidade, através de dois elétrodos colocados sobre o couro cabeludo, com o objetivo de induzir mudanças na atividade neuronal. Os efeitos secundários mais comuns são uma sensação de formigueiro, comichão e leve vermelhidão no local onde os elétrodos são colocados. Os protocolos terapêuticos mais comuns recomendam sessões diárias de 20 minutos ao longo de 4 semanas.

INSTRUÇÕES: Imagine que está perante uma paciente com diagnóstico de depressão pós-parto. Assinale com um círculo o número que melhor reflete o quanto concorda com cada afirmação. Tenha o cuidado de assinalar somente um número para cada afirmação e, por favor, responda a todas as questões.

1 - Discordo totalmente, 2 - Discordo muito, 3 - Discordo moderadamente, 4 - Concordo moderadamente, 5 - Concordo muito, 6 - Concordo totalmente

1. Sou capaz de explicar como funciona a ETCC.	1	2	3	4	5	6
2. A ETCC é um tratamento reprovável.	1	2	3	4	5	6
3. Os resultados da ETCC compensam quaisquer desvantagens que eu possa ter ao recomendar/administrar/prescrever esta técnica (ex.: esforço, tempo).	1	2	3	4	5	6
4. Sou capaz de aprender a administrar a ETCC.	1	2	3	4	5	6
5. Compreendo os efeitos secundários da ETCC.	1	2	3	4	5	6
6. Recomendar/administrar/prescrever ETCC ocupa demasiado tempo do meu dia.	1	2	3	4	5	6
7. A ETCC é eficaz.	1	2	3	4	5	6
8. Compreendo como se administra a ETCC.	1	2	3	4	5	6
9. A ETCC colide com os meus valores pessoais.	1	2	3	4	5	6
10. A ETCC tem uma forte aplicabilidade clínica.	1	2	3	4	5	6
11. Sou capaz de aprender sobre ETCC.	1	2	3	4	5	6
12. A ETCC pode representar uma vantagem para a minha prática clínica.	1	2	3	4	5	6
13. Recomendar/administrar/prescrever ETCC requer demasiado esforço.	1	2	3	4	5	6
14. Compreendo o mecanismo de ação da ETCC.	1	2	3	4	5	6
15. Sou favorável à recomendação/administração/prescrição da ETCC.	1	2	3	4	5	6
16. A ETCC é uma técnica que eu valorizo.	1	2	3	4	5	6

17. A ETCC é um tratamento eticamente adequado.	1	2	3	4	5	6
18. Dada a eficácia da ETCC posso recomendá-la a familiares e amigos.	1	2	3	4	5	6
19. Aprender mais sobre ETCC requer demasiado esforço.	1	2	3	4	5	6
20. Apoiaria familiares ou amigos que optassem por um tratamento com ETCC.	1	2	3	4	5	6
21. Recomendar/administrar/prescrever ETCC põe em causa a minha reputação.	1	2	3	4	5	6

Appendix B

ACCEPTpro-ETCC
(FINAL VERSION)
(Saraiva-Martins, Caria-Rodrigues, Canavarro, & Ganho-Ávila, 2019)

A Estimulação Transcraniana por Corrente Contínua (ETCC) é uma técnica de estimulação cerebral não-invasiva que tem demonstrado ser eficaz em pacientes com perturbação depressiva major e que tem sido sugerida como abordagem alternativa para o tratamento da depressão pós-parto. A ETCC envolve a aplicação de uma corrente elétrica de baixa intensidade, através de dois elétrodos colocados sobre o couro cabeludo, com o objetivo de induzir mudanças na atividade neuronal. Os efeitos secundários mais comuns são uma sensação de formigueiro, comichão e leve vermelhidão no local onde os elétrodos são colocados. Os protocolos terapêuticos mais comuns recomendam sessões diárias de 20 minutos ao longo de 4 semanas.

INSTRUÇÕES: Imagine que está perante uma paciente com diagnóstico de depressão pós-parto. Assinale com um círculo o número que melhor reflete o quanto concorda com cada afirmação. Tenha o cuidado de assinalar somente um número para cada afirmação e, por favor, responda a todas as questões.

1 - Discordo totalmente, 2 - Discordo muito, 3 - Discordo moderadamente, 4 - Concordo moderadamente, 5 - Concordo muito, 6 - Concordo totalmente

1. Sou capaz de explicar como funciona a ETCC.	1	2	3	4	5	6
2. Os resultados da ETCC compensam quaisquer desvantagens que eu possa ter ao recomendar/administrar/prescrever esta técnica (ex.: esforço, tempo).	1	2	3	4	5	6
3. Sou capaz de aprender a administrar a ETCC.	1	2	3	4	5	6
4. Compreendo os efeitos secundários da ETCC.	1	2	3	4	5	6
5. A ETCC é eficaz.	1	2	3	4	5	6
6. Compreendo como se administra a ETCC.	1	2	3	4	5	6
7. A ETCC tem uma forte aplicabilidade clínica.	1	2	3	4	5	6
8. Sou capaz de aprender sobre ETCC.	1	2	3	4	5	6
9. A ETCC pode representar uma vantagem para a minha prática clínica.	1	2	3	4	5	6
10. Compreendo o mecanismo de ação da ETCC.	1	2	3	4	5	6
11. Sou favorável à recomendação/administração/prescrição da ETCC.	1	2	3	4	5	6
12. A ETCC é uma técnica que eu valorizo.	1	2	3	4	5	6
13. A ETCC é um tratamento eticamente adequado.	1	2	3	4	5	6
14. Dada a eficácia da ETCC posso recomendá-la a familiares e amigos.	1	2	3	4	5	6
15. Apoiaria familiares ou amigos que optassem por um tratamento com ETCC.	1	2	3	4	5	6

II.

Saraiva-Martins, A., Canavarro, M. C., & Ganho-Ávila, A. (2019). *Impact of a psychoeducational video on the acceptability of health care professionals to transcranial Direct Current Stimulation in postpartum depression disorder*. Manuscript in preparation.

Impact of psychoeducational video on the acceptability of health care professionals towards transcranial Direct Current Stimulation in postpartum depression disorder

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Resumo

Objetivo: Explorar o impacto de um vídeo psicoeducativo na aceitabilidade de profissionais de saúde em relação ao uso da estimulação transcraniana por corrente contínua (ETCC) na depressão pós-parto.

Metodologia: Foi realizado um estudo quantitativo transversal com análises de medidas repetidas e de medidas independentes. Aplicámos um questionário de autorrelato com 15 itens que avalia a aceitabilidade da ETCC a uma amostra de conveniência não-probabilística de 173 profissionais de saúde, antes e depois da visualização de um vídeo de três a cinco minutos de duração. Os profissionais de saúde foram semi-aleatoriamente inseridos no grupo experimental ou no grupo de controlo. Enquanto os participantes do grupo experimental visualizaram um vídeo informativo sobre a ETCC, os do grupo de controlo visualizaram um vídeo neutro. Todos os participantes concederam o seu consentimento informado para participarem no estudo.

Resultados: Os resultados revelaram diferenças significativas na aceitabilidade dos profissionais de saúde antes e depois da visualização do vídeo psicoeducativo. Não foram detetadas diferenças no grupo de controlo. A maior parte das variáveis sociodemográficas avaliadas não revelaram ter qualquer influência sobre a aceitabilidade, quer em pré-intervenção, quer em pós-intervenção.

Conclusões: Aumentar o conhecimento dos profissionais de saúde em relação à ETCC aumenta significativamente a sua aceitabilidade como uma opção de tratamento na depressão pós-parto. No entanto, a psicoterapia permanece como a opção de tratamento mais aceitável e mais provável de ser recomendada. Investigações futuras deverão replicar este estudo em amostras de maior dimensão.

Palavras-chave: ETCC; estimulação transcraniana por corrente contínua; psicoeducação; aceitabilidade; profissionais de saúde; depressão pós-parto.

Abstract

Purpose: We aimed to explore the impact of a psychoeducational video on the acceptability of health care professionals concerning the use of transcranial direct current stimulation (tDCS) in postpartum depression.

Methods: A quantitative cross-sectional within-between-subjects design was used to conduct the current study. A 15-item self-administered questionnaire measuring acceptability towards tDCS was administered to a non-probability convenience sample of 173 health care professionals before and after exposure to a three to five-minute video. Health professionals were semi-randomly assigned to participate in the study either in the experimental or the control group. Whereas participants in the experimental group watched a video lecturing about tDCS, participants in the control group watched a neutral video. Informed consent was obtained from all health care professionals who took part in the study.

Results: Results showed significant differences in health professionals' acceptability before and after the visualization of the psychoeducational video, and no differences after the visualization of the neutral video. Most sociodemographic variables assessed did not show to have a significant influence on acceptability at pre-intervention or at post-intervention.

Conclusions: Increasing health professionals' knowledge about tDCS significantly increases their acceptability as a treatment option in postpartum depression. However, psychotherapy is still the most acceptable treatment option for professionals that provide health care to women with this diagnosis. Future studies should be conducted in larger samples to support our results.

Keywords: tDCS; transcranial direct current stimulation, psychoeducation; acceptability; health professionals; postpartum depression disorder.

1. Introduction

Bridging knowledge from research to daily care requires implementation research studies to define strategies for the uptake of novel health interventions. Implementation research studies include research on health professionals' acceptability towards innovative treatments. Transcranial Direct Current Stimulation (tDCS) is a non-invasive brain stimulation technique which efficacy has been extensively studied. Also, tDCS' low cost, portability and home-based solutions (Lefaucher et al., 2017; Brunoni, 2019) have been drawing academia and industry attention to this promising tool for treating distinctive neuropsychiatric disorders (Baeken, Brunelin, Duprat, & Vanderhasselt, 2016). However, tDCS is still barely known (from policy makers to health managers and end-users), raising endemic resistance to its full implementation. In this study, we aim to understand how a simple psychoeducational video impacts health practitioners' acceptability towards tDCS, increasing their commitment to the technique, their adherence to delivery or their likelihood to recommend tDCS as a treatment option.

tDCS involves the application of a weak electric current (1 to 2 mA) using two electrodes placed on the scalp. The application of such current aims at inducing localized changes in neuronal activity (Woods et al., 2016) improving psychological symptoms. Its mechanism of action is based on temporary variations of cognitive states (Nitsche et al., 2008); these variations are caused by differences on the polarity of the neurons located on the stimulation site, i.e., differences on cortical excitability. Stimulation by tDCS induces shifts on the subthreshold of resting membrane potentials either towards depolarization or hyperpolarization (Lefaucher et al., 2017). Anodal stimulation is known to increase cortical excitability leading to enhanced probability of action potentials, whereas cathodal stimulation decreases excitability, thus reducing the likelihood of action potentials (Stagg, & Nitsche, 2011). Moreover, longer stimulations can induce excitability changes that last for one hour or more (Nitsche & Paulus, 2001), considering that tDCS can also interfere with surrounding neuronal networks beyond the local effects (Lefaucher et al., 2017).

The advantages of tDCS are its portability, low-cost, tolerability to minor side effects, non-invasive nature and easy-to-use devices (Brunoni et al., 2012; Moffa et al., 2018; Woods et al., 2016). Moreover, tDCS is a promising non-pharmacological

intervention for treating major depressive disorder that can be used as a stnd-alone treatment or supporting pharmacotherapy and psychotherapy (Shiozawa et al., 2014). Each session usually lasts around 20-30 minutes and the typical frequency is ≤ 2 sessions per day (Kekic et al., 2016). On major depression disorder protocols with tDCS, the placement of the electrodes is usually anodal over the left dorsolateral prefrontal cortex (DLPFC) and cathodal over the right DLPFC (Palm, Hasan, Strube, & Padberg, 2016), based on evidence that the left DLPFC is hypoactive and the right DLPFC is hyperactive during depressive disorder (Grimm et al., 2008). tDCS' most common side effects are mild and transient, and can include tingling sensation, moderate fatigue and a light itching sensation under the electrodes (Woods et al., 2016, Vigod et al., 2014), none of which being especially disturbing or debilitating.

Recently, there has been an increased interest in tDCS for the treatment of several mental health conditions such as major depression disorder (Shiozawa et al., 2014), and peripartum depression disorder in particular (for a review about the use of tDCS during pregnancy see Kurzeck et al., 2018). According to the Diagnostic and Statistical Manual of Mental Disorders – 5 (5th ed.; DSM-5, American Psychiatric Association, 2013), peripartum depression disorder is defined as a major depression disorder with its onset either during pregnancy (prenatal) or after giving birth (postpartum). Postpartum depression disorder (PPD) is a psychiatric condition that brings suffering to women and their families (Stewart & Vigod, 2016), leading to increased, impaired attachment and impaired emotional, social and cognitive development in the child (Stein et al., 2014). Its symptoms include sleep disruption (not due to the child care tasks), anxiety, irritability, obsessive worry, fixation about the baby's health, and concerns about causing harm to the baby, associated to suicidal ideation in the most extreme cases (Wisner et al., 2013). 10-15% of women suffer from depression after giving birth (Darcy et al., 2011; Brummelte & Galea, 2016) and according to Goodman (2004) and Wisner et al. (2013) about 21% of those women persist with the disorder after the first year post-delivery, 13% after two years and 40% of women will have a relapse either during future pregnancies or other non-pregnancy related occasions.

PPD management depends on the severity of symptoms and the level of functional impairment. In cases of severe depression, pharmacotherapy (e.g. antidepressants; Stewart & Vigod, 2016) or electroconvulsive therapy (ECT; Thomson and Sharma, 2016)

are recommended. However, clinicians and women tend to avoid ECT due to its invasiveness and prolonged side effects (Kim et al., 2014). There is also some resistance to pharmacotherapy and clinicians often prescribe reduced dosages during the breastfeeding period aimed at limiting exposing infants to drugs due to its potential long-term neurodevelopmental effects (Kim et al., 2014; MacQueen et al., 2016). Mild and moderate depression are typically managed using psychosocial strategies and psychological therapy. However, psychotherapies can also be ineffective in cases that request for immediate results, given that months of treatment may be necessary for the improvement and remission of depressive symptoms (Milgrom et al. 2015). As such, alternative treatments to PPD that combine low drug-exposure risk and fast treatment responses are of the utmost importance (Vigod et al., 2014) and have been suggested (e.g. Ganho-Ávila, Poleszczyk, Mohamed, & Osório, 2019). tDCS potentially offers the answer to each of the noted limitations, especially in severe or resistant PPD.

However, tDCS studies in general mainly assess the efficacy and effectiveness of the treatment, overlooking end-users' acceptability. The study of the acceptability factors that may contribute to patients' and professionals' thoughts, attitudes and acceptance or reluctance towards innovative health treatments is a critical feature for its successful implementation in daily health care services. Such is the case of tDCS as a novel treatment in PPD, leading to the importance of combining implementation research with effectiveness studies (Sharma, Ghai, & Grover, 2017) and supporting the definition of the future for tDCS within research and health care services provision.

Previous studies have explored the impact of educational programs on end-users' acceptability towards more controversial clinical approaches, such as ECT. For example, a study by Poster, Baxter, and Hammon (1985) observed that the attitudes of nursing students towards ECT increased to 83% after exposure to an educational videotape. More recently, Dawood et al. (2013) examined the effects of educational videos on nursing students (Dawood, Selim, & Khalil, 2013) and medical students (Solomon, Simiyon, & Vedachalam, 2015) concerning ECT. The three studies showed improved attitudes towards ECT as a psychiatric treatment.

Based on the literature review, subjects exposed to more information regarding a new health intervention tend to be more willing to engage in behaviours that comply with

it. Accordingly, we hypothesize that the visualization of an educational video about tDCS' mechanisms of action, psychiatric applications, treatment protocols, procedure, involved equipment and most common side-effects, increases health professionals' acceptability to tDCS (Poster et al., 1985; Kim et al., 2011; Dawood et al., 2013; Solomon et al., 2015).

In the present study we used a parallel-arm design where we compared the effect of a psychoeducational video on the acceptability of health professionals towards the use of tDCS for treating PPD, when compared to no intervention (control video). The primary hypothesis of our study stated that health professionals' acceptability towards tDCS would increase after the visualization of a psychoeducational video. As we used a control group of health professionals to which we offered a distractor video to control for the impact of the intervention, we also hypothesized that health professionals' acceptability in the control group would be similar before and after the visualization of the video. Finally, we hypothesized that health professionals' acceptability would be higher for the experimental group when compared to the control group. To measure acceptability, we used the recently developed ACCEPTpro-tDCS (Saraiva-Martins, Canavarro, Caria-Rodrigues, & Ganho-Ávila, 2019).

Additionally, we aimed at observing how several sociodemographic variables (age, gender, area of residence, marital status, profession, level of education and years of clinical experience) impact health professionals' acceptability towards tCDS.

2. Material and Methods

2.1. Measures

2.1.1. ***Sociodemographic questionnaire***. Participants provided information on sociodemographic data (including age, gender, marital status, area of residence, and level of education), professional status (profession, if he/she is currently providing health care services, and years of clinical experience,), psychiatric/psychological clinical history (if he/she ever consulted a psychologist or psychiatrist), and previous knowledge/experience with tDCS (if he/she has any knowledge on tDCS and if he/she has ever recommended/administered/prescribed tDCS to his/her patients).

2.1.2. *ACCEPTpro-tDCS questionnaire.* (Saraiva-Martins, Caria-Rodrigues, Canavarro, & Ganho-Ávila, 2019. Health care professionals completed the questionnaire aimed to assess acceptability towards tDCS before and after the visualization of either the psychoeducational or the control video. Subjects rated each sentence on a Likert scale of 6 points (1 = *Completely disagree*; 6 = *Completely agree*) where higher scores indicate higher levels of acceptability (e.g.*"tDCS has a strong clinical applicability"*). Cronbach's α was 0.93 at the time of development of the instrument, 0.92 in this study at pre-intervention and 0.94 at post-intervention.

To better understand acceptability towards tDCS in postpartum depression disorder when compared to other available treatments, we included the following question to the protocol: "*Between the different treatment options available for postpartum depression, which one would you be more willing to recommend to a patient?*". The possible answers were: (1) Electroconvulsive Therapy; (2) Pharmacotherapy; (3) Psychotherapy; (4) Transcranial Direct Current Stimulation; (5) None of the above; and (6) I don't know.

2.2. Participants and design

The non-probability sample consisted of 173 Portuguese health care professionals (72.8% women) that completed the protocol. Participants were assigned to either the experimental group or the control group by order of participation.

Participants were surveyed through internet-based approaches (e.g. e-mail, LinkedIn, Facebook), using a convenience sample method. Inclusion criteria were as follows: (1) being at least 21 years old, (2) having professional practice as health care provider and being effectively or hypothetically directly or indirectly involved on treatment decision in PPD, and (3) having the ability to read and understand Portuguese.

Experimental group: 141 health professionals (n = 101, 72.3% women), with clinical experience (mean years of clinical practice = 15.49 [*SD* = 11.65]) currently providing health care services (n = 133, 94.3%) were assigned to the experimental group. Psychology was the most represented profession (n = 51, 36.2%), followed by nurses (n = 47, 33.3%) and medical doctors (n = 43, 30.5%). Most participants had no previous knowledge about tDCS (n = 82, 58.2%) and only 5 (3.5%) had previous experience with tDCS.

Control group: 32 health professionals (n = 24, 75% women), with clinical practice (mean years of clinical experience = 14.20 [*SD* = 12.44]) currently providing health care services (n = 31, 96.9%) were assigned to the control group. Nursing was the most represented profession (n = 14, 43.8%), followed by both psychologists and medical doctors with the same frequency (n = 9, 28.1%). Half of participants (n = 16, 50%) had no previous knowledge about tDCS and none had previous experience with tDCS.

There were no differences between groups in what concerns sociodemographic variables. Tables 1 and 2 depict the information per group and show the differences between groups before intervention.

This is a quasi-experimental study of non-equivalent control group in a pre-intervention/post-intervention design to investigate the effect of an educational video on tDCS' acceptability.

Table 1

Characteristics regarding practice and knowledge about tDCS

		Experimental (n = 141) ***Frequency (%)***	**Control (n = 32)** ***Frequency (%)***	χ^2	***Cramer's V***
Currently providing health care services	Yes	133 (94.3)	31 (96.9)	.34	.05
	No	8 (5.7)	1 (3.1)		
Previous knowledge about tDCS	Yes	59 (41.8)	16 (50)	.71	.06
	No	84 (58.2)	16 (50)		
Previous experience with tDCS	Yes	5 (3.5)	0 (0)	1.17	.08
	No	136 (96.5)	32 (100)		

Table 2

Sociodemographic characteristics and clinical history

		Experimental (n = 141) *Frequency (%)*	Control (n = 32) *Frequency (%)*	χ^2	*Cramer's V*
Gender				.09	.02
Male		39 (27.7)	8 (25)		
Female		102 (72.3)	24 (75)		
Area of residence				4.47*	.16*
Rural		32 (22.7)	2 (6.3)		
Urban		109 (77.3)	30 (93.8)		
Marital status				4.55	.16
Single		38 (27)	14 (43.8)		
Married/cohabiting		89 (63.1)	14 (43.8)		
Divorced		12 (8.5)	3 (9.4)		
Widowed		2 (1.4)	1 (3.1)		
Profession				1.34	.08
Doctor		43 (30.5)	9 (28.1)		
Nurse		47 (33.3)	14 (43.8)		
Psychologist		51 (36.2)	9 (28.1)		
Level of education				1.00	.08
Bachelor		69 (48.9)	15 (46.9)		
Master		56 (39.7)	15 (46.9)		
PhD		16 (11.3)	2 (6.2)		
Psychiatric/psychological clinical history	Yes	43 (30.5)	7 (21.9)	.94	.07
	No	98 (69.5)	25 (78.1)		
		M (SD)	*M (SD)*	*F (df)*	*p*
Age (years)		40.01 (11.91)	39.03 (12.55)	.17 (1)	.68
Years of clinical experience		15.59 (11.65)	14.20 (12.44)	.31 (1)	.58

Note. * $p < .05$.

2.3. Procedures

Data collection was conducted between February 2019 and June 2019 through e-mail and telephone contacts with Portuguese maternity hospitals, general hospitals, primary health care units, private health units, physicians, psychologists and nursing forums and blogs, nursing schools, and private offices. The standard e-mail included a link to the web survey site where the protocol was available to participants. E-mails sent were often preceded by telephone contacts informing about the study protocol and asking for collaboration. Researchers also posted the link on their Facebook and LinkedIn personal pages and sent it individually to health professionals within their network, additionally asking for further sharing to their eligible contacts.

The complete study protocol consisted of the sociodemographic questionnaire, the ACCEPTpro-tDCS (pre-intervention), a question about treatment option preference, the psychoeducational video or the neutral video for the experimental and control groups respectively, and again, the ACCEPTpro-tDCS (post-intervention), and a question about treatment preference.

The psychoeducational video was developed by the researchers and included information on tDCS based on an updated literature review. In the video, a researcher explains tDCS' mechanisms of action, psychiatric applications, application procedure, involved equipment, most common side-effects and treatment protocols. It also included a representation of the process of montage and administration.

The neutral video was extracted from the internet entitled "Transportations and Health". It lightly addresses the diverse means and companies of transportation of cities across Portugal. We chose this video to be presented in the control protocol as it does not mention health related to tDCS or postpartum depression, providing no information on those topics or eliciting any position/attitude towards tDCS or mental health care.

No financial incentive was given to the subjects for participation. Surveys were coded to protect respondent privacy and stored into a secure database. The survey included a first page presenting the project, its main goals, the research team, and the procedures implemented to assure confidentiality and anonymity.

A consent paragraph with information on the voluntary nature of participation, confidentiality of responses and benefits for participating in the study was included in the online survey protocol. Following the current European General Data Protection Regulation (GDPR, 2016/679), a consent answer was required to access and complete the survey. Participants willing to collaborate had to give their informed consent. The Social Sciences Research Ethics Committee from the Faculty of Psychology and Educational Sciences of the University of Coimbra approved the current study.

2.3.1. Data analyses

The quantitative analysis followed a within-between-subjects cross-sectional design. Data analysis was conducted using the Statistical Package for Social Sciences (SPSS 22.0).

We conducted descriptive statistics for subject demographics, including frequencies, means (*M*) and standard deviations (*SD*), as well as normality and homogeneity tests. We also analysed skewness (Sk), kurtosis (Ku) values, considering the conventions of Kline (2011) where Sk < 3 and Ku < 8 constitute acceptable values.

To compare continuous demographic characteristics between groups (experimental and control) in terms of age and years of clinical experience, we ran independent one-way analysis of variance (ANOVAs) with Welch's test (for unequal sample sizes), at pre-intervention and for the overall sample. Between-groups differences for the categorical demographic variables (gender, area of residence, marital status, profession, level of education, current status concerning delivery of health care services, history of psychiatric/psychological attendance, previous knowledge about tDCS and previous recommendation/administration/prescription) were analysed using chi-square (χ^2) test.

The influence of demographic measures on acceptability global score at pre-intervention for the overall sample, was assessed using a three-way analysis of covariance (ANCOVA) with gender, residence and marital status as fixed factors, corrected by age. Because we have a small number of participants within the category PhD, the influence of level of education was assessed separately through a one-way ANCOVA, also corrected by age. To better understand the effect of intervention over time and its interaction with the demographic measures, we ran four distinctive three-way mixed

ANCOVAs where the demographic variables were separately considered as between-subjects factors (gender, area of residence, marital status and level of education) Across tests, time (pre and post-intervention) was defined as within-subjects factor, and group (experimental and control) as between–subjects factor, corrected for age.

The influence of the professional status on acceptability global score at pre-intervention for the overall sample, was assessed using a two-way ANCOVA with profession and current clinical practice as fixed factors, corrected for the number of years of clinical experience, for the overall sample. To better understand the effect of intervention over time and its interaction with the professional status, we conducted two three-way mixed ANCOVAs with profession and current clinical practice separately as between-subjects factors. Across tests, time (pre and post-intervention) was defined as within-subjects factor (experimental and control), and group (experimental and control) as between-subjects factor, corrected for the number of years of clinical experience.

Because we have a small number of participants within the categories "Previous knowledge about tDCS" and "Previous experience with tDCS", the influence of previous knowledge/experience over acceptability at pre-intervention for the overall sample, was assessed using two one-way ANCOVAs with previous knowledge and previous recommendation/administration/prescription as fixed factors separately, corrected by the number of years of clinical experience. To better understand the effect of intervention over time and its interaction with previous knowledge/experience with tDCS, we conducted two three-way mixed ANCOVAs with knowledge and previous recommendation/administration/prescription separately as between subject-factors. Across tests, time (pre and post-intervention) was defined as within-subjects factor, and group (experimental and control) as between–subjects factor, corrected for the number of years of clinical experience.

The influence of the psychiatric/psychological clinical history of participants over acceptability global score at pre-intervention for the overall sample was assessed using a one-way ANOVA. To better understand the effect of intervention over time and its interaction with the clinical history of participants, we conducted a three-way mixed ANOVA with psychiatric/psychological clinical history and group (experimental and

control) and between-subjects factors, and time (pre and post-intervention) as within-subjects factor.

The influence of treatment preference on acceptability global score at pre-intervention for the overall sample, was assessed using a one-way ANOVA with treatment option at pre-intervention as fixed factor. To better understand the effect of intervention over time and its interaction with initial treatment preference, we conducted a three-way mixed ANOVA with treatment option at pre-intervention and group (experimental and control) as between-subjects factors and time (pre and post-intervention) as within-subject factor.

Finally, to assess our main hypothesis and verify any differences on acceptability global scores from pre-intervention to post-intervention across groups, we conducted a two-way mixed ANOVA with group (experimental and control) as the between-subjects factor and time (pre and post-intervention) as within-subjects factor. The planned comparisons involve an increase on acceptability from pre to post-intervention within the experimental group, and no differences within the control group, as well as a higher acceptability at post-intervention on the experimental group, when compared to the control group.

Overall, whenever results showed significant interactions, follow-up *post hoc* tests (Bonferroni corrected, two-tailed) were conducted.

The reliability of the instrument was analysed using Cronbach's α. Statistical significance was set at the .05 level. Effect sizes were analysed using Cramer's V and Partial Eta Squared (η_p^2). We adopted the following conventions: small effect: Cramer's $V \geq .01$ and $\eta_p^2 \geq .01$; medium effect: Cramer's $V \geq .03$ and $\eta_p^2 \geq .06$; large effect: Cramer's $V \geq .05$ and $\eta_p^2 \geq .14$ (Cohen, 1992).

3. Results

3.1. Descriptive analyses

Pre-intervention between-groups differences

The comparative analyses suggested that the control and experimental groups did not present statistical significant differences (see Table 1), except to what concerns the area of residence (see Table 2), in which participants from the control group were more likely to live in an urban area.

Homogeneity and normality tests

Levene's tests were used to assess the equality of variances for the total of the ACCEPTpro-tDCS in both pre-intervention and post-intervention, in the control and experimental groups (homogeneity of variance; Nordstokke & Zumbo, 2010), which was verified ($p > .05$).

Shapiro-Wilk's tests (Shapiro & Wilk, 1965) and visual inspections of their histograms showed that acceptability global scores were not normally distributed for the experimental group at pre-intervention ($p > .05$), however the values of skewness (-.34, $SE = .20$) and kurtosis (.43, $SE = .41$) indicate that the distribution did not deviate much from normality. The scores of acceptability on post-intervention for the experimental group presented a normal distribution ($p > .05$), a skewness of -.23 ($SE = .20$) and a kurtosis of .39 ($SE = .41$). The control group presented a normal distribution in both moments ($p > .05$) with a skewness of -.42 ($SE = .41$) and a kurtosis of .44 ($SE = .81$) at pre-intervention and a skewness of -.14 ($SE = .41$) and a kurtosis of .29 ($SE = .81$) at post-intervention (Doane & Seward, 2011). Standard-deviation for each item was below 1.5 (Terwee et al., 2007).

3.2. Testing the hypotheses

The impact of sociodemographic variables on acceptability

A series of assumptions for using parametric tests were reviewed before proceeding to further analysis. Levene and normality tests were carried out for every analysis and the most important assumptions (continuous and normally distributed dependent variables, homogeneity of variances; Montgomery, 2012) were met without major prejudice.

The impact of the sociodemographic variables on acceptability was observed according to five clusters: demographic variables, professional status, previous knowledge/experience with tDCS, psychiatric/psychological clinical history and

treatment preference. The main analyses regarding the impact of those variables on acceptability at pre-intervention, and their interaction with intervention, are depicted in Table 3. Follow-up tests will be detailed in the following text.

Demographic variables

The influence of gender, residence, marital status and level of education on acceptability at pre-intervention was not significant. The effect of intervention (group assignment across time) and its interaction with the demographic variables revealed statistically non-significant results (see Table 3).

Professional status

We found a non-significant influence of profession and current clinical practice on acceptability pre-intervention when controlling for the number of years of clinical experience. Similarly, the interaction between intervention and profession and the interaction between current clinical practice and intervention, both controlled for the number of years of clinical experience, were not statistically significant (see Table 3).

Previous knowledge/experience with tDCS

We found that previous knowledge about tDCS seems to have a significant influence on acceptability measured before intervention, with a medium size effect (η_p^2 = .07), where participants reporting previous knowledge show higher acceptability global score. Additionally, there is a marginal significant effect of previous experience (p = .06), where participants reporting having recommended/administered/prescribed tDCS in the past showed a higher acceptability global score (see Table 3). However, this is small size effect as determined by the η_p^2 = .02.

The interaction between previous knowledge about tDCS and intervention, controlled for the number of years of clinical experience, was marginally significant (p = .06 with a small size effect, η_p^2 = .02). A follow-up two-way ANCOVA to observe the interaction between previous knowledge and group showed a non-significant effect, F (1, 168) = .09, p = .77, η_p^2 = .00. The follow-up two-way ANCOVA to observe time and group interaction revealed to be significant, F (1, 170) = 20.26, p < .001, η_p^2 = .11, as well as the main effect of time, F (1, 170) = 10.52, p = .001, η_p^2 = .06 but no significant main effect of group was found F (1, 170) = .25, p = .62, η_p^2 = .00.

Table 3

Analysis of the influence of sociodemographic variables on acceptability pre and post-intervention

	Impact at pre-intervention (whole sample)					Interaction with intervention (between-groups across time)			
	df	***F***	η_p^2	***p***		***df***	***F***	η_p^2	***p***
Demographic measures					**Demographic measures**				
Gender, residence and marital status	(1, 160)	.71	.00	.40	Gender	(1, 168)	.47	.00	.49
					Residence	(1, 168)	.35	.00	.56
					Marital status	(3, 164)	.18	.00	.91
Level of education	(2, 169)	.11	.00	.90	Level of education	(2, 166)	.51	.00	.60
Professional status					**Professional status**				
Profession and current clinical practice	(2, 166)	.11	-	.89	Profession	(2, 166)	.05	.00	.95
					Current clinical practice	(1, 168)	1.05	.01	.31
Previous knowledge/experience with tDCS					**Previous knowledge/experience with tDCS**				
Previous knowledge about tDCS	(1, 170)	13.52	.07	.00**	Previous knowledge about tDCS	(1, 168)	3.59	.02	.06
Previous experience with tDCS	(1, 170)	3.67	.02	.06	Previous experience with tDCS	-	-	-	-
Psychiatric/psychological clinical history	(1, 171)	1.85	-	.18	**Psychiatric/psychological clinical history**	(1, 169)	.00	.00	.97
Treatment preference	(4, 168)	2.64	-	.04*	**Treatment preference**	(3, 164)	.59	.01	.62

Note. * $p < .05$. ** $p < .001$.

The interaction between previous experience with tDCS and intervention, controlled for the number of years of clinical experience, revealed impossible to be conducted through a three-way ANCOVA, as the number of subjects that had recommended/administered/prescribed tDCS in the past was too low (n = 5). Time and intervention (group across time) interaction was significant, F (1, 169) = 21.65, $p < .001$, $\eta_p^2 = .02$. However, the interaction between time and previous experience was not statistically significant, F (1, 169) = 2.90, $p = .09$, $\eta_p^2 = .02$, as well as the main effect of time, F (1, 169) = 1.36, $p = .25$, $\eta_p^2 = .00$. Descriptive statistics showed that participants within the experimental group who had previous experience with tDCS, showed a higher mean of acceptability than the ones that did not, at both pre and post-intervention. On the control group, none of the participants had any experience with tDCS.

Psychiatric/psychological clinical history

Only 50 participants, regardless of group, reported a past history of consultations on Psychiatry or Psychology for distinctive treatment duration, ranging from a few months to 14 years. The most common motive to seek for mental health professional support was related to symptoms of depression and anxiety, followed by individual analysis, personal development and reactive disorders related to adverse life events.

The influence of the psychiatric/psychological clinical history of participants over acceptability global score at pre-intervention was non-significant, as well as the interaction with intervention (see Table 3).

Treatment preference

The analysis of the one-way ANOVA to verify the influence of treatment preference over acceptability global score at pre-intervention revealed to be significant. *Post hoc* tests were not performed given that for the dependent variable (acceptability global score), at least one group has less than two cases (no participant answered electroconvulsive therapy as a treatment they would recommend, and only one participant [.6%] answered "*None of the above*"). Descriptive analyses revealed that participants that chose tDCS had the highest acceptability (M = 68.90). The following higher acceptability results came from participants that were indecisive (M = 60.57) and that chose pharmacotherapy (M = 59.58); the lowest acceptability corresponded to the psychotherapy option (M = 56.50).

The interaction between treatment preference and intervention was non-significant.

Changing acceptability: from pre-intervention to post-intervention

We tested if there were differences on acceptability global scores between pre-intervention and post-intervention across groups, which was confirmed (see Figure 1). The results presented a significant interaction between time and group, F (1, 171) = 20.70, $p < .001$, $\eta_p^2 = .11$, and a main effect of time, F (1, 171) = 32.46, $p < .001$, $\eta_p^2 = .16$, but no main effect of group, F (1, 171) = .21, $p = .65$, $\eta_p^2 = .00$.

Follow-up *post hoc* one-way ANOVAs with Welch's test explored this results further. At pre-intervention, the tendency for the mean acceptability global score of the experimental group ($M = 57.62$, $SD = 13.77$) was lower than the mean of the control group ($M = 60.31$, $SD = 10.33$). However, the one-way ANOVA suggest no differences between groups pre-intervention, F (1, 171) = 1.17, $p = .28$.

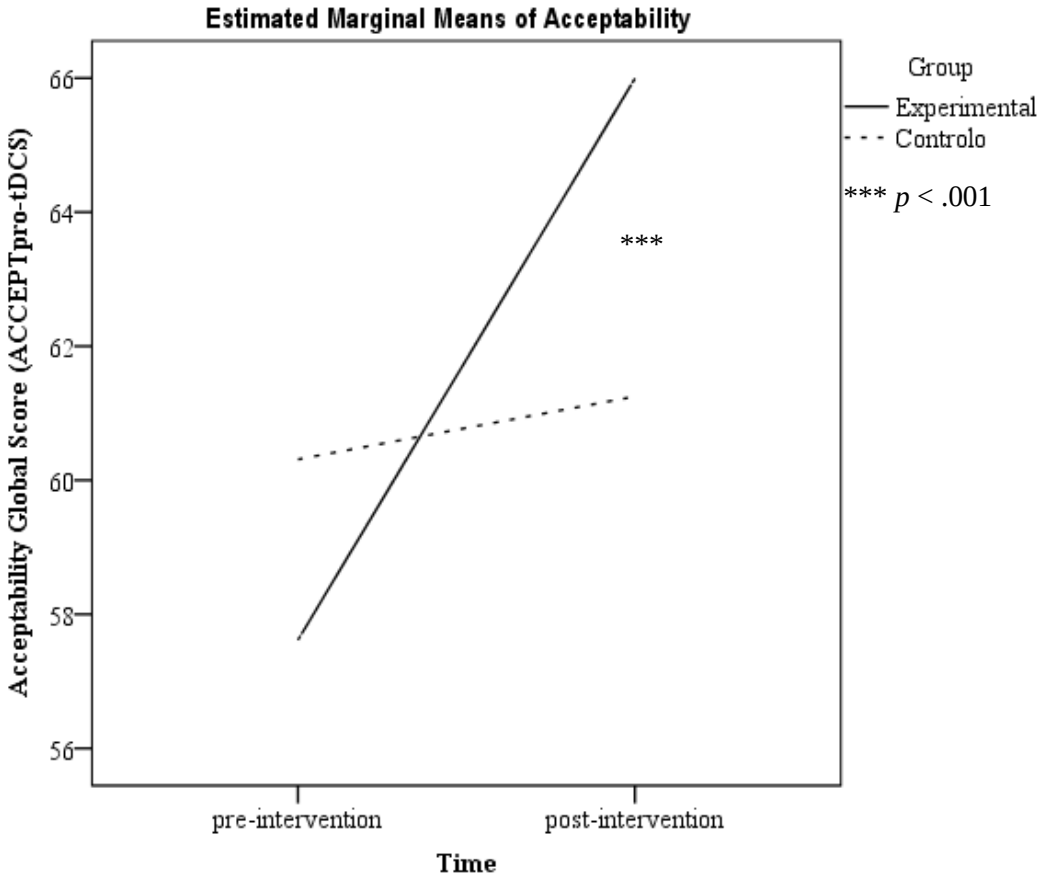

Figure 1. *Means of acceptability global scores between-subjects over time*

At post-intervention, the mean acceptability global score of the experimental group (M = 65.99, SD = 11.49) was higher than the mean of the control group (M = 61.25, SD = 12.99), with a statistically significant difference between groups, F (1, 171) = 4.37, p = .05 (Welch's test corrected; see Figure 1).

Considering the differences between pre and post-intervention for each group in acceptability global scores, the control group showed no significant time effect, Wilk's Lambda = .94, F (1, 31) = 1.86, p = .18, η_p^2 = .06. On the contrary, the experimental group showed a significant difference in acceptability global scores between pre and post-intervention, Wilk's Lambda = .54, F (1, 140) = 120.94, p < .001, η_p^2 = .46. Follow-up pairwise comparisons confirm this significance after Bonferroni adjustment (p < .001) suggesting that the psychoeducational video indeed increased participants' level of acceptability towards tDCS.

3.3. Descriptive analysis of secondary measures potentially associated with acceptability

Treatment options

Concerning the question "*Between the different treatment options available for postpartum depression, which one would you be more willing to recommend to a patient?*", at pre-intervention, psychotherapy was the most frequently selected in the control group (n = 15, 46.9%), followed by the option "*I don´t know*" (n = 7, 21.9%; see Figure 2). In control group, only four participants (12.5%) recommended tDCS. For the experimental group, psychotherapy was also the most frequently selected option (n = 100, 70.9%; see Figure 3) and tDCS was chosen by only six (4.3%) participants.

Between pre and post-intervention, the control group showed the exact same frequencies of response. With respect to the experimental group, some changes occurred: most participants would still recommend psychotherapy, but in a smaller percentage (n = 87, 61.7%) and the number of participants that would recommend tDCS increased to 20 (14.2%). Also, the number of indecisive participants increased to ten (7.1%; see Figure 3).

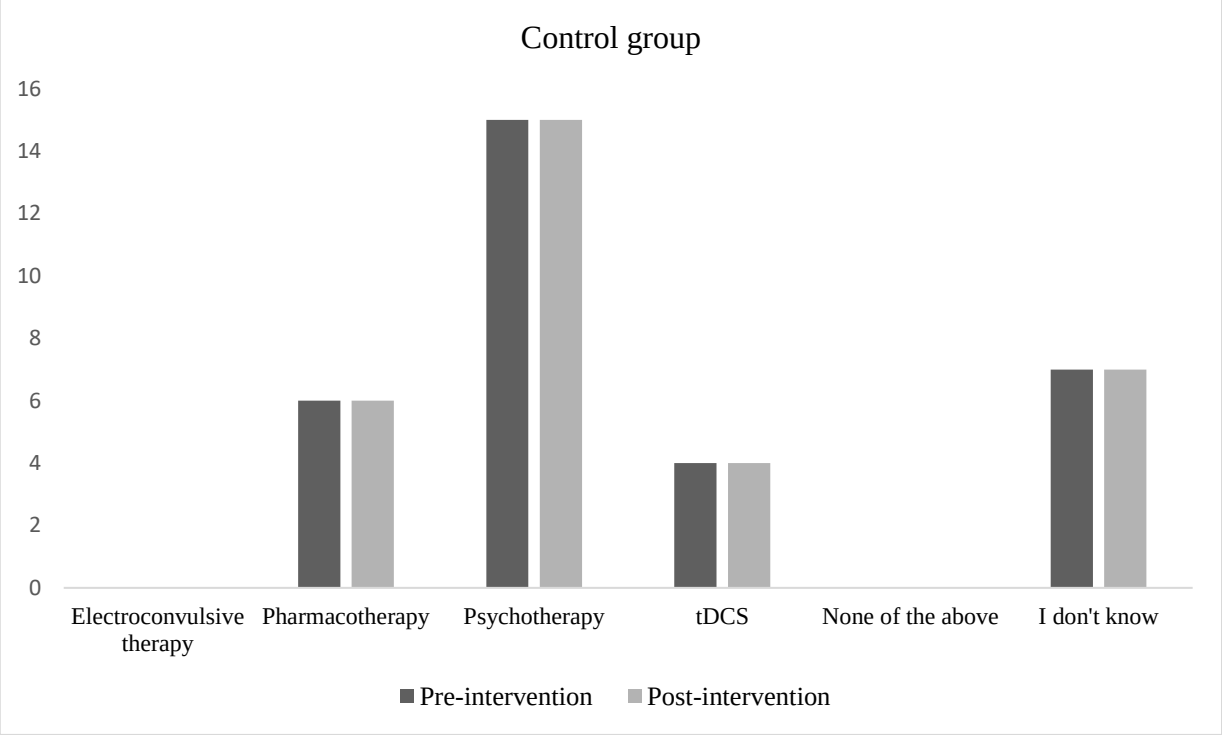

Figure 2. *Treatment options at pre-intervention and post-intervention in the control group*

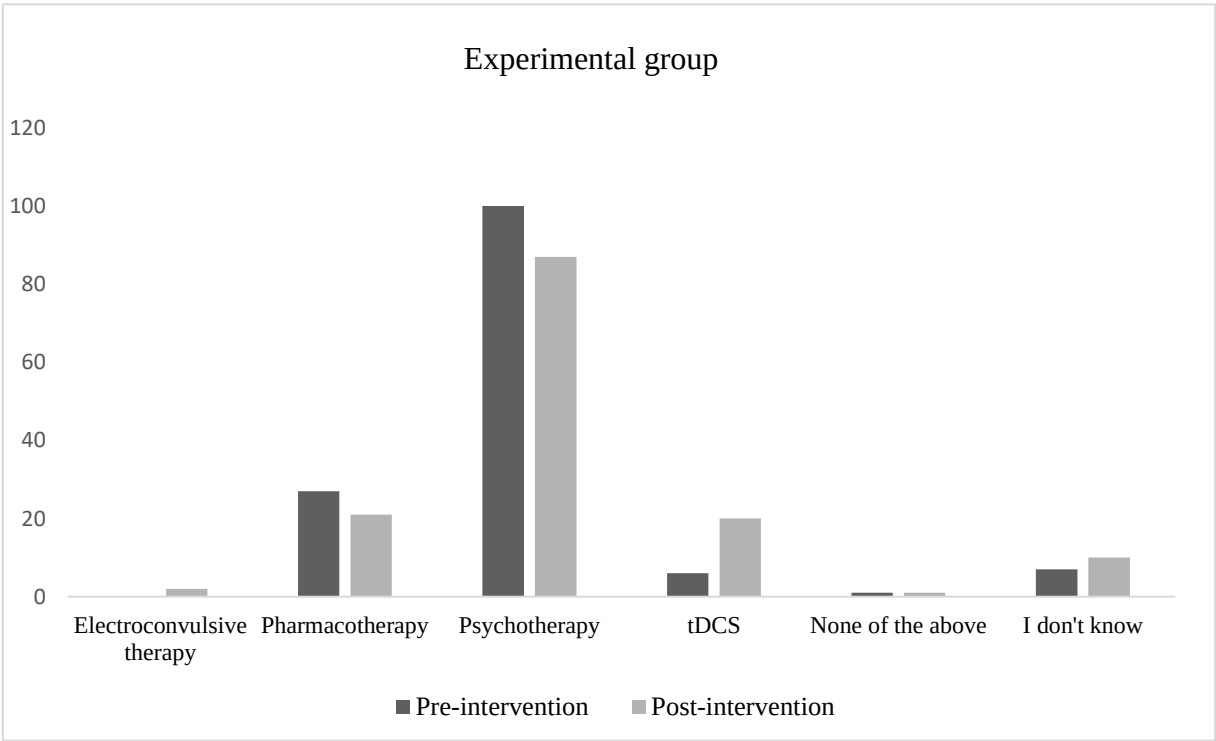

Figure 3. *Treatment options at pre-intervention and post-intervention in the experimental group*

The results of acceptability global score according to treatment preference, both at post-intervention are depicted in Table 5. We highlight the fact that a higher acceptability at post-intervention seems to correspond to a greater chance to recommend tDCS to a patient diagnosed with postpartum depression.

Table 5

Treatment preference and acceptability global score at post-intervention for the overall sample (N = 173)

		Acceptability post-intervention			
	n	***M***	***SD***	***Min.***	***Max.***
Electroconvulsive therapy	2	70.50	3.54	68	73
Pharmacotherapy	27	63.56	11.02	40	90
Psychotherapy	102	62.65	11.48	28	86
tDCS	24	77.33	8.56	64	90
None of the above	1	53.00	-	53	53
I don't know	17	65.24	7.57	54	78

4. Discussion

Here we aimed to assess for the first time the effects of a psychoeducational video on acceptability of health care professionals towards tDCS as a treatment option in postpartum depression.

tDCS is a potential non-pharmacological treatment for depression, that may be extended as a treatment option to depressive symptoms with its onset either during pregnancy or after delivery. In particular, tDCS seems to be an adequate treatment alternative to women who do not respond to psychotherapy/pharmacotherapy or that are looking for non-pharmacological alternatives to reduce their symptoms (see Nguyen, 2017 for alternative treatments). Although tDCS was FDA approved as an "off-label" treatment, knowledge on its safety and efficacy has not yet been wide spread among health professionals. Additionally, although a few health and research centres have tDCS

devices available, their access is still limited to end-users (both health professionals and patients; Kim et al., 2015).

The informational video developed by our team, aimed to overcome the lack of knowledge about tDCS - one of the factors that has been limiting tDCS' full implementation as a treatment alternative, not only in Portugal but globally. The video provides information on the most fundamental aspects that would allow a general understanding of the technique. The control group was not exposed to this information during the study. The comparative analyses showed that control and experimental groups did not differ significantly in terms of sociodemographic variables (except for the area of residence).

Concerning the data analyses procedures, our main hypothesis was based on planned comparisons (Seltman, 2018). Regarding the use of ANOVA and ANCOVA tests, their main disadvantage are the need for follow-up tests when a significant *p*-value is achieved and the null hypothesis is rejected, given that they only provide the information that at least one group differs from another, without determining which one(s) is(are) different. However, both are very robust designs, even to the violation of their assumptions (Marôco, 2018).

ANOVA presents an advantage from t-tests that is controlling for the error-rates that sum-up in multiple tests analyses. Other benefits of using ANOVA concern the fact that they allow the analysis of not only the planned comparisons or contrasts, but also the unplanned ones. This allows to observe interactions that the researchers may have not thought about and that reveal accurately how the data behaves (Field, 2013).

The major advantage of the use of ANCOVA is that it allows to control the effect of one or more variables that are not part of the main experiment but that have an influence on the dependent variable, reducing within-group error variance and eliminating confound variables (Field, 2013). The Bonferroni correction we used for *post hoc* tests is considered conservative, which results difficult to obtain statistically significant results, given that the significance value considered is smaller (Andrade, 2019). However, the number of tests we applied at once was not large, and so, the risk of committing a type II error was minor.

Our planned comparisons were met. The results clearly indicate that there is a difference within the experimental group from pre to post-intervention, and no differences within the control group, as well as a difference between-groups at post-intervention. Specifically, our results suggest that health professionals' acceptability towards tDCS increases after brief educational experience consisting of less than five minutes of an instructive video. Before the visualization of the video, less than 45% of the total sample reported to have previous knowledge on tDCS and only 2.9% reported to had ever recommended/administered/prescribed it. At pre-intervention, 10 people (5.8%) chose tDCS as a treatment option for a hypothetically postpartum depression patient. After the educational video, in the experimental group, people who would choose tDCS as a treatment recommendation for a patient went from six (4.3%) to 20 (14.2%). On the other hand, for the control group there were no changes.

Our findings are consistent with previous literature that explored the impact of educational programs (Sim, Jang, & Kim, 2016; Solomon et al., 2015), informative videos (Battersby, Ben-Tovim, & Eden, 1993; Dawood et al., 2013), and live demonstrations or self-experiments (Oldewening et al., 2007) with the innovative treatments/techniques under investigation, on the overall acceptability, knowledge and attitudes of their end-users towards them. In this sample of psychologists, nurses and medical doctors, acceptability towards tDCS for postpartum depression disorder improved favourably after the visualization of the psychoeducational video.

When we explored the influence of sociodemographic variables on acceptability global scores, almost none showed significant results. Only previous knowledge, previous experience with tDCS, and treatment preference at pre-intervention had impact on participants' decisions and attitudes towards tDCS as measured by the ACCEPTpro-tDCS. Having some knowledge about tDCS and having recommended/administered/prescribed it in the past, seemed to impact acceptability positively, both at pre and post-intervention. This effect could be explained by an increased knowledge at baseline due to previous experience contributing to its global acceptability. Similarly, treatment preference influenced acceptability at pre-intervention as far as having a pre-established preference to tDCS, expressed in higher acceptability. Interestingly, participants that chose psychotherapy as a treatment option also show the lowest mean of acceptability towards tDCS. This trend can be explained by a lower

tolerability to treatments that take some part of the autonomy, self-responsibility and self-determination of patients towards their treatment processes (Brenning, & Soenens, 2017). Another possible explanation is associated with professional perception of risk and managing novelty. That is, an increased preference by health professionals for a novel intervention such as tDCS may correspond to an increased perception of risk, underlying fear of novelty and concerns towards the uncertainties associated to tDCS (Palm et al., 2016). Alternatively, to recommend a well-known, well-established and widespread treatment option, underlies a safer clinical option and a more conservative professional attitude, where psychotherapy seems to represent the 'safe choice' (Karyotaki et al., 2016).

The current study has several limitations that need to be addressed. First, post-intervention assessment was conducted right after the visualization of the psychoeducational video without any time interval between the two phases of the study. Such design may hinder health professionals' acceptability over time, when compared with larger between-assessment periods. Secondly, because this was an online survey, we can not guarantee the full attention and understanding of all aspects that were addressed in the video. Similarly, we can not guarantee that the participants viewed the entire video and were, therefore, exposed to its total content. Thirdly, the relatively low number of participants may limit the generalizability of research conclusions.

Recommendations for future research include replicating the current study considering psychiatric conditions other than postpartum depression, and proceeding to the adaptation of the ACCEPTpro-tDCS to other NIBS. Future studies can also improve the psychoeducational session, whether in duration, quantity of information transmitted, means of transmission and quality of experience with the technique. For example, psychoeducation could be a series of workshops where health professionals could be more fully acquainted to tDCS, with hands-on methods to learn how to use the technique. Furthermore, future implementation research studies should address other issues that might contribute to the lack of implementation of tDCS on health systems, such as clinical designs, legal issues, ethical issues concerning self-enhancement in healthy subjects (Brunoni et al., 2012), and education and training of health professionals, maybe through the development of a psychiatric neuromodulation unit (PNU; Sauvaget et al., 2018).

In sum, providing and expanding knowledge about tDCS is necessary and desirable in order to improve its acceptability by health professionals. Our results show the importance of supporting updated educational programmes targeting health professionals, that address the most innovative and cutting-edge scientific knowledge. This would guarantee a faster transference of up-to-date knowledge and practices enabling increased acceptability of innovative treatments and facilitating its implementation in health care services.

Contributors

Authors ASM, AGA and MCC designed the study, prepared the measures and wrote the protocol. ASM and AGA recruited and assessed the participants. ASM conducted literature research and provided summaries of previous research studies, conducted the statistical analysis and wrote the manuscript throughout its development stages. AGA and MCC supervised and contributed throughout the conduction of these tasks and approved the final manuscript.

Conflict of interest

The authors declare no conflicts of interest.

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