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REVIEW

Emotion recognition support system: Where physicians and psychiatrists meet linguists and data engineers

Peyman Adibi, Simindokht Kalani, Sayed Jalal Zahabi, Homa Asadi, Mohsen Bakhtiar, Mohammad Reza Heidarpour, Hamidreza Roohafza, Hassan Shahoon, Mohammad Amouzadeh

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Abstract

An important factor in the course of daily medical diagnosis and treatment is understanding patients' emotional states by the caregiver physicians. However, patients usually avoid speaking out their emotions when expressing their somatic symptoms and complaints to their non-psychiatrist doctor. On the other hand, clinicians usually lack the required expertise (or time) and have a deficit in mining various verbal and non-verbal emotional signals of the patients. As a result, in many cases, there is an emotion recognition barrier between the clinician and the patients making all patients seem the same except for their different somatic symptoms. In particular, we aim to identify and combine three major disciplines (psychology, linguistics, and data science) approaches for detecting emotions from verbal communication and propose an integrated solution for emotion recognition support. Such a platform may give emotional guides and indices to

the clinician based on verbal communication at the consultation time.

Key Words: Physician-Patient relations; Emotions; Verbal behavior; Linguistics; Psychology; Data science

Core Tip: In the context of doctor-patient interactions, we focus on patient speech emotion recognition as a multifaceted problem viewed from three main perspectives: Psychology/psychiatry, linguistics, and data science. Reviewing the key elements and approaches within each of these perspectives, and surveying the current literature on them, we recognize the lack of a systematic comprehensive collaboration among the three disciplines. Thus, motivated by the necessity of such multidisciplinary collaboration, we propose an integrated platform for patient emotion recognition, as a collaborative framework towards clinical decision support.

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INTRODUCTION

In order to establish a therapeutic relationship between physician and patient, it is necessary to have knowledgeable practitioners in various specialties as well as an effective interaction and communication between physician and patient which starts with obtaining the patient's medical history and continues to convey a treatment plan[1,2]. Doctor-patient communication is a complex interpersonal interaction where different types of expertise and techniques are required to understand this relationship completely in verbal and nonverbal forms, especially when trying to extract emotional states and determinants during a medical consultation session[3]. Doctor-patient communication is a complex interpersonal interaction which requires an understanding of each party's emotional state. In this paper, our focus is on physicians' understanding of patients' emotions. When patients attend medical consultation, they generally convey their particular experiences of the perceived symptoms to physicians. They interpret these somatic sensations in terms of many different factors including their unique personal and contextual circumstances. Motivated by the illness experience, they generate their own ideas and concerns (emotions), leading them to seek out consultation[4-6]. Generally, patients expect and value their doctors caring for these personal aspects of their experience[7,8]. During interactions and conversations with patients, physicians should be able to interpret their emotional states, which can help build up trust between patients and them[9,10]. This will ultimately lead to better clinical outcomes. Also, identifying and recording these states will help complete patients' medical records. Many diseases that seem to have physical symptoms are, in fact, largely intertwined with psychological variables, such as functional somatic syndromes (FSS)[11]. Increasingly, physicians have realized that recognizing the psychological state of patients with FSS will be very effective in providing an appropriate treatment. For example, the ability to accurately understand sound states may help interpret a patient's pain. Thus, the presence of information about patients' mental states in their medical records is essential.

Emotion detection accuracy, *i.e.*, the ability to detect whether a patient is expressing an emotion cue, has consequences for the physician–patient relationship. The key to patient-centered care is the ability to detect, accurately identify, and respond appropriately to the patient's emotions[12-15]. Failure to detect a patient's emotional cues may give rise to an ineffective interaction between doctor and patient, which may, in turn, lead to misdiagnosis, lower recall, mistreatments, and poorer health outcomes[16,17]. Indeed, if the emotion cue is never detected, then the ability to accurately identify or respond to the emotion never comes into play. Doctors who are more aware of their patients' emotions are more successful in treating them[13]. Patients have also reported greater satisfaction with such physicians[18-22]. Recognizing the emotions and feelings of patients provides the ground for more physician empathy with patients[23,24]. The academic and medical literature highlights the positive effects of empathy on patient care[25]. In this regard, the medical profession requires doctors to be both clinically competent and empathetic toward the patients. However, in practice, meeting both needs may be difficult for physicians (especially inexperienced and unskilled ones)[26]. On the other hand, patients do not always overtly express these experiences, feelings, concerns, and ideas. Rather, they often communicate them indirectly through more or less subtle nonverbal or verbal "clues" which nevertheless contain

interesting clinical information which can be defined as "clinical or contextual clues"[27-29]**.** They do not say, ‘‘Hey doctor, I’m feeling really emotional right now; or do you know whether I’m angry or sad?’’ Thus, emotional cues are often ambiguous and subtle[30-33].

On the other hand, patients' emotional audiences (*i.e.*, physicians) are often inexperienced in detecting emotions. One of the most important problems physicians face in the development of this process is the difficulty of capturing the clues that patients offer and failing to encourage them to expose details about these feelings[34]. Research indicates that over 70% of patients’ emotional cues are missed by physicians [34]. It is unclear whether missed responses were the result from physicians detecting an emotional cue and choosing not to respond, or from failing to detect the cue in the first place. Indeed, these emotional cues present a challenge to doctors who often overlook them, as clinical information and therefore opportunities to know the patient's world are lost[34-37]. Physicians vary in their ability to recognize patients' emotions, with some being fully aware of the significance of understanding emotions and capable of identifying them. They also range from high emotional intelligence to low emotional intelligence. Another argument often heard from physicians is that they do not have time for empathy [38].

Despite the importance of such issues, this aspect remains grossly overlooked in conventional medical training. This comes from the fact that training emotion skills in medical schools is variable, lacks a strong evidence- base, and often does not include the training of emotion processing[39].

In the preceding paragraphs, four reasons were offered as to why physicians have failed to detect and interpret patients’ emotional states, and hence why we need to find a solution for this problem. These reasons could be summarized as follows. First, detecting patients’ emotions can contribute to healing them, as well as to increasing their satisfaction. Secondly, emotional cues are mostly indirectly found in patients’ speech. That is, emotional cues can be very subtle and ambiguous. Further, many physicians do not possess enough experience to detect patients’ emotions or even when they are skilled and experienced enough to do so, they do not have time to deal with it. In addition, training doctors to detect patients’ emotions has been thoroughly overlooked in routine medical training. Thus, if a solution can be found to help physicians recognize patients' emotions and psychological states, this problem can be overcome to a large extent.

One strategy is to develop and employ a technology that can provide information about the patient’s emotions, feelings, and mental states by processing their verbal and non-verbal indicators (Figure 1). In the present manuscript, we focus on verbal communication. Human speech carries a tremendous number of informative features, which enables listeners to extract a wealth of information about speakers’ identity. These features can range from linguistic characteristics through extralinguistic features to paralinguistic information, such as the speaker’s feelings, attitudes, or psychological states [40]. The psychological states (including emotions, feelings, and affections) embedded in people's speech are among the most important parts of the verbal communication array humans possess. As with other non-verbal cues, they are under conscious control much less than verbal cues. This makes speech an excellent guide to a human’s “true” emotional state even when he/she is trying to hide it.

In order to design and present such technology, the first step is to know which indicators in speech can be used to identify emotions. Psychologists, psychiatrists, and linguists have done extensive research to identify people's emotions and feelings, and have identified a number of indicators. They believe that through these markers, people's emotions and feelings can be understood.

THE PSYCHOLOGICAL APPROACH

Psychologists and psychiatrists pay attention to content indicators and acoustic variables to identify people's emotions through their speech. Scholarly evidence suggests that mental health is associated with specific word use[41-43]. Psychologists and psychiatrists usually consider three types of word usage to identify emotions: (1) Positive and negative emotion words; (2) standard function word categories; and (3) content categories. They distinguish between positive (“happy”, “laugh”) and negative (“sad”, “angry”) emotion words, standard.

Function word categories (*e.g.*, self-references, first, second, and third person pronouns) and various content categories (*e.g.*, religion, death, and occupation). The frequent use of “You” and “I” suggests a different relationship between the speaker and the addressee than that of “We”. The former suggests a more detached approach, whereas the latter expresses a feeling of solidarity. Multiple studies have indicated that the frequent use of the first-person singular is associated with negative affective states[44-48], which reveals a high degree of self-preoccupation[49]. People with negative emotional states (such as sadness or depression) use second and third person pronouns less often[38-40]. These people have a lower ability to express positive emotions and express more negative emotions in their speech[44-48]. Also, people with negative emotional states use more words referring to death[44].

In addition to the content of speech, psychologists and psychiatrists also look at several acoustic variables (such as pitch variety, pause time, speaking rate, and emphasis) to detect emotions. According to the research in this area, people with negative emotional states typically have a slower speaking rate [50-54], lower pitch variety[55,56], produce fewer words[57], and have longer pauses[53,54,58].

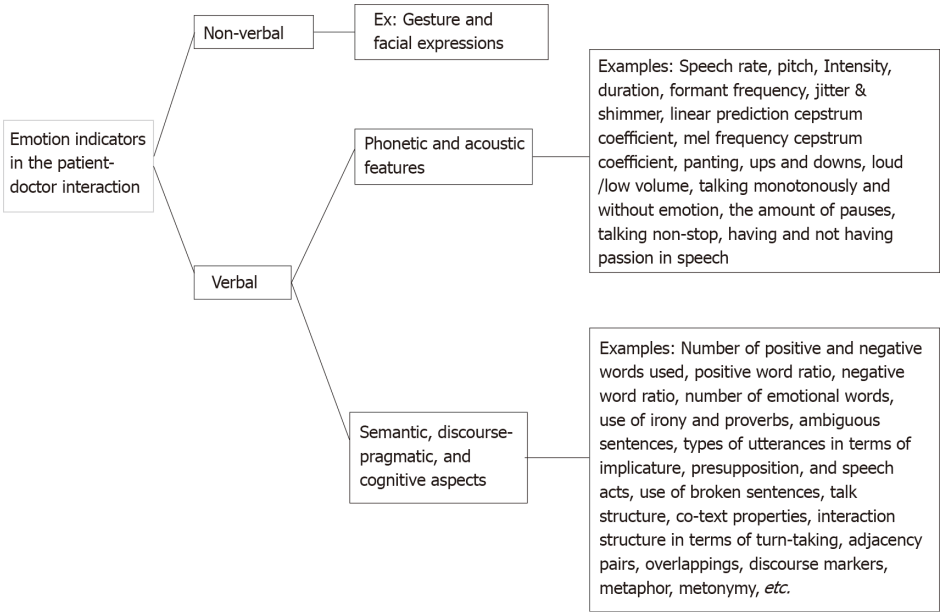

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Figure 1 Emotion indicators in the patient-doctor interaction.

THE LINGUISTIC APPROACH

Within linguistics, various approaches (*e.g.*, phonetic, semantic, discourse-pragmatic, and cognitive) have been adopted to examine the relationship between language and emotion[56,59,60]. As far as the phonetic and acoustic studies are concerned, emotions can be expressed through speech and are typically accompanied with physiological signals such as muscle activity, blood circulation, heart rate, skin conductivity, and respiration. This will subsequently affect the kinematic properties of the articulators, which in turn will cause altered acoustic characteristics of the produced speech signals of the speakers. Studies of the effects of emotion on the acoustic characteristics of speech have revealed that parameters related to the frequency domain (*e.g.*, average values and ranges of fundamental frequency and formant frequencies), the intensity domain of speech (*e.g.*, energy, amplitude), temporal characteristics of speech (*e.g.*, duration and syllable rate), spectral features Mel frequency cepstral coefficients, and voice quality features (*e.g.*, jitter, shimmer, and harmonics-to-noise-ratio are amongst the most important acoustically measurable parameters for correlates of emotion in speech. For instance, previous studies have reported that the mean and range of fundamental frequency observed for utterances spoken in anger situations were considerably greater than the mean and range for the neutral ones, while the average fundamental frequency for fear was lower than that observed for anger[61] (Figure 2 and Table 1).

Past research has produced many important findings to indicate that emotions can be distinguished by acoustical patterns; however, there are still a multitude of challenges regarding emotional speech research. One of the major obstacles that must be tackled in the domain of emotion recognition relates to variable vocalization which exists within speakers. Voices are often more variable within the same speaker (within-speaker variability) than they are between different speakers and it is thus unclear how human listeners can recognize individual speakers' emotion from their speech despite the tremendous variability that individual voices reveal. Emotion is sensitive to a large degree of variation within a single speaker and is highly affected by factors such as gender, speakers, speaking styles, sentence structure in spoken language, culture, and environment. Thus, identifying what specific mechanisms motivate variability in acoustic properties of emotional speech and how we can overcome differences arising from individual properties remain major challenges ahead of the emotion recognition field.

With regard to investigations in the area of pragmatics (in its continental notion which encompasses discourse analysis, sociolinguistics, cognitive linguistics, and even semantics), we observe a flourishing trend in linguistics focusing on the emotion in language[59,62]. These studies have examined important issues related to referential and non-referential meanings of emotion. In semantics, the focus has been on defining emotional and sentimental words and expressions, collocations and frames of emotion[63,64], field semantics[62], as well as lexical relations including semantic extensions. However, more pragmatic and discourse-oriented studies have looked at issues in terms of emotion and cultural identity[65,66]; information structure/packaging (*e.g.* topicalization and thematicization[67] and emotion, emotive particles and interjections[68-70], emotional implicatures, and emotional illocutionary acts, deixis, and indexicality (*e.g.* proximalization and distalization[71,72], conversational analysis and emotion (*e.g.* turn-taking and interruption)[73,74], *etc.*

Table 1 Acoustic differences related to prosody and spectral features of the word (sahar) produced by a Persian female speaker in neutral and anger situations

	Neutral	Angry
Prosody features		
Mean Fundamental frequency (F0)	200 Hz	225 Hz
Minimum of the fundamental frequency	194 Hz	223 Hz
Maximum of the fundamental frequency	213 Hz	238 Hz
Mean intensity	60 dB	78 dB
Spectral features		
First formant frequency (F1)	853 Hz	686 Hz
Second formant frequency (F2)	2055 Hz	1660 Hz
Third formant frequency (F3)	3148 Hz	2847 Hz
Fourth formant frequency (F4)	4245 Hz	3678 Hz

Cognitive linguists use other methods to recognize emotion in speech. The cognitive linguistic approach to emotion concepts is based on the assumption that conventionalized language used to talk about emotions is a significant tool in discovering the structure and content of emotion concepts[75]. They consider a degree of universality for emotional experience and hold that this partial universality arises from basic image schemas that emerge from fundamental bodily experiences[76-79]. In this regard, the cultural model of emotions is a joint product of (possibly universal) actual human physiology, metonymic conceptualization of actual human physiology, metaphor, and cultural context [77]. In this approach, metaphor and metonymy are used as conceptual tools to describe the content and structure of emotion concepts.

Conceptual metaphors create correspondences between two distinct domains. One of the domains is typically more physical or concrete than the other (which is thus more abstract)[76]. For example, in the Persian expression *gham dar delam* â*shiyâneh kardeh* 'sadness has nested in my heart', *gham* 'sadness' is metaphorically conceptualized as a bird and *del* 'heart/stomach' is conceived of as a nest. The metaphor focuses on the perpetuation of sadness. The benefit of metaphors in the study of emotions is that they can highlight and address various aspects of emotion concepts[75,76]. Metonymy involves a single domain, or concept. Its purpose is to provide mental access to a domain through a part of the same domain (or vice versa) or to a part of a domain through another part in the same domain[80]. Metonymies can express physiological and behavioral aspects of emotions[75]. For example, in *she was scarlet with rage*, the physiological response associated with anger, *i.e.*, redness in face and neck area, metonymically stands for anger. Thus, cognitive linguistics can contribute to the identification of metaphorical and metonymical conceptualizations of emotions in large corpora.

Although speech provides substantial information about the emotional states of speakers, accurate detection of emotions may nevertheless not always be feasible due to challenges that pervade communicative events involving emotions. Variations at semantic, pragmatic, and social-cultural levels present challenges that may hinder accurately identifying emotions *via* linguistic cues. At the semantic level, one limitation seems to be imposed by the "indeterminacy of meaning", a universal property of meaning construction which refers to "situations in which a linguistic unit is underspecified due to its vagueness in meaning"[81]. For example, Persian expressions such as *ye juriam* or *ye hâliam* roughly meaning 'I feel strange or unknown' even in context may not explicitly denote the emotion(s) the speaker intends to convey, and hence underspecify the conceptualizations that are linguistically coded. The other limitation at the semantic level pertains to cross-individual variations in the linguistic categorization of emotions. Individuals differ as to how they linguistically label their emotional experiences. For example, the expression *tu delam qoqâst* 'there is turmoil in my heart' might refer to 'extreme sadness' for one person but might suggest an 'extreme sense of confusion' for another. Individuals also reveal varying degrees of competence in expressing emotions. This latter challenge concerns the use of emotion words, where social categories such as age, gender, ethnic background, education, social class, and profession could influence the ease and skill with which speakers speak of their emotions. Since emotions perform different social functions in different social groups[82], their use is expected to vary across social groups.

Language differences are yet another source of variation in the use and expression of emotions, which presents further challenges to the linguistic identification of emotions. Each language has its own specific words, syntactic structures, and modes of expressions to encode emotions. Further, emotions are linked with cultural models and reflect cultural norms as well as values[83]. Thus, emotion words cannot be taken as culture-free analytical tools or as universal categories for describing emotions[84].

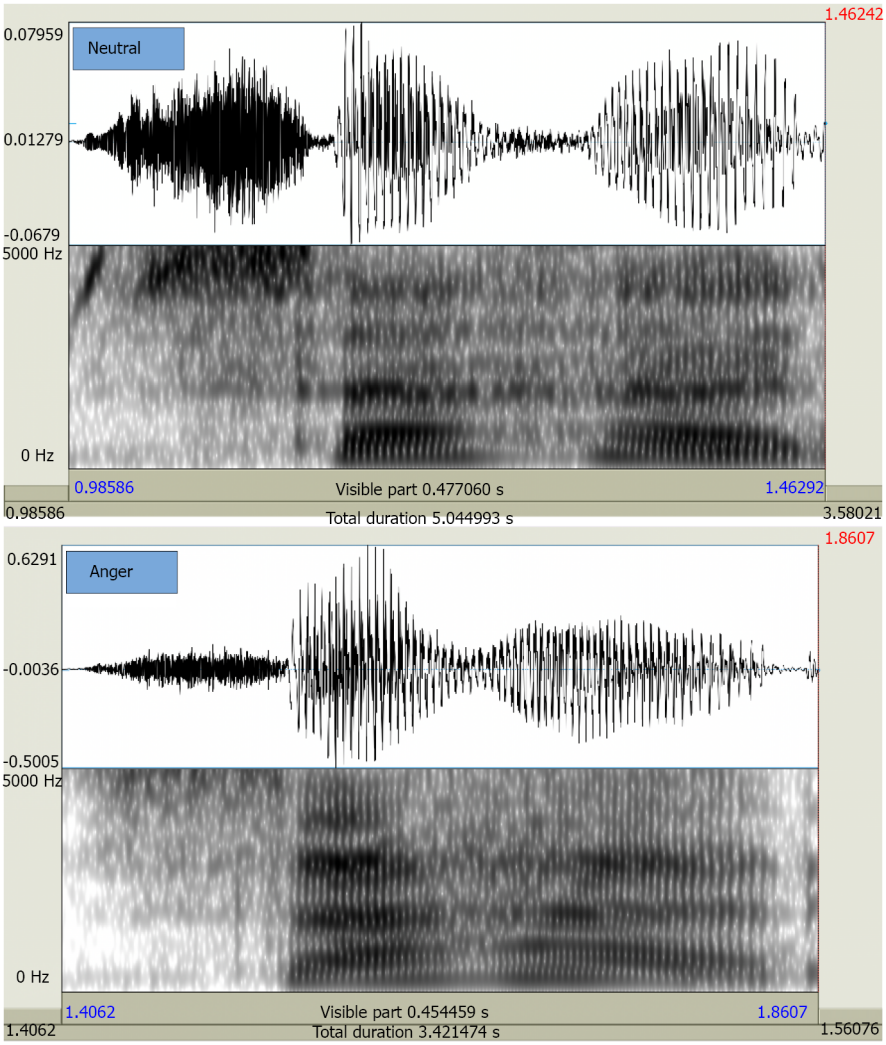

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Figure 2 Spectrograms of the Persian word (sahar) pronounced by a Persian female speaker in neutral (top) and anger (down) situations. Figure 2 shows spectrograms of the word (sahar), spoken by a native female speaker of Persian. The figure illustrates a couple of important differences between acoustic representations of the produced speech sounds. For example, the mean fundamental frequency in anger situations is higher (225 Hz) than that observed for neutral situations (200 Hz). Additionally, acoustic features such as mean formant frequencies (*e.g.* F1, F2, F3, and F4), minimum and maximum of the fundamental frequency, and mean intensity are lower in neutral situations. More details are provided in Table 1.

Patterns of communication vary across and within cultures. The link between communication and culture is provided by a set of shared interpretations which reflect beliefs, norms, values, and social practices of a relatively large group of people[85]. Cultural diversity may pose challenges to doctors and health care practitioners in the course of communicating with patients and detecting their emotions. In a health care setting, self-disclosure is seen as an important (culturally sensitive) characteristic that differentiates patients according to their degree of willingness to tell the doctor/practitioner what they feel, believe, or think[86]. Given the significance of self-disclosure and explicitness in the verbal expression of feelings in health care settings (Robinson, ibid), it could be predicted that patients coming from social groups with more indirect, more implicit, and emotionally self-restrained styles of communication will probably pose challenges to doctors in getting them to speak about their feelings in a detailed and accurate manner. In some ethnic groups, self-disclosure and intimate revelations of personal and social problems to strangers (people outside one's family or social group) may be unacceptable or taboo due to face considerations. Thus, patients belonging to these ethnic groups may adopt avoidance strategies in their communication with the doctor and hide or understate intense feelings. People may also refrain from talking about certain diseases or use circumlocutions due to the taboo or negative overtones associated with them. Further, self-restraint may be regarded as a moral virtue in some social groups, which could set a further obstacle in self-disclosing to the doctor or healthcare practitioner.

Overall, it is seen that these linguistically-oriented studies reveal important aspects of emotion in language use. In particular, they have shown how emotion is expressed and constructed by speakers in discourse. Such studies, however, are not based on multi-modal research to represent a comprehensive and unified description of emotion in language use. This means that, for a more rigorous and fine-

grained investigation, we need an integrative and cross-disciplinary approach to examining emotions in language use.

THE DATA SCIENCE APPROACH

From the data science perspective, speech emotion recognition (SER) is a machine learning (ML) problem whose goal is to classify the speech utterances based on their underlying emotions. This can be viewed from two perspectives: (1) Utterances as sounds with acoustic and spectral features (non-verbal); and (2) Utterances as words with specific semantic properties (verbal)[87-91]. While in the literature, SER typically refers to the former perspective, the latter is also important and provides a rich source of information, which can be harvested in favor of emotion recognition *via* natural language processing (NLP). Recent advances in the NLP technology allow for a fast analysis of text. In particular, word vector representations (also known as word embeddings) are used to embed words in a high dimensional space where words maintain semantic relationships with each other[92]. These vector representations, which are obtained through different ML algorithms, commonly capture the semantic relations between the words by looking into their collocation/co-occurrence in large corpora. In this way, the representation of each word and the machine's understanding of that partially reflect the essential knowledge that relates to that word, thus capturing the so-called frame semantics. The problem of SER can thus be tackled by analyzing the transcript of the speech by running various downstream tasks on the word vectors of the given speech.

As for the former perspective, different classifiers have so far been suggested for SER as candidates for a practically feasible automatic emotion recognition (AER) system. These classifiers can be put broadly into two main categories: Linear classifiers and non-linear classifiers. The main classification techniques/models within these two categories are: (1) Hidden Markov model[93-96]; (2) Gaussian mixture model[97,98]; (3) K-Nearest neighbor[99]; (4) Support vector machine[100,101]; (5) Artificial neural network[94,102]; (6) Bayes classifier[94]; (7) Linear discriminant analysis[103,104]; and (8) Deep neural network[102-107].

A review of the most relevant works within the above techniques has recently been done in[108]. We have provided a short description of the above techniques in Appendix. One of the main approaches in the last category, *i.e.*, deep neural networks, is to employ transfer learning. Recently[109] has reviewed the application of generalizable transfer learning in AER in the existing literature. In particular, it provides an overview of the previously proposed transfer learning methods for speech-based emotion recognition by listing 21 relevant studies.

The classifiers developed for SER may also be categorized in terms of their feature sets. Specifically, there are three main categories of speech features for SER: (1) The prosodic features[110-114]; (2) The excitation source features[110,111,115,116]; and (3) The spectral or vocal tract features[117-120].

Rosodic features, also known as continuous features, are some attributes of the speech sound such as pitch or fundamental frequency and energy. These features can be grouped into the following subcategories[104,105]: (1) Pitch-related features; (2) Formant features; (3) Energy-related features; (4) Timing features; and (5) Articulation features. Excitation source features, which are also referred to as voice quality features, are features which are used to represent glottal activity, such as harshness, breathiness, and tenseness of the speech signal.

Finally, spectral features, also known as segmental or system features, are the characteristics of various sound components generated from different cavities of the vocal tract system that have been extracted in different forms. The particular examples are ordinary linear predictor coefficients[117], one-sided autocorrelation linear predictor coefficients[113], short-time coherence method[114], and least squares modified Yule–Walker equations[115].

Table 2 summarizes the three discussed approaches to recognizing emotional indicators in speech 1.

Given the breadth and complexity of emotion detection indicators in psychology and linguistics, it is difficult to establish a decision support system for a doctor's emotional perception of patients. This requires a comprehensive and multidisciplinary approach. In order to build such a system, an application will be very useful. When a person experiences intense excitement, in addition to a reduction in his/her concentration, his/her mental balance is also disturbed more easily and quickly. This is also used as a strategy in sociology to take hold of people's minds.

Under unstable conditions, reasoning and logical thinking (and thus more effective and active behavior), which emerge in response to the activity of new and higher parts of the brain, are dominated by older parts of the brain, which have more biological precedents (several thousand *vs* millions of years). Thus, these older parts act impulsively or reactively.

Working in an emergency environment and sometimes even in an office has special conditions, such as excessive stress due to medical emergencies, pressure from patient companions, patient's own severe fear, as well as the impact of the phenomenon of "transference" and "countertransference" between physician and patient or between physician and patient companion. These can impair a physician's ability to reason and think logically. Thus, use of such an intelligent system can enhance doctors' efficiency, increase their awareness, and make it easier for them to manage the conditions.

Table 2 Different approaches to recognizing the emotional indicators in speech

Approaches	Emotional indicators
Psychological	(1) Positive and negative emotion words; (2) Standard function word categories; (3) Content categories; (4) The way of pronoun usage; and (5) Acoustic variables (such as pitch variety, pause time, speaking rate and emphasis)
Linguistic	(1) Phonetic: Spectral analysis, temporal analysis; (2) Semantic & Discourse-pragmatic: Words, field, cultural identity, emotional implicatures, illocutionary acts, deixis and indexicality; and (3) Cognitive: Metaphor, metonymy
Data science	(1) SER: Looking at sounds with acoustic and spectral features; and (2) NLP: Looking at words with specific semantic properties, word embedding

SER: Speech emotion recognition; NLP: Natural language processing.

THE PROPOSED SOLUTION

In the previous sections, the problem of SER was viewed from its three main perspectives: Psychology/psychiatry, linguistics, and data science, and the key elements within each perspective were highlighted. One way to integrate these three sides and benefit from their potential contributions to SER is through developing an intelligent platform. In what follows, focusing on SER in the context of doctor-patient interactions, we propose a solution for such integration.

The proposed solution consists of two key components: (1) The intelligent processing engine; and (2) The data-gathering platform.

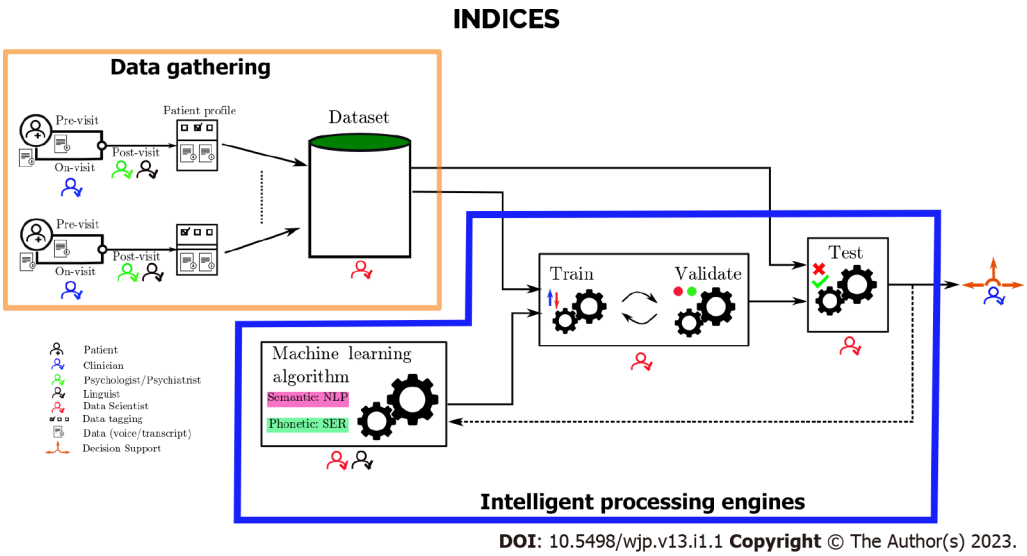
The intelligent processing engine, at the algorithmic level, is based on NLP, speech processing, and in a wider context, behavioral signal processing methods. While it is clear that the processing engine will serve as the brain of the proposed intelligent platform, and is indeed a place where the novelty, creativity, and robustness of implemented algorithms can make a great difference, it will not practically function desirably without a well-thought, flexible data-gathering platform. Thus, despite the genuine algorithms which are to be developed at the core of the platform, and the undeniable impact they will have on the performance of the system, we believe it is the data-gathering platform that will make the solution very unique. One idea is to develop a cloud-based multi-mode multi-sided data gathering platform, which has three main sides: (1) The patient side; (2) The physician side; and (3) The linguistic/psychologist side.

Regarding the functioning of the platform, three modes can be considered: (1) The pre-visit mode; (2) The on-visit mode; and (3) The post-visit mode.

The pre-visit mode will include the patient's declaration of his/her health-related complaints/conditions and concerns, which will be automatically directed to the cloud-based processing engine, and labeled *via* a SER algorithm. This mode is reinforced *via* receiving additional multi-dimensional data from the patient through filling various forms and questionnaires. Also, it is possible for the patient to submit text to accompany his/her speech. This allows one to perform additional classification/clustering tasks such as sentiment analysis or patient segmentation on the provided text, using biomedical NLP methods. The on-visit mode enables the recording of the visiting session and the clinician-patient conversations. Finally, the post-visit mode of the application provides an interface for the psychiatrist/psychologist as well as the linguist to extract and label the psychological and linguistic features within the patient's speech. Such tagging of the data by a team of specialists will in the long term lead to a rich repository of patient speech, which is of great value in training the ML algorithms in the processing engine. The proposed platform, which we have named INDICES, is depicted in Figure 3.

Although the proposed platform is to be designed such that it scales up at the population level in order to benefit from the diversity of the gathered data, it will also serve every individual as a customized personalized electronic health record that keeps track of the patient's psycho-emotional profile. As for the implementation of the platform, it is practically possible to tailor it to various devices (cell phones, tablets, PCs, and Laptops) *via* android/macOS, and web service applications

Note that emotion is essentially a multifaceted concept and no matter how sophisticated the proposed signal processing and data mining technology is, it would eventually face limitations in grasping all of its aspects. For instance, cultural aspects of expressing emotions can be a serious challenge to the technological system. Extracting the appropriate measurable features for correctly interpreting the cultural indices of emotion in speech can be a challenge, which nonetheless adds to the beauty of the problem. Further, as mentioned earlier, not all emotional indicators are embedded in the speech. Indeed, facial expressions and body gestures play important roles in expressing one's emotions as well. Hence, since the technology considered in our proposed method is focused merely on speech signals, it will of course have *blind spots* such as the visual aspects of emotion which are not exploited. This can be thought of as a main limitation that bounds the performance of the proposed emotion recognition system. However, with the same pattern that technology has always emerged throughout history, the proposed method can similarly serve as a baseline to which further improvements and additional capabilities can be added in future. We must also note that in capturing the different aspects of emotion, we are faced with



DOI: 10.5498/wjp.v13.i1.1

Figure 3 Integrated platform for patient emotion recognition and decision support. It consists of the data gathering platform and the intelligent processing engines. Each patient's data, in the form of voice/transcripts is captured, labeled, and stored in the dataset. The resulting dataset feeds the machine language training/validation and test engines. The entire process of intelligent processing may iterate several times for further fine tuning. It is crucial to have collaboration among the three relevant expertise in different parts of the proposed solution.

a tradeoff between computational complexity and performance. In particular, depending on the required accuracy of the system, one may need to customize the aspects of emotion which are to be examined *via* technology, taking into account the computational burden they would impose on the system.

We shall finally end this section with two remarks. First, it is important to note that despite all integrations and optimizations involved in the design and training of the proposed intelligent platform, it would still have the intrinsic limitations of a machine as a decision-maker, some of which were mentioned above. Thus, the proposed solution would eventually serve as a decision aid/support (and not as a decision replacement). Secondly, while the proposed solution provides a global framework, it invites for a series of methodologies and solutions, which are to be adapted and customized to each language and culture setting for local use.

APPENDIX

We provide Table 3, which includes a brief description of each of the data science techniques and models mentioned earlier, along with reference sources in which further technical details of the methods can be found.

CONCLUSION

In the context of doctor-patient interactions, this article focused on patient SER as a multidimensional problem viewed from three main aspects: Psychology/psychiatry, linguistics, and data science. We reviewed the key elements and approaches within each of these three perspectives, and surveyed the relevant literature on them. In particular, from the psychological/psychiatric perspective, the emotion indicators in the patient-doctor interaction were highlighted and discussed. In the linguistic approach, the relationship between language and emotion was discussed from phonetic, semantic, discourse-pragmatic, and cognitive perspectives. Finally, in the data science approach, SER was discussed as a ML/signal processing problem. The lack of a systematic comprehensive collaboration among the three discussed disciplines was pointed out. Motivated by the necessity of such multidisciplinary collaboration, we proposed a platform named indices: An integrated platform for patient emotion recognition and decision support. The proposed solution can serve as a collaborative framework towards clinical decision support.

Table 3 A brief description of some data science models/methods

Method/Model	Short description	Ref.
HMM	A HMM is a statistical model that can be used to describe the evolution of observable events that depend on internal factors, which are not directly observable. The observed event is called a 'symbol' and the invisible factor underlying the observation is called a 'state'. A HMM consists of two stochastic processes, namely, an invisible process of hidden states and a visible process of observable symbols. The hidden states form a Markov chain and the probability distribution of the observed symbol depend on the underlying stateVia this model, the observations are modeled in two layers: One visible and the other invisible. Thus, it is useful in classification problems where raw observations are to be put into a number of categories that are more meaningful to us (Supplementary Figure 1)	[121, 122]
Gaussian mixture model	A Gaussian mixture model is a probabilistic model that assumes all data points are generated from a mixture of a finite number of Gaussian distributions with unknown parameters (Supplementary Figure 2)	[123]
KNN	KNN is a type of supervised learning algorithm used for classification. KNN tries to predict the correct class for the test data by calculating the distance between the test data and all training points. The algorithm then selects the K number of points which are closest to the test data. The KNN algorithm calculates the probability of the test data belonging to the classes of 'K' training data where the class that holds the highest probability (by majority voting) will be selected (Supplementary Figure 3)	[123]
SVM	The SVM is an algorithm that finds a hyperplane in an N-dimensional space (N: The number of features) that distinctly classifies the data points in a way that the plane has the maximum margin, *i.e.*, the maximum distance between data points of the two classes. Maximizing this margin distance would allow the future test points to be classified more accurately. Support vectors are data points that are closer to the hyperplane and influence the position as well as orientation of the hyperplane (Supplementary Figure 4)	[123]
Artificial neural network	An artificial neural network is a network of interconnected artificial neurons. An artificial neuron which is inspired by the actual neuron is modeled with inputs which are multiplied by weights, and then passed to a mathematical function which determines the activation of the neuron. The neurons in a neural network are grouped into layers. There are three main types of layers: – Input Layer – Hidden Layer(s) – Output Layer. Depending on the architecture of the network, outputs of some neurons are carried along with certain weights as inputs to some other neurons. By passing an input through these layers, the neural network finally outputs a value (discrete or continuous) which can be used to perform various classification/regression tasks. In this context, the neural network first has to learn the set of weights *via* the patterns within the so called training dataset, which is a sufficiently large set of input data labeled with their corresponding correct (expected) output (Supplementary Figure 5)	[124]
Bayes classifier	Bayes classifier, which is based on Bayes' theorem in probability, models the probabilistic relationships between the feature set and the class variable. Based on the modeled relationships, it estimates the class membership probability of the unseen example, in such a way that it minimizes the probability of misclassification	[123]
Linear discriminant analysis	Linear discriminant analysis is a method used in statistical machine learning, to find a linear combination of features that characterizes or separates two or more classes of objects or events. The resulting linear combination can be used as a linear classifier, or, as a means to dimension reduction prior to the actual classification task	[124]

HMM: Hidden markov model; KNN: K-nearest neighbor; SVM: Support vector machine.

FOOTNOTES

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ORIGINAL ARTICLE

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Evaluation of a culturally adapted cognitive behavior therapy-based, third-wave therapy manual

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Abstract

BACKGROUND

Recommendations for psychotherapy have evolved over the years, with cognitive behavioral therapy (CBT) taking precedence since its inception within clinical guidelines in the United Kingdom and United States. The use of CBT for severe mental illness is now more common globally.

AIM

To investigate the feasibility and acceptability of a culturally adapted, CBT-based, third-wave therapy manual using the Comprehend, Cope, and Connect approach with individuals from a diverse population presenting to primary and secondary healthcare services.

METHODS

A pilot study was used to assess the feasibility and acceptability of the manualised intervention. Outcome measures were evaluated at baseline, post-intervention and 12 wk-follow up. 32 participants with mental health conditions aged 20-53 years were recruited. Assessments were completed at three time points, using Clinical Outcomes in Routine Evaluation (CORE), Hospital Anxiety and Depression Scale (HADS), Bradford Somatic Inventory and World Health Organization Disability Assessment Schedule 2.0 (WHODAS). The Patient Experience Questionnaire was completed post-treatment.

RESULTS

Repeated measures of analysis of variance associated with HADS depression, F (2, 36) = 12.81, P < 0.001, partial η^2 = 0.42 and HADS anxiety scores, F (2, 26) = 9.93, P < 0.001, partial η^2 = 0.36; CORE total score and WHODAS both showed significant effect F (1.25, 18.72) = 14.98, P < 0.001, partial η^2 = 0.5. and F (1.29, 14.18) = 6.73, P < 0.001, partial η^2 = 0.38 respectively.

CONCLUSION

These results indicate the effectiveness and acceptability of the culturally adapted, CBT-based, third-wave therapy manual intervention among minoritized groups with moderate effect sizes. Satisfaction levels and acceptability were highly rated. The viability and cost-effectiveness of this approach should be explored further to support universal implementation across healthcare systems.

Key Words: Cognitive behavioral therapy; Comprehend; Cope; Connect; Ethnicity; Culture

Core Tip: This study explores the relevance of a cultural cognitive behavioral therapy manual to manage mental health and wellbeing in primary and secondary care settings in the United Kingdom. Specificity and adaptability are key to demonstrating the relevance as well as the cost-effectiveness of mental health management approaches. Results show the effectiveness of the proposed intervention, with high levels of acceptability and participant satisfaction.

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INTRODUCTION

Cognitive behavioral therapy (CBT) was developed by Beck *et al*[1] with the aim of reducing cognitive biases and dysfunctional behaviors in order to alleviate symptoms of psychopathology. CBT was developed in an ethnocentric environment however, recent research has enabled adaptations to be made to CBT in various aspects[2]. Changes to treatment goals, assigned homework, and types of coping mechanisms taught are some of the adjustments that have been made to this intervention to make it more applicable to different psychological conditions[3,4]. Currently, adaptations to CBT to ensure relevancy and accessibility to ethnic minority groups are also being implemented such as introducing family involvement, use of appropriate language terms, and developed understanding of psychopathology from a culture viewpoint[5,6]. Social constructs and determinants play a vital role in the psychotherapies developed, driven by varying cultural factors of those within developed country-based populations. This is often identified with dysfunctions such as inadequate health policies, transparency in healthcare access and accountability mechanisms, and democratic deficits of global governance systems due to persistent global political determinants of health that have a negative impact. As such, the inclination for cultural factors and sociological constructs to influence the delivery of evidence-based therapeutics would be a logical consensus.

Few CBT adaptations employ surface changes to the intervention, which involve general and practical adaptations, such as increased awareness of cultural issues, aligning therapy with public service messages, or translating materials[7-9]. Most studies used cognitive behavioral strategies and included a variety of ethnic minority samples[6,10-15]. These studies also found that culture-specific values related to interpersonal relationships, family, and spirituality could play a significant role when providing therapy to culturally diverse patients[6,12,13,16]. Specifically, treatments that carefully accommodated cultural values resulted in improved outcomes, especially when adaptions ensured that therapy was problem-focused and direct, supports arguments that culturally diverse individuals may struggle with open-ended and non-directive therapy[17-20].

The implementation of Improving Access to Psychological Therapies (IAPT) initiatives within the United Kingdom increased the development and delivery of psychology treatments for depression and anxiety to be jointly provided with primary care services[21]. IAPT services operate through a 5-stage model, which enable adequate adjustments to be made to ensure beneficial treatment outcomes[22]. Minority ethnic groups face difficulties with accessing mental health services and it is common for them to have unfavorable experiences[23]. Hence, IAPT implemented the BAME Service User Positive Practice Guide which outlines core elements needed in IAPT service provision in order for ethnic minority groups to receive equitable treatments and outcomes[24]. One change currently active within IAPT services is ability to self-referral, removing to obstacle of organizational discrimination for many groups[24]. This has seen an increase in recovery rates from 43.8% to 50% among Black and Asian populations between Quarter 4 2015/16 and Quarter 1 2021/22 data[25]. This being said, there is still a huge gap in culturally-accommodating interventions within IAPT service provision.

Interestingly, National Health Service (NHS) Digital reported that the service users of IAPT were primarily Caucasian patients (78.2%) while only 16.4% were from ethnic minority background[26]. This may indicate a lack of acceptability of IAPT treatments in their current form and it could be argued that the accessibility of IAPT services to diverse populations may still be limited. Although these initial findings have highlighted the need for adaptation of therapy for patients from diverse ethnic minority backgrounds, concerns around the adaptation of CBT for every ethnic group have been raised from a pragmatic perspective, due to limitations within scalability and sustainability[27]. In the past few years, there has been a huge shift towards personalised mental health care services, highlighting the need to consider the individual and any interplaying factors when implementing services[27,28]. Culture is an entity which has significant effects on the psychopathology and help-seeking behavious of individuals hence should be accounted for when implementing interventions[6]. It is common for interventions and assessment tools to be translated to endless languages[29,30], and adaptations in accordance to culture should be accepted on the same terms. This being said, the translatability of interventions to other languages raises socio-economical issues for healthcare systems and policymakers alike yet, not considering translatability could exacerbate health inequality concerns and the same goes for adaptations to cultures. For these reasons, the authors developed a therapy manual that uses a generic third-wave approach, taking into consideration the above factors as well as sensitive forms of therapy in recognition of cultural bias in psychological therapies[15,23,31-35]. CBT and Comprehend, Cope, and Connect (CCC) interventions can be adapted to treat various psychological illnesses but there is also scope for these treatments to be adjusted in accordance to culture[36]. CCC has been chosen due to its universal applicability to levels of processing as it does not require specific adaptation for different ethnicities[37], and indeed the current study included individuals from African, Caribbean, South Asian, and Chinese backgrounds among others. Many Western therapies were developed through an individualistic approach but CCC lends itself to involving family and significant others within the intervention, incorporating aspects of mindfulness, spirituality, and faith. Third-wave approaches to CBT moved the focus towards interpersonal impacts on psychopathology and treatments such as relationships, values, acceptance, and beliefs[38]. Acceptance of different faiths and beliefs are equally important to ensure clinically optimal, yet culturally sensitive diagnostic and treatment approaches are rendered to all patients. Previous literature reports on the increased efficacy of third wave treatments, such as mindfulness-based cognitive therapy or acceptance and commitment therapy, compared with standard interventions across all populations and this paper aims to add to current understandings[39-41].

CCC is a third-wave cognitive behavioral approach based on a collaboratively arrived at, emotion focused, strengths based and trauma informed formulation that leads naturally to the identification of vicious cycles. It is evident at this stage that breaking the cycles is necessary, and skills such as mindfulness, arousal management and emotion management, as well as behavior change are identified and encouraged[42]. The development of the culturally adapted CBT based third-wave CCC manual offers high replicability of this study and the potential for a larger sample and introduction of a control group for comparison. High feasibility for further research using this manualized therapy is also indicated by the good recovery and retention rates, as well as positive patient experience questionnaire (PEQ) scores, which significantly indicated high levels of satisfaction and experience.

MATERIALS AND METHODS

Study design

An uncontrolled pilot study was conducted to explore the feasibility, acceptability, and effectiveness of culturally adapted, a third-wave based cognitive behavioral approach using CCC as a therapeutic intervention for patients with common mental disorders and emotional problems. The study was conducted within IAPT and secondary adult mental health services at an NHS Foundation Trust in the United Kingdom as CCC training has been implemented across both services.

Recruitment of participants

The recruitment of participants was through Community Mental Health Team (CMHT) services and IAPT's iTalk service at NHS Trust. The study was advertised through posters in CMHT and iTalk services. Recruiting participants for this study was difficult despite inclusion across both IAPT and CMHT services.

Potential participants could also contact the study therapist if they were interested in taking part. All potential participants were screened for eligibility before joining the study to ensure they met the inclusion criteria. Permission to approach potential participants was obtained from the treating clinicians. Participants who agreed to be approached were contacted and provided with an ethically approved participant information sheet. The researcher met participants in person to discuss the study in detail and obtain informed consent if interested in taking part. Participants were given a minimum of 48 h to decide if they would like to participate in the study. All participants who consented were informed that they could withdraw from the study at any time.

Eligibility

Participants with moderate to severe mental health problems were identified from IAPT services and secondary care services within the NHS Trust. Our target population was adult patients, aged 18 years and above, with moderate to severe mental illness as confirmed by specialist psychiatric services and documented in the electronic health records (F32: Depressive episode; F20: Schizophrenia; F41.1: Generalised anxiety disorder; F40.1: Social phobia; F43.1: Post-traumatic stress disorder; F42: Obsessive-compulsive disorder; F41.8: Mixed depression and anxiety). All patients from ethnic minority backgrounds were included following written informed consent. However, participants with an organic illness or a primary diagnosis of substance misuse and those experiencing acute psychotic symptoms were excluded from the study. Overall, 32 participants met the inclusion criteria and consented to take part in the study (Figure 1).

Ethics statement

The study was approved by the Health Research Authority London-Camden & Kings Cross Research Ethics Committee, reference number: 16/LO/1899.

Intervention

In terms of simultaneous interventions, CMHT patients were provided this intervention alongside standard treatment whilst IAPT patients were offered the adapted intervention. The CCC intervention was first evaluated within Acute Mental Health services[39-41] and developed for delivery in primary care IAPT services for complex cases[43]. Within primary care, the programme consisted of four individual sessions in which the collaborative emotion and trauma-focused formulation is agreed followed by a 12-wk group and skills-based interventions targeting emotion management and behaviour change (Tables 1 and 2). One or two review sessions concluded the programme. The CCC manual was culturally adapted by the authors using the cultural adaptation framework published elsewhere[23]. A full account of the intervention outlining the theory and applicability of CCC is published elsewhere[44]. Although this is aside from the focus of this study, research on acute services and CCC has also been published[43].

The adaptation facilitated the inclusion of family members and careers to be involved in the therapy; allowed for the somatic conceptualisation of emotional issues and teaching stories Spirituality and religion, where relevant, are integral to all versions of CCC. The manual developed this aspect further to meet the needs of a diverse population. In many ethnic minority cultures, the family is the nucleus within households and communities, so incorporating this core value with ensure more efficacious treatment outcomes. Families are able to provide support within therapy sessions, at home with homework tasks, but also within the wider community promoting positive outcomes for the patient and acceptance of such interventions and services in the wider community[12,14]. Similarly, ethnic minority groups hold various spiritual and religious values which greatly impact understanding of psychopathology and influence help-seeking behaviors[6,45-48]. It is important to understand these elements as they greatly impact values and beliefs, and these are the concepts of wellness explored within therapy[37]. Culturally-adapted CCC used in the current study is an abridged version of standard CCC offered in IAPT therapy at the moment.

Table 1 Comprehend, Cope, and Connect schedule of sessions

Session no	Activity
1-4	Listening; introducing the states of mind; introducing mindfulness and/or breathing
	Collaboratively creating the formulation diagram
	Negotiating goals for therapy based on what is needed to break the vicious circles
	Sharing the draft compassionate summing up letter and looking forward to what to work on through the group programme
5-12	Goals based interventions aimed at breaking the cycles. Mindfulness is the core intervention, and the following are employed as indicated by the formulation
	Arousal management, including relaxation breathing and lifestyle adjustment to reduce chronic stress
	Behavioural activation
	Emotion management includes facing, expressing and letting go of emotion self-compassion
	Aspects of self; mindfulness managed subpersonality work. Relationship management including assertiveness building a new relationship with the past
	Follow-up at 12 wk post-therapy

Table 2 Principal interventions post formulation

Intervention
Mindfulness is the core intervention; it informs the application of the others
Arousal management (relaxation breathing *etc*.)
Behavioral activation
Facing, expressing and letting go of emotion
Self-compassion
Positive anger work
Aspects of self (mindfulness managed subpersonality work)
Relationship management including assertiveness
Building a new relationship with the past

A collaborative and compassionate conceptualisation was completed within the first four sessions (Figure 2). The process starts with open-minded listening and starts with the individual's internal state and how this has been affected by recent circumstances and past adversities. The impact of the past on the present is explained. Strengths, potential values, faith, or spiritual connections are identified before the vicious cycle, representing the current management of the internal state, are tracked. Finally, a compassionate letter summing up the formulation is shared, and the intervention phase of the therapy comprises new skills to break the vicious cycles.

Modifications to the manual

Refining the manual was a key aim of the study in light of new learning arising from the challenges that emerged during therapy delivery. Adherence to the manual was monitored by an independent experienced clinician, where key cultural issues were identified and addressed accordingly. Adaptations followed the cultural adaptation framework already published elsewhere[6]. Some of the modifications included the following: (1) Allowing somatic conceptualisation of emotional challenges; (2) Managing faith issues where this impacts mental health; (3) Managing the balance between family and system expectations of the individual and their own needs; and (4) Cultural differences in attitudes to assertiveness and anger.

Outcome measures

Use of clinical outcome measures varies across primary, secondary and tertiary services. The measures used in this study were not adapted to diverse communities. This is acknowledged in the discussion section under limitations. IAPT participants in the current study also completed standard IAPT measures as this was a service requirement. The study specific outcome measures are listed below:

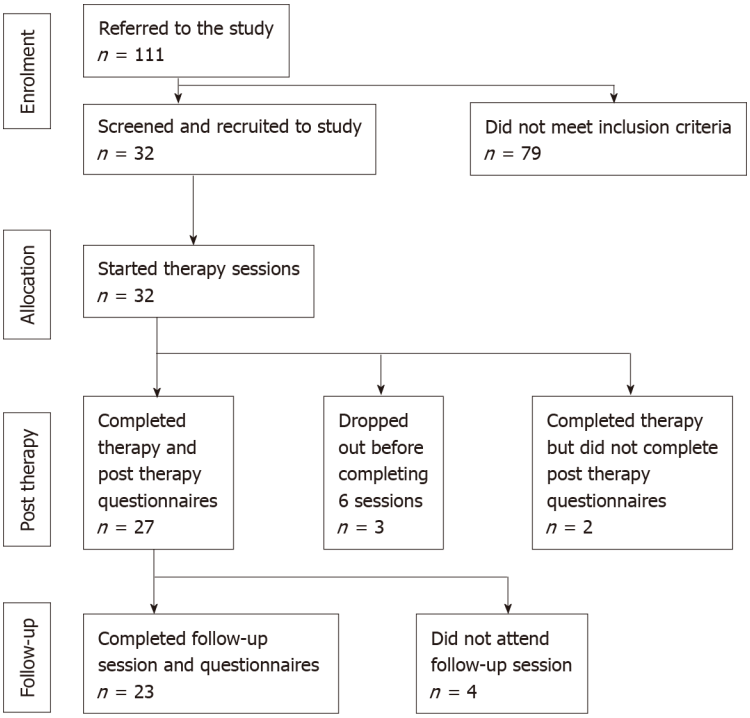

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Figure 1 Study Consort flow diagram.

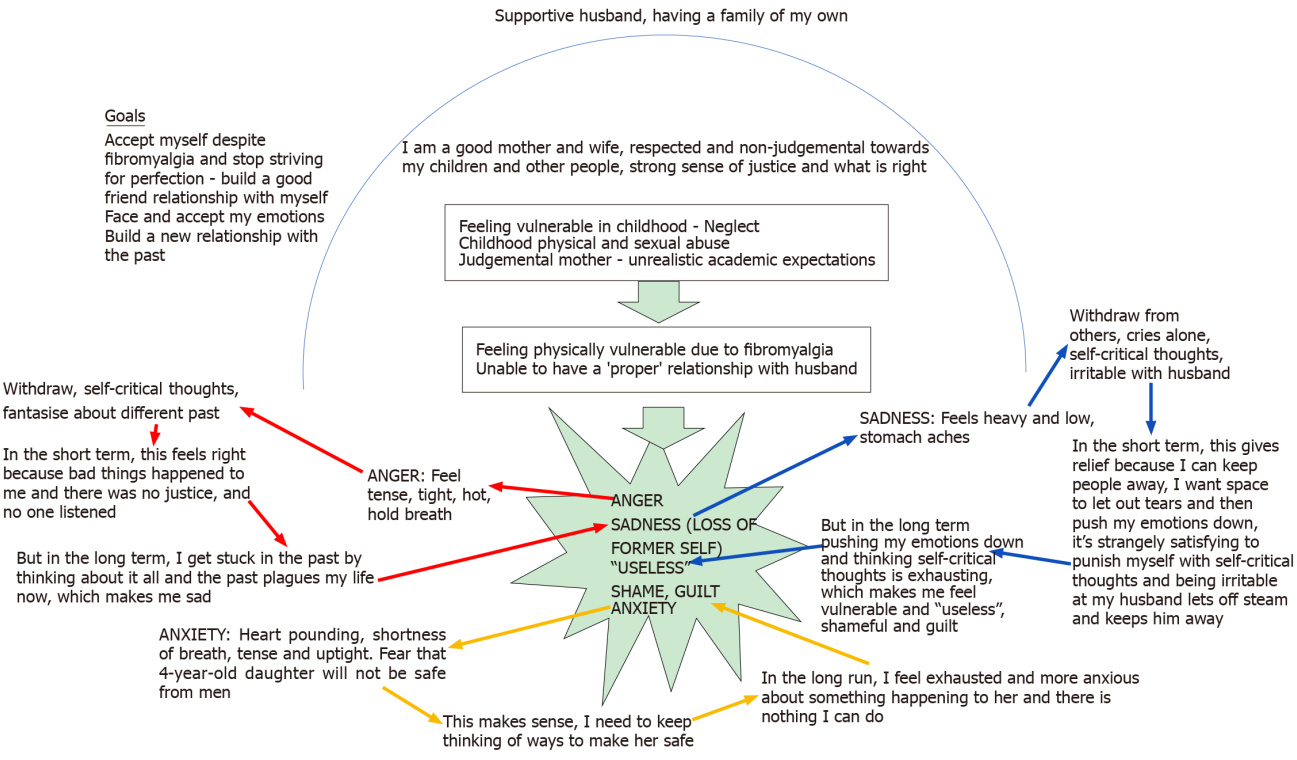

Figure 2 Jade's spikey formulation diagram. Reproduced with permission from IntechOpen. Citation: Phiri P, Clarke I, Baxter L, Elliot K, Rathod S, Naeem F. Culture Free CBT for Diverse Groups. Copyright© The Authors 2021. Published by Intechopen Publishers. The authors have obtained the permission for figure using from the Intechopen Publishers Group (Supplementary material).

Socio-demographic measures: A case report form was developed and used to collect this information from the participants. This included the following variables: Date of birth, gender, primary diagnosis, ethnicity, education, and employment history.

Hospital Anxiety and Depression scale: Hospital Anxiety and Depression Scale (HADS) is a 14-item self-report measure of anxiety and depression. It is scored on a 4-point Likert scale. It has good internal consistency[47,48] and good concurrent validity[49].This measure was designed for a nonclinical population but has recently been validated for a mental health population and the reliability estimates have shown that the Cronbach's alpha for HADS (all items), HADS-Anxiety subscale (HADS-A) and HADS-Depression subscale (HADS-D) was 0.91, 0.90 and 0.80 respectively[45,47].

The Bradford Somatic Inventory: Bradford Somatic Inventory (BSI) is used to measure somatic symptoms. It has 45 items[50]. Scores above 21 indicate depression. It was developed from symptom reports by psychiatric patients in Pakistan and Britain with clinical diagnoses of common mental health problems. The BSI enquires about a wide range of somatic symptoms during the previous month, and if the subject has experienced a particular symptom, whether the symptom has occurred on more or less than 15 d during the month (scoring 2 or 1, respectively).

World Health Organization Disability Assessment Schedule 2.0: World Health Organization (WHO) Disability Assessment Schedule 2.0 (WHODAS) was developed by the WHO to measure disability due to physical and psychological problems and has been used extensively in research[51]. The scale covers 6 domains of functioning, including cognition, mobility, self-care, getting along, life activities, and participation. Responses are on a Likert scale of 0-4.

Clinical outcomes in Routine Evaluation: Clinical outcomes in Routine Evaluation (CORE) is a self-report questionnaire designed to be administered before and after therapy[52]. The participants were asked to respond to 34 questions about how they have been feeling over the last week, using a 5-point scale ranging from 'not at all' to 'most or all of the time'. The 34 items of the measure cover four dimensions: (1) Subjective well-being; (2) Problems/symptoms; (3) Life functioning; and (4) Risk/harm. The responses are designed to be averaged by the practitioner to produce a mean score to indicate the level of current psychological global distress (from 'healthy' to 'severe').

PEQ: Participant therapy satisfaction will be measured using the post-treatment PEQ, an 11-item self-administrated questionnaire[53]. Items 1-10 ask respondents to indicate whether their needs were met using either a two-point scale (1 being yes and 2 being no) or a five-point scale (ranging from 0 = 'not satisfied' to 5 = 'very satisfied with services'). Item 11 will capture qualitative data with any recommendations for improvement.

Statistical analysis

Frequency and descriptive commands were used to measure descriptive statistics, and an explore command was utilised to measure the normality of the data, using histograms and the Kolmorogov-Smirnov test. For each questionnaire score, an analysis of variance (ANOVA) and analysis of covariance (ANCOVA) were used. Factors used for the covariates included age, gender, diagnosis, psychiatric medication, living with someone or alone, ethnic group, having higher education or not having a partner or not, duration of mental illness, being under care of a CMHT or IAPT, history of the previous admission, use of additional services and employment status. However, because of the small sample size, these were individually entered into the analysis.

PEQ measured patient satisfaction with the intervention. It had an ordinal structure, with some items having three or more levels and others having only two levels. A correlation was carried out between PEQ and other outcome scales to investigate whether satisfaction with the intervention was related to other outcomes. Kendal's Tau was calculated where PEQ items had three or more levels, and Sommer's D was calculated where PEQ items had two levels. The statistical package IBM SPSS v20 was used to analyse the data.

RESULTS

Overall characteristics of participants

Demographic data was collected and coded between 29th March 2017 and 4th September 2019. A total of 32 participants (n = 27) female were included in the final sample. Nine participants were from Back African, Black Caribbean and Black Other ethnic groups. Thirteen participants were from either Indian, Bangladeshi, Chinese or Other Asian groups. Ten participants were from Other/Mixed groups. Baseline demographic characteristics are detailed in Table 3. It is worth noting that most participants in this study presented with a high proportion of such complexity and history of trauma (Table 4).

ANOVA results

Change in HADS depression using repeated measures ANOVA: HADS depression score was significantly different when all three time points were compared simultaneously: F (2, 36) = 12.81, P < 0.001, partial eta squared = 0.42 (Figure 3A). However, Bonferroni-adjusted pairwise comparisons

Table 3 Demographic characteristics

Characteristics	Total sample, (*n* = 32)
Gender (*n*, %)	
Male	5 (16)
Female	27 (84)
Age in years range (mean)	20-53 (34.8)
Ethnicity (*n*, %)	
Black African	2 (6)
Black Caribbean	4 (12)
Black Other	3 (9)
Indian	7 (21)
Bangladeshi	1 (3)
Chinese	3 (9)
Other Asian	2 (6)
Other/mixed	10 (32)
Diagnosis (*n*, %)	
F32: Depressive episode	12 (38)
F20: Schizophrenia	1 (3)
F41.1: Generalised anxiety disorder	9 (28)
F40.1: Social phobia	2 (6)
F43.1: Post traumatic stress disorder	2 (6)
F42: Obsessive compulsive disorder	2 (6)
F41.8: Mixed depression and anxiety	4 (13)
Setting (*n*, %)	
Community Mental Health Team	6 (19)
Improving Access to Psychological Therapies	26 (81)
Therapist delivering intervention (*n*, %)	
1	2 (6)
2	19 (60)
3	9 (28)
4	2 (6)
Number of sessions completed (*n*, %)	
12 (maximum)	19 (60)
6-11	9 (28)
Under 6	2 (6)
Unrecorded	2 (6)

showed that HADS depression significantly reduced from baseline to post-treatment and baseline to follow-up, but there was no significant difference between posttreatment and follow-up (Table 5). This meant that there was a benefit at post-treatment and that the benefit was maintained at follow-up.

No difference between ethnic groups meant that the intervention showed similar effect in the groups (Figure 3B). However, the effect of employment status as a covariate on HADS depression was significant: F (1, 17) = 9.73, P = 0.006, eta squared = 0.36 (Figure 3C). Employed people showed lower HADS depression mean scores at all three time points. Interaction of employment with timepoint was not significant.

Table 4 Presentation information and strategies used

Participant	Earlier life experiences (traumatic context)	Presenting problem and impact of past	Specific CCC coping, strategies in addition to mindfulness
1	Childhood abuse (by a close family member), age 4 yr, and neglect; judgmental mother - unrealistic academic expectations	Acquiring physical disability (fibromyalgia and chronic pain), triggers sadness, anger, shame and anxiety, and feeling useless	Building a new relationship with the past: Self compassion
2	Childhood abuse. Domestic violence from partners	Anger and cannot cope when feeling unsupported, let down in the present. Unassertiveness	Building a new relationship with the past: Self-compassion; positive; anger work
3	Over-looked academically as a girl; sense of injustice. Sexual abuse by older brother told not to tell (approx 7 years old) told mother, who blamed and chastised her for the act	Unacknowledged in current family leading to disproportionate depression and anger	Emotion management; selfcom-passion
4	Punishing and neglectful mother. Anxious childhood	Inability to deal with emotions. Avoidant of relationships	Self-compassion; emotion management
5	Childhood trauma. Father nearly died in car crash when 9 years old. Family preoccupied with impact on sibling	Obsessional thoughts regarding harm to daughter. Avoidance	Arousal management; aspects of self[1]; self compassion
6	Extreme childhood fear engendered by tales of black magic	Post-natal fears for safety of son. High anxiety. Compensates with controlling pre-emptive and perfectionist behaviors	Arousal management; building a new relationship with the past; emotion management
7	Neglectful and chaotic childhood. Alcoholic father	Avoidance of emotion leading to constant activity and chronic stress. Alcohol	Arousal management; emotion management
8	Multiple deaths of family members coming close together	Obsessive health anxiety	Arousal management; self-compassion; relationship management[2]
9	Shamed within family as teen for (culturally unacceptable) homosexuality. Physical and emotional abuse by mother. Father left when 3 years old	Envy, anger, relationship and career difficulties. Loneliness copes with perfectionist ideas but behavioral inactivity (fear of failure)	Emotion management; relationship management[2]
10	Sister preferred. Sexual abuse by ex-partner. Experienced racism at work	Low self-esteem. Perfectionism leading to high stress	Positive anger work; aspects of self; relationship management
11	Childhood trauma - mother left. Sex abuse by a parent at 12 yr. Abusive childhood. Adult trauma - loss of daughter in a road traffic accident. Impact of road traffic accident - reduced memory, increased emotionality and impulse control	Flashbacks. Dissociation. Low self-esteem. Problems with emotions and relationships	Building a new relationship with the past; emotion management; relationship management[2]
12	Childhood trauma - loving family, experienced war conflict while in Turkey during Kurdish and Turkish conflict - witnessed village members being tortured by soldiers. 'Reported seeing 'Jinns', dead bodies and evil spirits' - hallucinations? Adult trauma - illegal immigrant for 14 yr - experienced extreme anxiety and feeling under attack from others	Panic, hypervigilance, avoidance of crowds and exercise	Arousal management; emotion management
13	Mental, physical and sexual abuse	Avoidance of emotion. Avoidance of intimacy	Building a new relationship with the past; relationship management[2]; emotion management; aspects of self[1]
14	Childhood sexual abuse by a parent between 5 to 12 yr. Experienced 13 yr of mental and physical abuse from husband	Emotionally overwhelmed. Withdrawal and unmotivated, or dysregulated anger	Arousal management; relationship management; self-compassion
15	Emotionally abusing and criticising childhood	Dissociation. Emotional overwhelm and relationship difficulties	Positive anger work; emotion management;self-compassion
16	Migration age 19 yr of age; hostile in-laws. Major health difficulties severely impact marriage	Suicidal and self-harm. Low mood	Arousal management; relationship management; self compassion[2]
17	Unhappy childhood; migration distress. Breast cancer	Obsessive anger at neighbours leading to conflict	Arousal management positive anger work; emotion management
18	Diagnosed with Autism. Early childhood developmental problems	Social avoidance	Arousal management; behavioral activation;

			relationship management[2]
19	Ran away from home age 11 yr. 'Kicked out' of family home at the age of 19 yr. Loss of young sibling and felt excluded	Suicidal. Avoidant of emotion	Building a new relationship with the past; self compassion; emotion management
20	Long exploitative and abusive marriage plus racial bullying at work	Stress, chronic hypertension. Relationship difficulties	Arousal management; emotion management; positive anger work; aspects of self[1]

[1]Aspects of self is mindfulness managed subpersonality work.

[2]Relationship management includes assertiveness.

Mindfulness is the core intervention; it informs the application of the others. Arousal management includes relaxation breathing and lifestyle adjustment emotion management includes facing, expressing and letting go of emotion. CCC: Comprehend, Cope, and Connect.

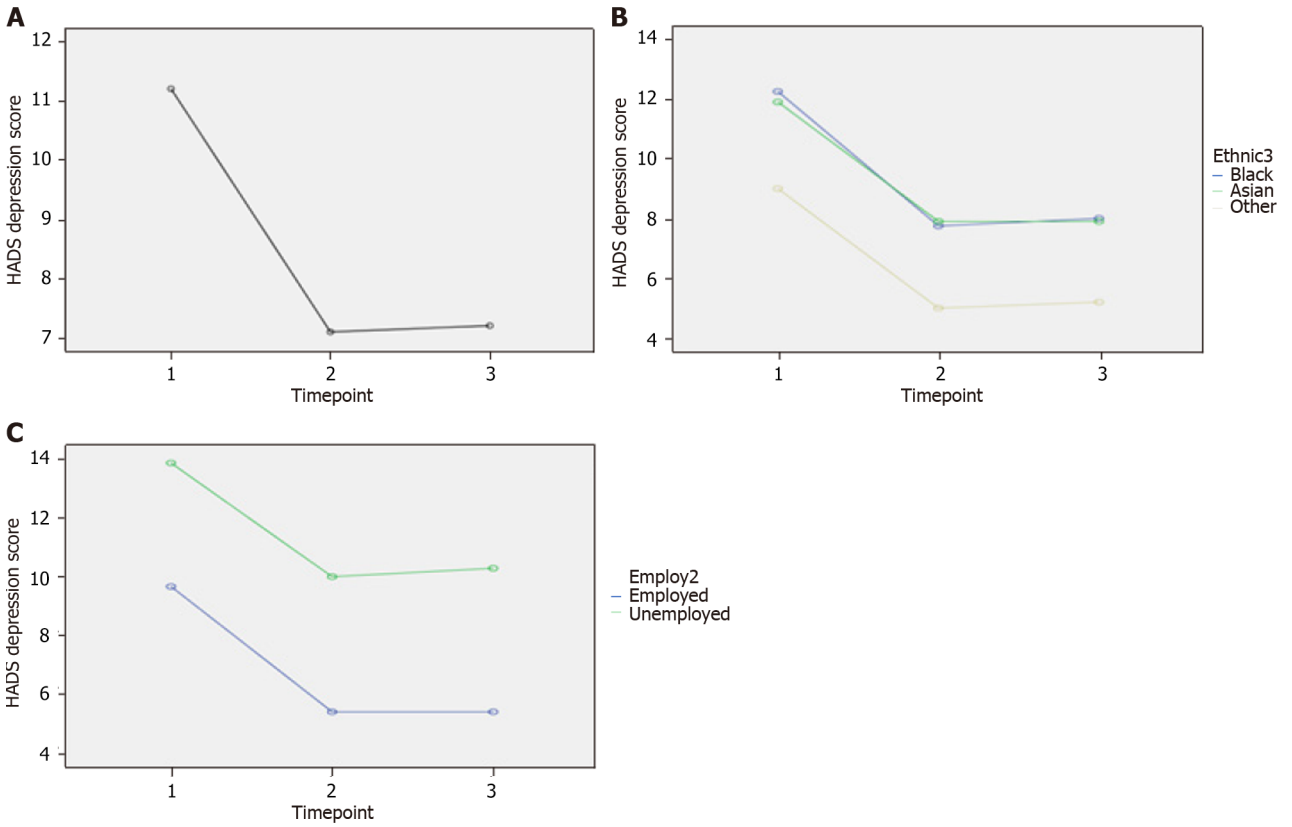

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Figure 3 Hospital Anxiety and Depression Scale Scores. A: Hospital Anxiety and Depression Scale (HADS)-depression scores; B: HADS-depression scores by ethnic groups; C: HADS-depression scores by employment states. HADS: Hospital Anxiety and Depression Scale.

Change in HADS anxiety using repeated measures ANOVA: HADS anxiety score was significantly different when all three time points were compared simultaneously: F (2, 36) = 9.93, $P < 0.001$, partial eta squared = 0.36 (Figure 4). However, Bonferroni-adjusted pairwise comparisons showed that HADS anxiety significantly reduced from baseline to post-treatment and baseline to follow-up, but there was no significant difference between post-treatment and follow-up (Table 5). This meant that there was a benefit at post-treatment and that the benefit was maintained at follow-up.

Change in WHO disability scale using repeated measures ANOVA: WHO disability scale was significantly different when all three time points were compared simultaneously: F (1.29, 14.18) = 6.73, $P < 0.016$, partial eta squared = 0.38 (Figure 5A). However, Bonferroni-adjusted pairwise comparisons showed that the WHO disability scale significantly reduced from baseline to post-treatment and baseline to follow-up, but there was no significant difference between post-treatment and follow-up (Table 5). This meant that there was a benefit at post-treatment and that the benefit was maintained at follow-up. However, the effect of living alone as covariate on WHO disability scale was significant: F (1, 10) = 8.99, $P = 0.013$, eta squared = 0.47 (Figure 5B). Those who were living alone had higher mean score at all three times. Interaction of living with timepoint was not significant. In addition, the effect of

Table 5 Results of repeated measures analysis of variance for outcome variables

Dependent variable	Independent variable	Degrees of freedom	F value	*P* value	Partial eta squared (variance explained; *i.e.*, effect size)	Bonferroni adjusted pairwise comparisons		
HADS depression	Timepoint (within subjects)	2, 36	12.81	< 0.001	0.42	Baseline (mean 11.21 SD 4.28) *vs* post-treatment (mean 7.11, SD 3.99), *P* = 0.004	Baseline *vs* follow-up (mean 7.21, SD 4.99), *P* = 0.001	Post treatment *vs* follow-up, *P* = 1.0
	Employment (between subjects)	1, 17	9.73	0.006	0.36	Employed *vs* unemployed mean difference[1] -4.55 (95%CI: -7.62 to -1.47); employed have lower mean score at all three time points		
	Employment X time point (within subjects)	2, 34	0.06	0.94	0.004	NA	NA	NA
HADS Anxiety	Timepoint (within subjects)	2, 36	9.93	< 0.001	0.36	Baseline (mean 14.53 SD 4.01) *vs* post-treatment (mean 11.05, SD 3.40), *P* = 0.003	Baseline *vs* follow-up (mean 11.21, SD 4.05), *P* = 0.001	Post treatment *vs* follow-up, *P* = 0.831
WHO disability scale total	Timepoint (within subjects)	1.29, 14.18[2]	6.73[2]	0.016	0.38[2]	Baseline (mean 66.58 SD 40.13) *vs* post-treatment (mean 44.42, SD 32.35), *P* = 0.034	Baseline *vs* follow-up (mean 38.75, SD 26.499), *P* = 0.014	Post treatment *vs* follow-up, *P* = 0.194
	Living alone (between subjects)	1, 10	8.99	0.013	0.47	Living alone *vs* with someone mean difference[1] 51.9 (95%CI: 13.33 to 90.47); living alone have higher score at all three timepoints		
	Living alone X timepoint (within subjects)	1.21, 12.07[2]	0.39[2]	0.581	0.04[2]	NA	NA	NA
	Employment (between subjects)	1, 10	8.68	0.015	0.47	Employed *vs* unemployed mean difference[1] -44.26 (95%CI: -77.62 to -10.79); employed have lower mean score at all three time points		
	Employment X Time point (within subjects)	1.32, 13.18[2]	2.99[2]	0.1	0.23[2]	NA	NA	NA
CORE total	Timepoint	1.25, 18.72[2]	14.98[2]	0.001	0.5[2]	Baseline (mean 76.81, SD 23.26) *vs* post-treatment (mean 49.25, SD 27.00), *P* = 0.002	Baseline *vs* follow-up (mean 52.19, SD 25.72), *P* < 0.001	Post treatment *vs* follow-up, *P* = 0.404
CORE total mean with risk	Timepoint	1.25, 18.72[2]	14.98[2]	0.001	0.5[2]	Baseline (mean 2.26, SD 0.68) *vs* post-treatment (mean 1.45, SD 0.79), *P* = 0.002	Baseline *vs* follow-up (mean 1.53, SD 0.76), *P* < 0.001	Post treatment *vs* follow-up, *P* = 0.404
CORE Total mean without risk	Timepoint	1.24, 18.66[2]	16.58	< 0.001	0.53[2]	Baseline (mean 2.62, SD 0.71) *vs* post-treatment (mean 1, SD 0.87), *P* = 0.001	Baseline *vs* follow-up (mean 1.77, SD 0.79), *P* < 0.001	Post treatment *vs* follow-up, *P* = 0.523
CORE risk mean	Timepoint	2, 36	1.83	0.175	0.09	Baseline (mean 0.48, SD 0.75) *vs* post-treatment (mean 0.26, SD 0.55), *P* = 0.109	Baseline *vs* follow-up (mean 0.39, SD 0.77), *P* = 0.418	Post treatment *vs* follow-up, *P* = 0.096
CORE symptoms mean	Timepoint	2, 32	91.10	< 0.001	0.54	Baseline (mean 2.81, SD 0.77) *vs* post-treatment (mean 1.76, SD 1.03), *P* < 0.001	Baseline *vs* follow-up (mean 1.91, SD 0.89), *P* < 0.001	Post treatment *vs* follow-up, *P* = 0.317
CORE functioning mean	Timepoint	1.25, 19.92[2]	7.26	0.01	0.31	Baseline (mean 2.25, SD 0.88) *vs* post-treatment (mean 1.61, SD 0.86), *P* = 0.016	Baseline *vs* follow-up (mean 1.65, SD 0.83), *P* = 0.009	Post treatment *vs* follow-up, *P* = 0.692
CORE well being mean	Timepoint	2, 36	20.41	< 0.001	0.53	Baseline (mean 2.82, SD 0.67) *vs* post-treatment (mean 1.68, SD 0.68), *P* < 0.001	Baseline *vs* follow-up (mean 1.76, SD 0.87), *P* < 0.001	Post treatment *vs* follow-up, *P* = 0.61

BSI total	Timepoint	2, 36	6.50	0.008	0.26	Baseline (mean 22.11, SD 11.40) *vs* post-treatment (mean 19.05, SD 10.23), $P < 0.066$	Baseline *vs* follow-up (mean 16.47, SD 11.10), $P < 0.008$	Post treatment *vs* follow-up, $P = 0.041$

[1]This is the difference in average means across all three time-points.

[2]Greenhouse-Geisser value given due to significant Mauchly's test of sphericity.

CI: Confidence interval; NA: Not available; WHO: World Health Organization; CORE: Clinical Outcomes in Routine Evaluation; HADS: Hospital Anxiety and Depression Scale; BSI: Bradford Somatic Inventory.

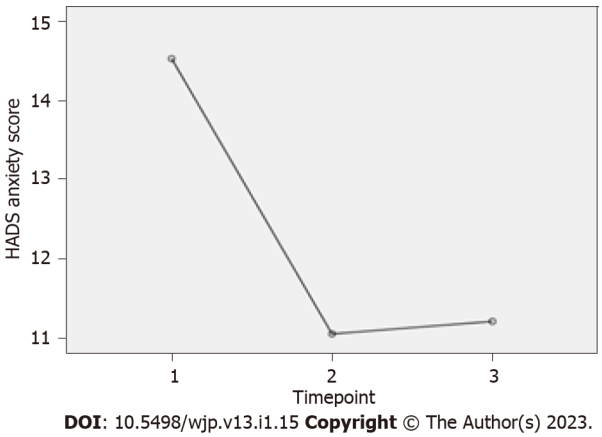

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Figure 4 Hospital Anxiety and Depression Scale Anxiety Scores. HADS: Hospital Anxiety and Depression Scale.

employment status as a covariate on WHO disability scale was significant, F (1, 10) = 8.68, $P = 0.015$, eta squared = 0.47 (Figure 5C). Employed people showed lower WHO disability scale mean score at all three time points. Interaction of employment with timepoint was not significant.

Change in CORE total score using repeated measures ANOVA: The CORE total score was significantly different when all three time points were compared simultaneously: F (1.25, 18.72) = 14.98, $P = 0.001$, partial eta squared = 0.5 (Figure 6A). However, Bonferroni-adjusted pairwise comparisons showed that CORE total score significantly reduced from baseline to post-treatment and baseline to follow-up, but there was no significant difference between post-treatment and follow-up (Table 5). This meant that there was a benefit at post-treatment and that the benefit was maintained at follow-up.

Change in CORE total mean to risk using repeated measures ANOVA: The CORE total mean with risk was significantly different when all three time points were compared simultaneously: F (1.25, 18.72) = 14.98, $P = 0.001$, partial eta squared = 0.5. However, Bonferroni-adjusted pairwise comparisons showed that the CORE total mean with risk significantly reduced from baseline to post-treatment and baseline to follow-up; but there was no significant difference between post-treatment and follow-up (Table 5). This meant that there was a benefit at post-treatment and that the benefit was maintained at follow-up.

The effect of the following covariates on the HADS, WHODAS, and CORE total mean with risk was not significant: Age, gender, diagnosis, psychiatric medication, living with someone or alone, ethnic group, having higher education or not, having a partner or not, duration of mental illness, being under care of CMHT or IAPT, history of previous admission, use of additional services and employment status. No difference between ethnic groups meant that the intervention showed similar effects in the groups.

Change in CORE total mean without risk using repeated measures ANOVA: The CORE total mean without risk was significantly different when all three time points were compared simultaneously: F (1.24, 18.66) = 16.58, $P < 0.001$, partial eta squared = 0.53. However, Bonferroni-adjusted pairwise comparisons showed that the CORE total mean without risk significantly reduced from baseline to post-treatment and baseline to follow-up; but there was no significant difference between post-treatment and follow-up (Table 5). This meant that there was a benefit at post-treatment and that the benefit was maintained at follow-up.

Change in CORE risk mean using repeated measures ANOVA: The CORE risk mean was not significantly different when all three time points were compared simultaneously: F (2, 36) = 11.83, $P = 0.175$, partial eta squared = 0.09. Furthermore, Bonferroni-adjusted pairwise comparisons showed that the CORE risk mean was not significantly different in any of the three-way comparisons (Table 5). This

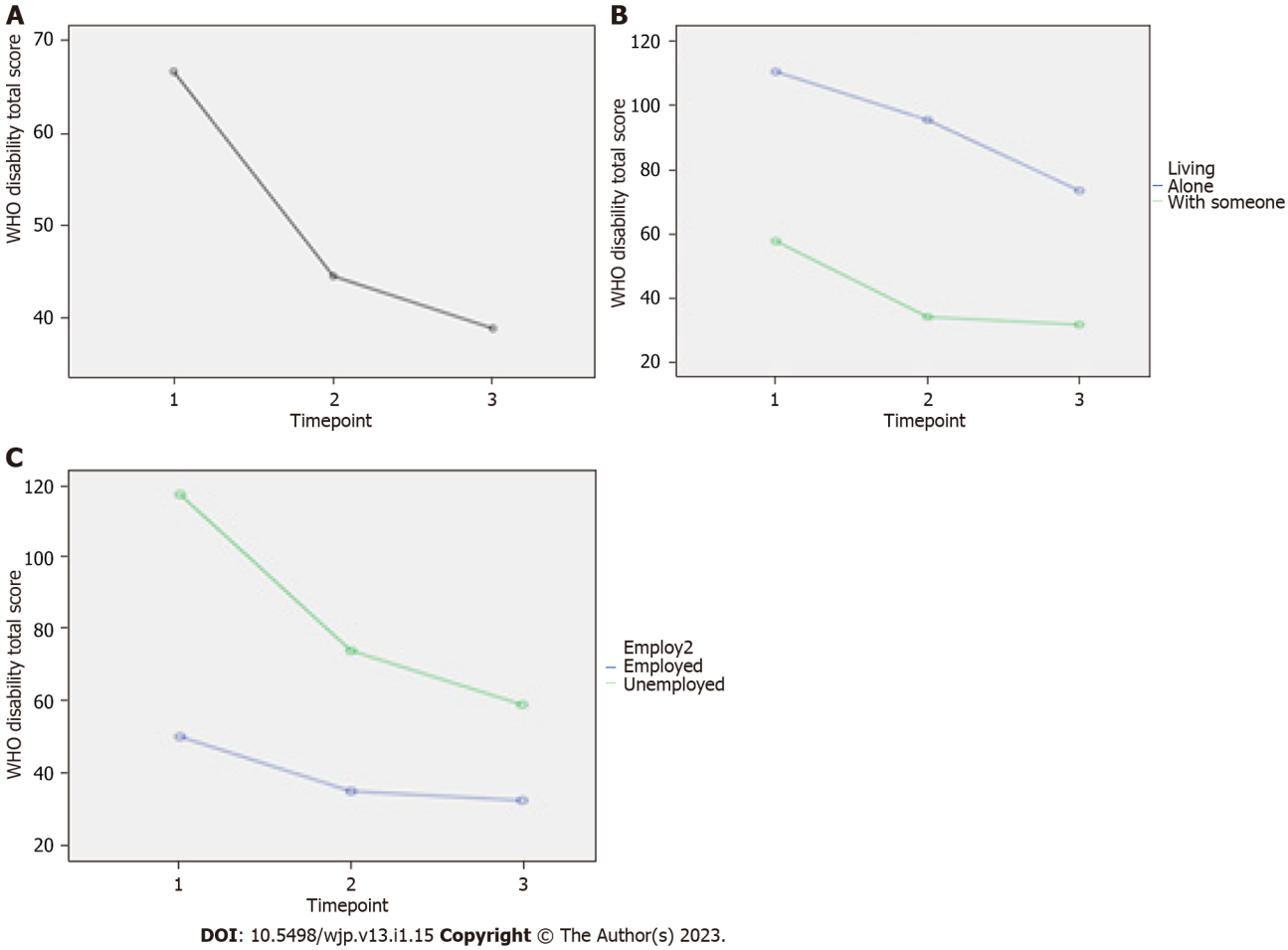

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Figure 5 World Health Organization Disability Assessment Schedule 2.0 scores. A: World Health Organization Disability Assessment Schedule 2.0 (WHODAS) scores; B: WHODAS scores by living status; C: WHODAS scores by employment status. WHO: World Health Organization.

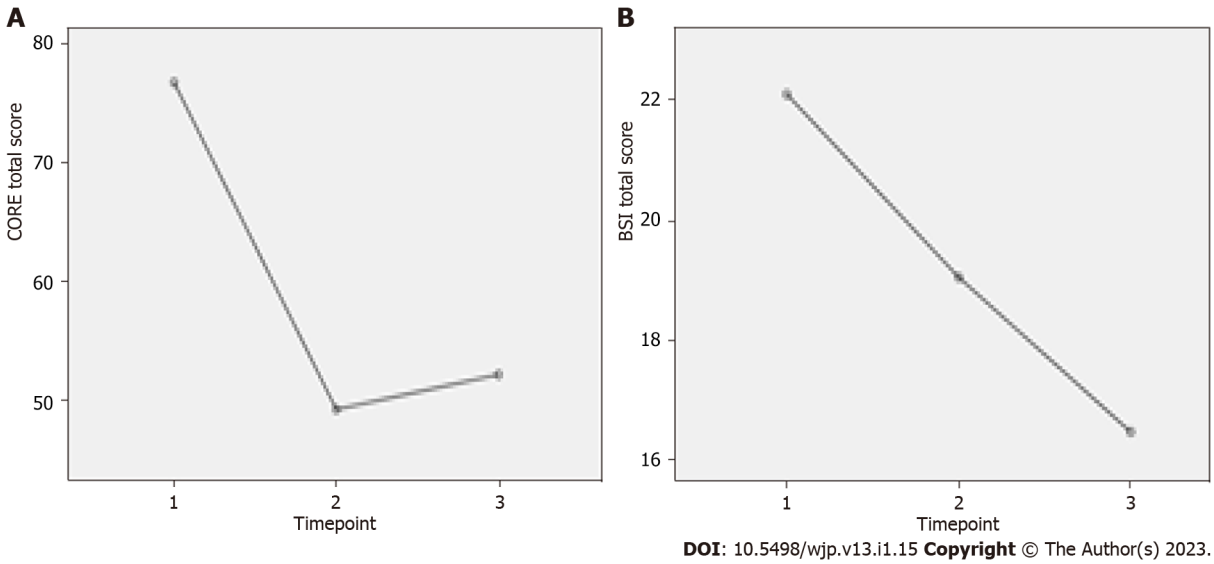

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Figure 6 Clinical Outcomes in Routine Evaluation and Bradford Somatic Inventory scores at three timepoints. A: Clinical Outcomes in Routine Evaluation; B: Bradford Somatic Inventory scores. CORE: Clinical Outcomes in Routine Evaluation; BSI: Bradford Somatic Inventory.

meant that this measurement did not change significantly between the three time points. Thus, no covariates were entered in this analysis.

Change in CORE symptoms mean using repeated measures ANOVA: The CORE symptom mean was significantly different when all three time points were compared simultaneously: F (2, 32) = 91.10, P < 0.001, partial eta squared = 0.54. However, Bonferroni-adjusted pairwise comparisons showed that the CORE symptom mean significantly reduced from baseline to post-treatment and baseline to follow-up; but there was no significant difference between post-treatment and follow-up (Table 5). This meant that there was a benefit at post-treatment and that the benefit was maintained at follow-up.

Changes in CORE functioning mean using repeated measures ANOVA: The CORE functioning mean was significantly different when all three time points were compared simultaneously: F (1.25, 91.92) = 7.26, P = 0.01, partial eta squared = 0.31. However, Bonferroni-adjusted pairwise comparisons showed that the CORE functioning mean significantly reduced from baseline to post-treatment and baseline to follow-up; but there was no significant difference between post-treatment and follow-up (Table 5). This meant that there was a benefit at post-treatment and that the benefit was maintained at follow-up.

Changes in CORE wellbeing mean using repeated measures ANOVA: CORE wellbeing mean was significantly different when all three time points were compared simultaneously, F (2, 36) = 20.41, P = 0.01, partial eta squared = 0.53. However, Bonferroni-adjusted pairwise comparisons showed that CORE wellbeing mean significantly reduced from baseline to post-treatment and baseline to follow-up; but there was no significant difference between post-treatment and follow-up (Table 5). This meant that there was a benefit at post-treatment and that the benefit was maintained at follow-up.

Change in BSI total using repeated measures ANOVA: The BSI total was significantly different when all three time points were compared simultaneously: F (2, 36) = 6.50, P = 0.008, partial eta squared = 0.26 (Figure 6B). However, Bonferroni-adjusted pairwise comparisons showed that the BSI total did not reduce significantly from baseline to post-treatment and but did so from baseline to follow-up; there was also a significant difference between post-treatment and follow-up (Table 5). This meant that there was no benefit at post-treatment but there was at follow-up.

ANCOVA results

Compared with ANOVA, ANCOVA further analysed the outcomes adjusted by certain covariates. This allowed us to examine the sensitivity of the findings in ANOVA towards certain covariates. If the significant results in ANOVA changed tremendously to unsignificant, the reliability of the results in ANOVA should be doubted. Such covariates could be influencing the outcomes in an undetected way and thereby contribute to the differences between groups. Therefore, we further analysed the significant model in ANOVA. After adding covariates, the P-value in ANOVA changed from less than 0.05 to larger than 0.05 in ANCOVA, thus these covariates were the key variables we should pay attention to. If the significant results in ANOVA remained significant in ANCOVA, *i.e.*, no drastic changes in the P-value, it would consolidate our finding in ANOVA by evidencing the insensitivity of the result towards the covariate.

Change in HADS depression using mixed factorial ANCOVA: With Timepoint and Employment being factor, HADS depression score adjusted by gender was not significantly different when all three time points were compared simultaneously: F (2, 42) = 0.158, P = 0.855. Also, when adjusted by age, HADS depression score did not show significant difference across three time points: F (2.42) = 0.595, P = 0.556 (Table 6). This suggested part of the differences of HADS depression scores across three timepoints could be explained by gender. Bonferroni-adjusted pairwise comparisons had the similar results to those of ANOVA.

In addition to this, other covariates, such as psychiatric medication, living with someone or alone, having higher education or not, having a partner or not, duration of mental illness, being under care of a CMHT or IAPT, history of previous admission and use of additional services, didn't change the results of the ANOVA analysis. Therefore, with factors living alone and employment, differences in questionnaire scores at three timepoints were not caused by these covariates.

Change in HADS anxiety using repeated measures ANCOVA: Results in ANOVA showed that HADS anxiety score was significantly different through three timepoints with a P-value less than 0.001 (Table 6). While HADS anxiety score adjusted by gender was not significantly different when all three time points were compared simultaneously: F (2, 44) = 0.014, P = 0.986 (Table 6). This suggested part of the difference of HADS anxiety score across three time points could be explained by gender. Bonferroni-adjusted pairwise comparison kept the similar results with those of ANOVA analysis.

Change in WHO disability scale using mixed factorial ANCOVA: Based on the results of ANOVA, model with factors employment and living alone had a P-value of 0.016 between three timepoints (Table 6). In ANCOVA analysis, with the same two factors, WHO disability scale adjusted by gender was not significantly different when all three time points were compared simultaneously: F (1.24, 22.38) = 0.354, P = 0.704 (Table 6). This meant that part of the difference of WHO disability scale across three time points could be explained by gender. With the same factors, using covariates age or higher education respectively resulted in a small increase in the P-value of time-point: From P = 0.016 (Table 5)

Table 6 Results of repeated measures analysis of covariance for outcome variables

Dependent variable	Covariate	Independent variable	Degrees of freedom	F value	*P* value	Bonferroni adjusted pairwise comparisons		
HADS depression	Gender	Timepoint (within subjects)	2, 42	0.158	0.855	Baseline (mean 11.77 SD 0.78) *vs* post-treatment (mean 7.75, SD 0.73), *P* = 0.003	Baseline *vs* follow-up (mean 7.55, SD 0.89), *P* < 0.001	Post treatment *vs* follow-up, *P* = 1.0
		Employment (between subjects)	1, 21	9.788	0.005	Employed *vs* unemployed mean difference[1] -3.96 (95%CI: -6.60 to -1.33); employed have lower mean score at all three time points		
	Age	Timepoint (within subjects)	2, 42	0.595	0.556	Baseline (mean 11.85 SD 0.77) *vs* post-treatment (mean 7.78, SD 0.74), *P* = 0.002	Baseline *vs* follow-up (mean 7.62, SD 0.89), *P* < 0.001	Post treatment *vs* follow-up, *P* = 1.0
		Employment (between subjects)	1, 21	11.266	0.003	Employed *vs* unemployed mean difference[1] -4.33 (95% CI: -7.02 to -1.65); employed have lower mean score at all three time points		
HADS Anxiety	Gender	Timepoint (within subjects)	2, 44	0.014	0.986	Baseline (mean 14.54 SD 0.77) *vs* post-treatment (mean 10.33, SD 0.75), *P* < 0.001	Baseline *vs* follow-up (mean 10.38, SD 0.86), *P* < 0.001	Post treatment *vs* follow-up, *P* = 1.0
WHO disability scale total	Gender	Timepoint (within subjects)	1.24, 22.38[2]	0.354[2]	0.704[2]	Baseline (mean 85.32 SD 8.72) *vs* post-treatment (mean 65.83, SD 7.42), *P* = 0.143	Baseline *vs* follow-up (mean 53.59, SD 8.26), *P* = 0.014	Post treatment *vs* follow-up, *P* = 0.016
		Living alone (between subjects)	1, 18	8.288	0.010	Living alone *vs* with someone mean difference[1] 37.82 (95%CI: 10.22 to 65.42); living alone have higher score at all three timepoints		
		Employment (between subjects)	1, 18	10.674	0.004	Employed *vs* unemployed mean difference[1] -30.52 (95%CI: -50.14 to -10.89); employed have lower mean score at all three time points		
	Age	Timepoint (within subjects)	1.25, 22.41[2]	3.631[2]	0.062[2]	Baseline (mean 84.69 SD 8.62) *vs* post-treatment (mean 65.47, SD 6.89), *P* = 0.138	Baseline *vs* follow-up (mean 53.30 SD 7.41), *P* = 0.011	Post treatment *vs* follow-up, *P* = 0.013
		Living alone (between subjects)	1, 18	8.167	0.010	Living alone vs with someone mean difference[1] 34.92 (95%CI: 9.25 to 60.59); living alone have higher score at all three timepoints		
		Employment (between subjects)	1, 18	14.555	0.001	Employed *vs* unemployed mean difference[1] -35.13 (95%CI: -54.47 to -15.78); employed have lower mean score at all three time points		
	Higher Education	Timepoint (within subjects)	1.22, 20.78[2]	3.506[2]	0.068[2]	Baseline (mean 84.60 SD 8.89) *vs* post-treatment (mean 65.38, SD 7.64), *P* = 0.165	Baseline *vs* follow-up (mean 52.48, SD 8.31), *P* = 0.014	Post treatment *vs* follow-up, *P* = 0.008
		Living alone (between subjects)	1, 17	7.318	0.015	Living alone *vs* with someone mean difference[1] 36.75 (95%CI: 8.09 to 65.41); living alone have higher score at all three timepoints		
		Employment (between subjects)	1, 17	10.370	0.005	Employed *vs* unemployed mean difference[1] -31.02 (95%CI: -51.34 to -10.70); employed have lower mean score at all three time points		
CORE total	Gender	Timepoint	1.47, 32.30[2]	0.028[2]	0.938[2]	Baseline (mean 73.88, SD 4.56) *vs* post-treatment (mean 47.42, SD 5.11), *P* < 0.001	Baseline *vs* follow-up (mean 48.04, SD 5.25), *P* < 0.001	Post treatment *vs* follow-up, *P* = 1.0
	Age	Timepoint	1.47, 32.23[2]	0.975[2]	0.364[2]	Baseline (mean 73.88, SD 4.48) *vs* post-treatment (mean 47.42, SD 4.95), *P* < 0.001	Baseline *vs* follow-up (mean 48.04, SD 5.15), *P* < 0.001	Post treatment *vs* follow-up, *P* = 1.0
BSI total	Age	Timepoint	2, 46	0.285	0.753	Baseline (mean 22.64, SD 2.06) *vs* post-treatment (mean 18.60, SD 2.06), *P* = 0.041	Baseline *vs* follow-up (mean 16.60, SD 2.09), *P* = 0.001	Post treatment *vs* follow-up, *P* = 0.406
	Gender	Timepoint	2, 46	1.027	0.366	Baseline (mean 22.64, SD 2.03) *vs* post-treatment (mean 18.60, SD 2.09), *P* = 0.026	Baseline *vs* follow-up (mean 16.60, SD 2.07), *P* = 0.001	Post treatment *vs* follow-up, *P* = 0.411
	Higher education	Timepoint	2, 44	2.811	0.071	Baseline (mean 22.58, SD 2.19) *vs* post-treatment (mean 18.21, SD 2.15), *P* =	Baseline *vs* follow-up (mean 16.75, SD 2.11), *P* = 0.003	Post treatment *vs* follow-up, *P* = 0.661

					0.028			
	Marital status	Timepoint	2, 46	3.146	0.052	Baseline (mean 22.64, SD 2.05) *vs* post-treatment (mean 18.60, SD 2.08), P = 0.040	Baseline *vs* follow-up (mean 16.60, SD 2.08), P = 0.002	Post treatment *vs* follow-up, P = 0.434

[1]This is the difference in average means across all three time-points.

[2]Greenhouse-Geisser value given due to significant Mauchly's test of sphericity.

CI: Confidence interval; NA: Not available; WHO: World Health Organization; CORE: Clinical Outcomes in Routine Evaluation; HADS: Hospital Anxiety and Depression Scale; BSI: Bradford Somatic Inventory.

to P = 0.062 and P = 0.068 (Table 6). It was evident from the results that the changes to the WHO disability scale between three time points was not easily explained by age or higher education. Bonferroni-adjusted pairwise comparison failed to show significant reduction of the WHO disability scale from baseline to post-treatment. However, our results showed a significant reduction of the WHO disability scale from baseline to follow-up and from post-treatment to follow-up.

Change in CORE total score using repeated measures ANCOVA: The CORE total score adjusted by gender and age respectively was not significantly different when all three time points were compared simultaneously: F (1.47, 32.30) = 0.028, P = 0.938 and F (1.47, 32.23), P = 0.364 (Table 6). After adding these two covariates respectively, the differences of scores between three timepoint were not that much, which suggested part of the difference of CORE total score across three time points could be explained by gender and age. Bonferroni-adjusted pairwise comparison result did not change.

Change in BSI total using repeated measures ANCOVA: The BSI total adjusted by age and gender respectively was not significantly different when all three time points were compared simultaneously: F (2, 46) = 0.285, P = 0.753 and F (2, 46), P = 0.366 (Table 6). As for the covariate higher education, it showed a small increase in the P-value of timepoint from ANOVA results to ANCOVA results: From P = 0.008 (Table 5) to P = 0.071 (Table 6). This suggested part of the difference of BSI total across three time points could be explained by age and gender. Bonferroni-adjusted pairwise comparison result was the same as ANOVA results.

Analysis of BSI items 45 and 46

BSI item 45 asked only at baseline 'Have felt that you have been passing urine in the semen?' A total n = 6 men answered "no". BSI item 46 asked at all three time points, 'Have you had difficulty getting a full erection?' All n = 6 male respondents answered "no" at baseline, while post-treatment (n = 4) responded "no" and (n = 1) said "yes", while 1 did not respond. At follow-up timepoint, (n = 4) responded "no" and (n = 2) did not respond.

PEQ post-treatment results

PEQ analysis involved descriptive data on each item relating to the patient experience and satisfaction of the intervention. Figures 7A-D display a graphical presentation of the PEQ items 1, 3, 5, and 10. A total of 24 out of 32 participants completed the questionnaire. There was a significant positive correlation between PEQ item 8 and CORE risk mean (Somers D = 0.5); between PEQ item 8 and HADS Depression (Somers D = 0.67); and between PEQ item 8 and CORE functioning mean (Somers D = 0.69). This meant that the people who had worse scores on risk, functioning, and depression were more engaged with the treatment. However, all other correlations were not significant. Therefore, overall, the experience of treatment was independent of the changes in the outcome scales.

DISCUSSION

Our feasibility study sought to explore how some of the cultural barriers could be addressed with a manual that adapts the CBT based, third-wave based, CCC therapy- for diverse ethnic minority groups. Of the 32 participants within our sample, 3 dropped out before completing a total of 6 sessions. Thus, there is a positive notion for acceptability and adherence to the intervention. Given the ethnic diversity within the study sample, our manual appears to have relevance to operate cross-culturally. Significant improvement on anxiety/depression (HADS, anxiety and depression, BSI, and CORE) and overall quality of life (WHODAS) is suggested within the study sample. Developing the manual in response to challenges posed by the therapy in supervision raised interesting issues that were resolved within the CCC framework. Therefore, the development of CBT approaches built around mindfulness, commonly referred to as the third-wave, promotes a reflective space between the individual's thoughts and feelings, in contrast to the direct challenge, which makes it more acceptable to ethnic minority groups.

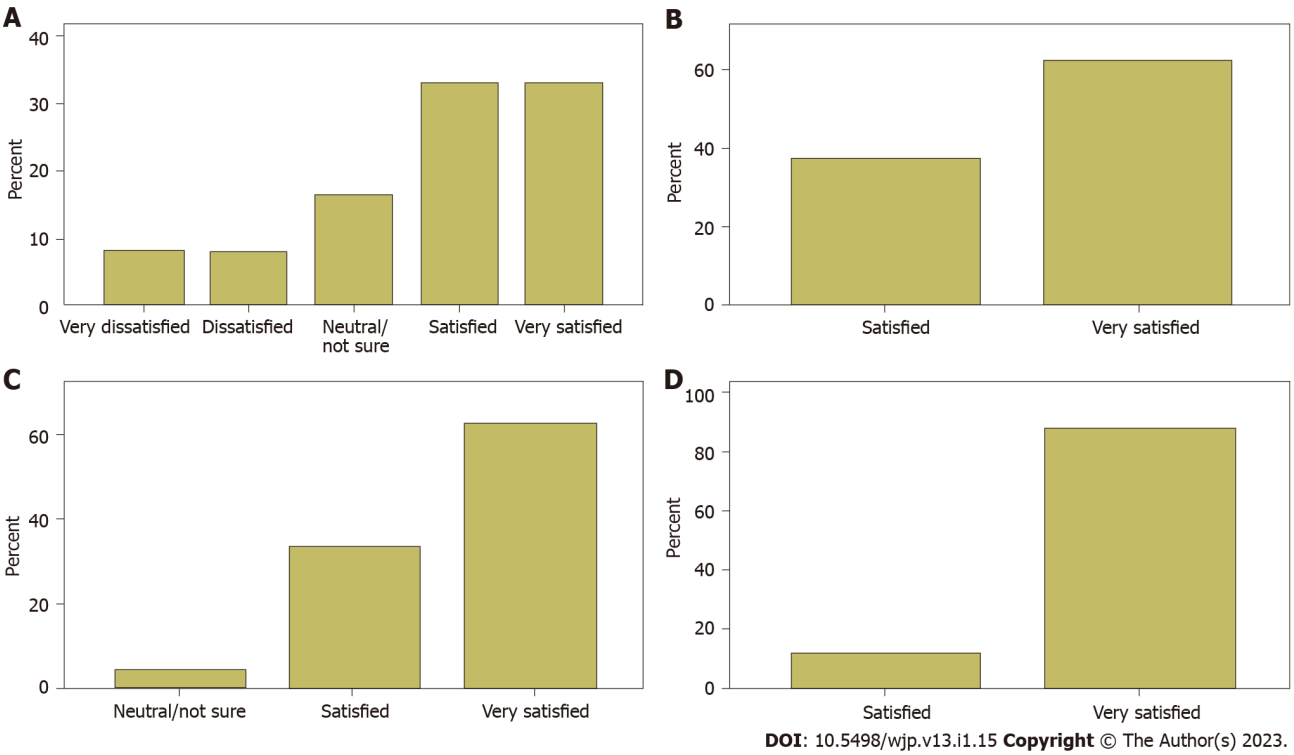

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Figure 7 Patient Experience Questionnaire Items. A: How satisfied are you with the amount of time you had to wait for your first appointment? B: How satisfied are you with the type of treatment that you received? C: How satisfied are you with the overall experience of using this service? D: How satisfied are you with the therapist that treated you?

CCC avoids much of the complexity of other therapies by drawing on its roots in cognitive science to target the universal human need to establish a tolerable internal state. Attempts to regain equilibrium where this state is not tolerable led to behaviors and experiences that are then labelled as symptoms.

In addition, difference in cultural attitudes where assertiveness and anger proved amenable to the controlled expression of emotion with a mindfulness approach, which is similar to previous research conducted[18,37]. This could also be an intervention that could aid managing family expectations' to highly sensitive subject matter[6]. Issues that raised religious and cultural sensitivity, such as sexual abuse, required both validation of the individual's experience and acceptance of the limitation of open acknowledgement by the wider group. The relational nature of the interacting cognitive subsystems-based model of the person opens the way to the discussion of religious and faith issues that sidestepped contentious dogmas. CCC enables deep reflection by accommodating cultural adjustments, it makes this process of therapy more applicable and relevant. At present, four studies on CCC have been published looking at acute psychology which is different to the intervention used in this study[43,54-56], while demonstrating the ability of the approach to engage a challenging population. Three more studies are in preparation. Research into CCC is sparse at the moment and this pilot study is preliminary research into the CCC intervention, hence currently lacks any research comparators. The findings of this study are largely in line with previous research on culturally adapted CBT. Previous research found that adaptations in core elements, such as family, therapy delivery, and religious/spiritual views, enabled for the most efficacious outcomes for ethnic minority groups[14,15].

The recognized role of childhood or adult trauma in the development of psychological stress needing clinical management and psychological input is fully incorporated into CCC. The participant characteristics highlight the spectrum of trauma and past adversity contributing to current mental health difficulties across a primary care sample not selected for trauma. In the United Kingdom, National Institute for Health and Care Excellence guidelines provide an important consideration for clinicians who have such patients. Therefore, it is essential that primary, secondary, and tertiary care health professionals are fully aware of such issues to ensure patients receive optimal short, medium, and long-term care that is detrimental to reducing distress and improving their quality of life. Similarly, emotional, and general wellbeing, should be considered as an undercurrent to this intervention that requires to be kept at proximity, when managing ongoing care for these patients. Equally, in the event, potential patients have underlying chronic long-term comorbidities, the correlational aspect should be considered at the time of introducing this intervention and measuring its outcome longitudinally.

The main limitation of this study was that it was an uncontrolled pilot study to assess the feasibility of the manualized intervention. Therefore, the sample size remained sizable to demonstrate an effect size. The sample used was skewed towards female participants (84.4%) and outcome measures were not

adapted accordingly. Future studies should consider gender accountability. The emphasis was on learning from individual therapies with individuals who presented to an IAPT service and a CMHT with a wide range of problems and from diverse ethnicities. In relation to using both primary and secondary care samples, results have shown that both groups accepted in intervention and participant satisfaction was significant. As such, it represents the normal clinical practice in its complexity, making generalization more difficult. However, within these limitations, the results are promising and should merit a more extensive and definitive phase three randomized controlled interventions in the future.

In terms of future research, it would be ideal for a comprehensive randomized study design to be implemented. It would be insightful to include a much larger sample size with proportionate participant numbers from each ethnic group included. This would allow for stronger statistical outputs and more generalizable conclusions regarding the impact of this CaCBT-based third-wave therapy manual.

CONCLUSION

The culturally adapted CBT third-wave based manual intervention showed significant improvement in symptoms (HADS, anxiety and depression and CORE) and overall quality of life (WHODAS) from baseline to post-treatment. The study therapists reported that the adapted CCC formulation was simple, effective, and validated the patients' experiences well. This study adds to the body of knowledge supporting cultural adaptations of evidence-based therapies for diverse and minoritized ethnic groups.

ARTICLE HIGHLIGHTS

Research background

Currently, cognitive behavioral therapy (CBT) is one of the most common interventions implemented to treat symptoms of psychopathology of various illnesses. Standardised CBT manuals may not be completely relevant to all populations for several reasons including cultural and psychosocial variations.

Research motivation

Culturally adapted CBT could be beneficial to individuals of minority ethnic backgrounds as the contextual relevance may elevate the therapeutic benefit. Hence, this paper proposes a CaCBT-based third-wave therapy manual based on the Comprehend, Cope and Connect model.

Research objectives

This study aimed to test the feasibility, acceptability and adherence of the proposed intervention within ethnic minority participants who are currently engaged in Improving Access to Psychological Therapies' iTalk and Community Mental Health Team services that are part of the United Kingdom's National Health Service.

Research methods

In order to test the intervention, an uncontrolled feasibility study was deployed with 32 participants. Various outcome measures were recorded at three time points (baselines, post-intervention, and 12-wk follow-up).

Research results

A repeated measures analysis of variance revealed significant improvements in symptoms across Hospital Anxiety and Depression Scale depression and anxiety scores as well as the Clinical Outcomes in Routine Evaluation total score and World Health Organization Disability Assessment Schedule 2.0 measures.

Research conclusions

The results of this feasibility study reported that the CaCBT-based third-wave therapy was effective. Our results also showed significant adherence and acceptability among minority ethnic participants. Moderate effect sizes were reported with high participant satisfaction levels although a wider clinical trial will be required to fully assess the efficacy and effectiveness of the manual in the future.

Research perspectives

It would be important to further explore a randomised controlled trial as well as its' cost-effectiveness, overall benefit and scalability to a more diverse sample within the United Kingdom. This would aid in conducting wider global clinical trials to better understand the suitability of this adapted intervention.

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FOOTNOTES

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