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Clinical-Based and Expert Selection of Terms Related to Depression for Twitter Streaming and Language Analysis

Angela LEIS^a, Miguel-Angel MAYER^a, Francesco RONZANO^a, Marta TORRENS^{b,c}, Claudio CASTILLO^b, Laura I. FURLONG^a and Ferran SANZ^{a,¹}

 ^a Research Programme on Biomedical Informatics (GRIB), Hospital del Mar Medical Research Institute (IMIM) and Universitat Pompeu Fabra, Barcelona, Spain
 ^b Institute of Neuropsychiatry and Addictions, IMIM, Barcelona, Spain
 ^cPsychiatric Department of Universitat Autonoma de Barcelona, Spain

> Abstract. People use language to express their thoughts and feelings, unveiling important aspects of their psychological traits and social interactions. Although there are several studies describing methodologies to create a collection of words in English related to depression and other conditions, in most of them the selection of words is not clinical or expert based. The objective of this study is twofold: firstly, to introduce a comprehensive collection of Spanish words commonly used by patients suffering from depression, which will be available as a free open source for research purposes (GitHub), and secondly, to study the usefulness of this collection of words in identifying social media posts that could be indicative of patients suffering from depression. The level of agreement among medical doctors to determine the best words that should be used to select tweets related to depression was low. This finding may be due to the complexity of depression and the extraordinary diversity in the way people express themselves when describing their illness. It is critical to perform a thorough analysis of the specific language used in each condition, before deciding the best words to be used for filtering the tweets in each disease. As our study shows, the words supposedly more linked to depression are very common words used in other contexts, and consequently less specific for detecting depressive users. In addition, grammatical gender forms should be considered when analysing some languages such as Spanish.

Keywords. Depression, social media, surveys and questionnaires, terminology

1. Introduction

People use words to reflect their thoughts and feelings, revealing a huge amount of information about their personality and social interactions, as well as different psychological traits [1]. Language is the medium by which mental health professionals attempt to understand human beings and mental disorders. Several studies have found that linguistic styles are indicative of depressed mood [2]. Another interesting point is that people's language is stable over time and consistent across subjects or context; consequently, it can be used as a tool to measure differences among individuals [3].

¹ Corresponding Author: E-mail: ferran.sanz@upf.edu.

Several studies used social media platforms such as Twitter to analyze psychiatric symptoms and diseases, including depression [4,5]. Although these studies describe different methodologies to create a collection of words in English related to depression and other mental disorders, in the majority of them the selection of words were not extensive or clinical and expert-based [6,7]. In addition, Spanish speaking countries, such as Spain and Mexico, are among the ten countries with most Twitter users worldwide, with more than 6 million and 7 million users, respectively [8]. As far as we know, there are no studies focused on the creation of a list of words of depression in Spanish. The selection of the best terminology and keywords in any information system, including electronic health records, bibliographic databases or social media platforms, is critical for their usefulness in management and scientific research.

The objective of this study is twofold: first, to create a comprehensive collection of Spanish words commonly used by patients suffering from depression, which will be used for streaming Twitter and that is available as a free open source for research purposes in GitHub. Second, we determine the usefulness of the different words in identifying social media posts potentially related to depression.

2. Methods

The methodological approach consisted of three phases. The first phase consisted of the review of the most common tests and rating scales for assessing depression (using their Spanish version) in order to extract terms related to the expression of the depression symptoms. The different tests and rating scales analyzed are shown in table 1. The review was carried out by a psychologist and a family physician with experience in the clinical characteristics of depression, who reached an agreement on the words representative of the language used by depressive patients. The Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5) [9] was reviewed to complete the list. In this way, a list of 255 words was created.

Table 1. Tests and rating scales used for selecting words related to the expression of depression by patients (the Spanish versions were used)

Name of the tests and rating scales
Beck Depression Inventory (BDI)
Brief Symptom Inventory (BSI)
Carroll Rating Scale for Depression
Center for Epidemiologic Studies Depression Scale (CESD-R)
Clinically Useful Depression Outcome Scale (CUDOS)
Goldberg Depression and Anxiety scales (GADS)
Hamilton Rating Scale for Depression (HRSD)
Hospital Anxiety and Depression de Zigmond and Snaith (HAD)
Montgomery-Asberg depression rating scales (MADRS)
The Patient Health Questionnaire (PHQ-9)
Zung Self-Rating Depression Scale (SDS)

In the second phase, a questionnaire was created including the aforementioned list of words. The questionnaire was sent in December 2017 via email to 50 psychiatrists from the Institute of Neuropsychiatry and Addiction (INAD) of Parc Salut Mar in Barcelona and 5 family physicians from the Spanish National Health Service. The email included the purpose of the questionnaire, the guidelines for its completion and an Excel file with the words selected. A second email was sent as a reminder in February 2018. The objective of this questionnaire was to obtain a score that represented how well these words are related to depression, as described by patients explaining their symptoms in clinical settings. The score of a word was obtained by adding the scores provided by each rater using a Likert scale (1. never, 2. rarely, 3. occasionally, 4. frequently and 5. very frequently). Since 20 raters participated in the scoring process, the maximum value of the score was 100 points. The list of 255 words and their scores are available at GitHub for research purposes: https://github.com/angelaleism/WordsDepression.

Finally, the third phase involved streaming of tweets that included at least one of the 375 words (the list of 255 words plus their different plural and gender forms), which was carried using the Twitter Application Programming Interface (API) [10]. The streaming was set up between June and September 2018 obtaining 8,832,256 tweets. In order to compare the usefulness of the words to detect tweets with signs of depression, two sets of 500 tweets were randomly selected after retweets removal. One of the sets was created by including five subsets of 100 tweets, each one composed by tweets that included one of the five most highly scored words, and the second 500-tweet set included low scored words. The 1,000 tweets were manually reviewed by two experts to determine whether they were potentially indicative of depression or not. The R programming language was used for the statistical analyses.

3. Results

The questionnaire was answered by 30% of psychiatrists (15/50) and all the family physicians (5/5; 100%). The respondents were 13 women and 7 men. All the respondents rated the complete list of 255 words. The mean and SD of the scores of all the participants are shown in figure 1.



Figure 1. Distribution of the means and standard deviations (SD) of the 20 participants' scores

In order to assess the reliability of agreement among the raters, we calculated the intraclass correlation coefficients (ICCs) and the agreement among all the raters was 0.47, for the psychiatrists was 0.53 and for the family physicians was 0.37.

Based on the health professionals' scores, the 10 words in Spanish most frequently expressed by depressive patients were (the translation in English is in parenthesis): *deprimido/a* (depressed), *triste* (sad), *tristeza* (sadness), *desanimado/a* (downhearted), *depression* (depression), *depresivo/a* (depressive), *ansiedad* (anxiety), *cansado/a* (tired), *lloro* (crying), *insomnio* (insomnia). The 10 less frequent words were: *autocrítico* (self-criticism), *ingrato/a* (ungrateful), *misero/a* (vile), *languidez* (languid), *mutilado/a* (disabled), *apetencia* (hunger), *sombrío/a* (gloomy), *achacoso/a* (sickly), *desdeñado/a* (disdained), *lasitud* (weariness). It is necessary to take into account that in the translation

of these words into English there are some nuances that may be missing. There are some words that are more frequent in its feminine form on Twitter such as anxious, distrustful, distressed, insecure or shy and more frequent in masculine such as loser, solitary, incompetent or defeated.

Regarding the analysis of the tweets, table 2 shows the number of tweets that included the studied words, as well as the scores assigned to these words by the health professionals and the ranking of the words on the basis of the scores. In addition, the table shows the proportion of tweets for each word that were potentially indicative of depression when manually reviewed by an expert.

Word	Number of tweets	Score (Rank)	% depressive tweets
Deprimido/a	63,019	97 (1)	12%
Triste	56,776	97 (2)	5%
Tristeza	54,789	96 (3)	10%
Desanimado/a	24,079	94 (4)	23%
Depresión	51,408	92 (5)	12%
Infelicidad	12,116	63 (110)	4%
Suicida	42,615	57 (127)	1%
Vencido/a	43,020	52 (162)	3%
Melancolía	22,896	43 (194)	9%
Desdichado/a	4,663	41 (203)	9%

Table 2. Frequencies of words in the 8,832,256 tweets analysed, scores and proportion of depressive tweets

4. Discussion and conclusions

The diagnosis of depression is a complex process because of the heterogeneous nature of this disease, the lack of biological markers, the different symptoms among individuals and the diverse ways in which patients express those symptoms.

In relation with the scores assigned by the health professionals that participated in the survey, there was more agreement among the psychiatrists than among the family physicians. These results may be consistent with the fact that the psychiatrists deal with more patients with depressive disorders, and therefore, they are more familiar with the language used by patients with depression. As a result, the agreement between psychiatrists and family doctors is low. This finding may be due to the extraordinary diversity in the way people express themselves when describing their illness, the complexity of depression [9], how health professionals interpret these words for making a diagnosis and their clinical experience. For this reason, it is critical to perform a thorough analysis of the specific language used in each condition, before deciding the most suitable words to be used for filtering the tweets in each disease [2]. As our study shows, the words supposedly more linked to depression are very common words used in other contexts on Twitter, and consequently less specific for detecting depressive people (e.g. triste/sad). On the other hand, words less frequently mentioned on Twitter can have more weight to link them to depression or suicide tendency (e.g. desanimado/ downhearted). The gender of words should be always considered when analyzing some languages that have grammatical gender forms such as Spanish.

Nevertheless, the analysis of words related to depression also require us to consider other aspects such as the linguistic features (i.e. the different use of personal pronouns, the number of negative words and the expressions associated to the basic emotions) and the behavioral patterns (i.e. the distribution of tweets over time and the number of characters or hashtags per tweet) [5]. However, the extensive list of words provided in this study can be used as a basis for developing new studies and strategies for the analysis of depression on Twitter in Spanish. Patients can be monitored, introducing new opportunities for studying depression and providing additional health services.

This study presents some limitations. On the one hand, the tweets can be considered an indirect and inaccurate way of detecting users suffering from depressive disorders and it is not possible to verify whether the diagnosis is genuine or not. On the other hand, although the list of words was carefully developed, there may be more expressions or words not included in the list.

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