An Overview of Factors Associated with Adherence and Dropout to Ecological Momentary Assessments in Depression

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Abstract. The use of technology-based Ecological Momentary Assessments (EMAs) allows to repeatedly assess patients during daily life, in naturalistic settings and in precise moments of the day. To date, EMAs have been broadly adopted for the investigation of Major Depressive Disorder (MDD). Nevertheless, adherence still represents a clinical challenge, as depressed patients may be less prone to regularly complete daily reports. Through a systematic narrative review, we qualitatively investigated factors affecting adherence and dropout of MDD patients to EMA protocols. The mean adherence rate across studies was generally encouraging (mean: 80.66%, SD 11.71%), and was higher in studies collecting self-reports by means of smartphones, prompting patients less than 8 times per day and using a prefixed sampling method. Dropouts were mainly related to technical problems or under-threshold number of collected answers, often occurring in studies collecting data by means of Personal Digital Assistants (PDAs). The implications of these results are discussed.

Keywords. Ecological Momentary Assessment, Major Depressive Disorder, mHealth, Adherence, Dropout

1. Introduction

According to the last estimates of the World Health Organization, Major Depressive Disorder (MDD) is one of the leading causes of disease and disability in the world, affecting approximately the 4.4% of the general population [1]. Notably, many of these patients do not receive an adequate assessment and, consequently, suitable psychological support [2]. In that sense, the clinical field tried for a long time to shed light upon new possible techniques to provide innovative self-help and low-cost ways

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for symptoms monitoring. Our current knowledge about MDD is mainly based on studies conducted in laboratory settings and on the retrospective recall of symptoms. On the one hand, there is evidence showing that depression is a dynamic disease, characterized by large symptoms fluctuations over time [4]. On the other hand, the recall of thoughts, feelings and behaviors was shown to be strongly biased by the time elapsing between real experiencing and retrieval [5]. Accordingly, the need for a more ecological understanding of depression and its underlying mechanisms is raising increasing interest. Ecological Momentary Assessments (EMAs) represent an innovative method for the repeated assessment of patients during daily life [6]. Originally administrated by means of paper-and-pencil daily diaries, EMAs subsequently started to be digitalized and provided to patients on Personal Digital Assistants (PDAs) or smartphones, in which all the needed processes could be easily included (i.e. signaling, data collection, data storage and transfer) and further integrated with the use of data from sensors and biosensors [7]. An increasing body of studies adopted EMAs for a more ecological investigation of different conditions, including depression [8,9]. Nevertheless, no specific guidelines have been proposed. Above all, the commitment required to constantly complete daily assessments may result in low adherence, i.e. a low percent of completed surveys. Especially when dealing with depression, the lack of energy and motivation that typically characterize this disease are likely to increase the number of patients dropping out from such studies, or to decrease their compliance to the procedure. The aim of this narrative review is to investigate factors that are likely to influence adherence and dropout rates of depressed patients in technology-based EMA protocols.

2. Method

2.1. Search Strategy

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines [10]. To collect relevant publications, the following string was used in two high-order databases, PubMed and Web of Science: ((EMA) OR (“ecological momentary assessment”) OR (“mobile health”) OR (mHealth) OR (smartphone) OR (ESM) OR ("experience sampling method") OR ("ambulatory assessment") OR ("personal digital assistant") OR ("ambulatory monitoring") OR ("real time data capture") OR (“real time monitoring”) OR ("electronic diary")) AND ((depression) OR (MDD) OR (“major depressive disorder”) OR (“unipolar depression”)). The search was performed by two individual researchers (D.C. and J.F.A.) for publications in English language. Based on that string, 3684 articles were retrieved (PubMed: n=1792; Web of Science: n=1892). After a first selection based on the deletion of duplicate papers and of the analysis of titles and abstracts, a total of 84 articles were retrieved. After applying the inclusion/exclusion criteria (excluded papers: type of manuscript, n=13; EMA as an adjunctive therapeutic tool, n=3; sample criteria, n=33; lack of data on adherence rate, n=11; paper-and-pencil EMAs, n=11), 13 articles were included.

2.2. Inclusion/exclusion criteria

We considered studies adopting technology-based EMAs for the investigation and/or assessment of clinical and mental-health related variables in a sample of adults (≥ 18 years old) with a primary diagnosis of MDD, defined by a valid criterion standard. Only studies reporting compliance rates (i.e. percent of completed surveys across the duration of the study) were included. When available, dropout rates were also considered. We excluded from the analysis non-English papers, studies that omitted the inclusion criteria and did not have an available full-text. Moreover, we excluded the following types of manuscripts: Conference papers, reviews, case reports, letters to the editor, extended abstracts, proceedings, editorials and other editorial materials.

2.3. Quality Assessment

To control for the risk of bias, PRISMA recommendations for systematic literature analysis were strictly followed [10].

3. Results

3.1. Adherence

Among the selected studies (see Table 1), the overall adherence to EMA protocols ranged between 64.5% and 96.05% (n=13, mean 80.66%, SD 11.71%) (Figure 1).

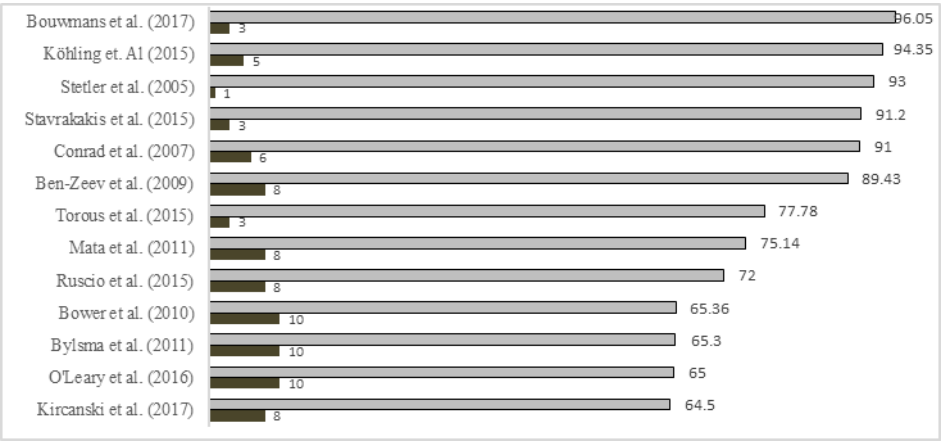

Figure 1. Adherence rates (light grey) and number of daily prompts (dark grey) of the selected studies.

Most of the included studies adopted a PDA for the daily completion of self-reports; only four studies were conducted with the use of a smartphone. Interestingly, smartphone-based EMAs could achieve higher adherence rates (PDAs: n=11, mean 76.02%, SD 10.98%; Smartphones: n=4, mean 89.85%, SD 7.18%). Compensation for participating in the protocol did not particularly influence the adherence of users (compensation: n=8, mean 81.92%, SD 10.27%; without compensation: n=5, mean

76.94%, SD 14.39%). Taking into consideration sampling methods, adherence rate was quite similar between studies adopting semi-randomized and randomized samplings (Semi-randomized: n=6, mean 74.27%, SD 13.20%; Randomized sampling: n=4, mean 79.82%, SD 8.64%). On the contrary, studies adopting a prefixed schema could achieve higher compliance (mean 91.73%, SD 0.90%). While the total duration of the protocol did not seem to affect participants' compliance, studies with a lower number of daily prompts obtained higher adherence: Generally, when 8 or more daily assessments were required, a higher number of missing answers were likely to be reported (see Figure 1). Finally, we considered the effect of the number of items composing each single daily assessment on adherence. As it was not possible to obtain the exact items count, we divided studies in 4 categories (<10 items; between 11 and 15 items; between 16 and 20 items; >21 items). Just a slight decrease in adherence was observed in correspondence to the increase of the number of items, especially when assessments were composed by more than 20 questions (10 items: n=2, mean 84.39%, SD 6.61%; between 11 and 15 items: n=2, mean 84.75%, SD 9.61%; between 16 and 20 items: n=3, mean 83.61%, SD 13.19%; >20 items: n=6, mean 75.17%, SD 12.24%).

Table 1. More detailed information about the selected studies. vNote: SR: Semi-randomized; P: Prefixed; R: Randomized; P: Personal Digital Assistant; S: Smartphone; MDD: Major Depressive Disorder; HCG: control group; BPD: Borderline Personality Disorder; GAD: Generalized Anxiety Disorder; mD: minor Depression.

Study	Sample size	Adherence (%)	Sampling	Device	Duration (days)	Prompts	Money	N° items
[1]	MDD (n=27), HCG (n=27)	96.05	SR	S	30	3	No	16-20
[2]	MDD (n=21), MDD + BPD (n=20)	94.35	R	S	7	5	Yes	11-15
[3]	MDD (n=37), HCG (n=36)	93	P	P	3	1	No	>21
[4]	MDD (n=10), HCG (n=10)	91.2	P	S	30	3	Yes	>21
[5]	MDD (n=46), HCG (n=19)	91	P	P	1	6	Yes	<10
[6]	MDD (n=26), HCG (n=25)	89.43	SR	P	7	8	Yes	16-20
[7]	MDD (n=13)	77.78	R	S	29.4	3	Yes	<10
[8]	MDD (n=53), HCG (n=53)	75.14	R	P	7	8	Yes	11-15
[9]	MDD (n=38), GAD (n=36), MDD + GAD (n=38), HCG (n=33)	72	R	P	7	8	Yes	>21
[10]	MDD (n=35), mD (n=25), HCG (n=36)	65.36	SR	P	3	10	No	16-20
[11]	MDD (n=35), mD (n=26), HCG (n=38)	65.3	SR	P	3	10	No	>21
[12]	MDD and mD (n=60), HCG (n=35)	65	SR	P	3	10	No	>21
[13]	MDD (n=16), GAD (n=15),	64.5	SR	P	6.5	8	Yes	>21

	MDD + GAD (n=20), HCG (n=19)

3.2. Adherence

Eleven out of thirteen selected studies reported the main reasons for dropout, that included: Technical problems, data lost, change in diagnosis, backfilling, under-threshold number of answered prompts, time/scheduling difficulties. The two most frequent problems, reported in six of the thirteen included studies [11,18,19,22–24], were the occurrence of technical problems and the collection of a too low number of self-reports. Six out of these seven studies adopted a PDA rather than a smartphone and prompted participants 8 or more times per day.

4. Discussion

Despite that technology-based EMAs have been widely used for the understanding and assessment of depression, no study specifically focused on features that could improve patients' adherence to EMA protocols.

According to our results, participants complete more self-reports when allowed to use their own smartphone rather than an additional external device. Consistently, the use of smartphones for the daily administration of EMAs seems to be associated not only with higher adherence, but also with lower technical problems and under-threshold number of answered prompts, i.e. the two main reasons for dropout. Currently, 2.32 billion people in the world are using smartphones and it is estimated that by 2020 the 70% of the world's population will own one, suggesting the potential of this device for the research and clinical field [25]. Familiarity with smartphones as well as their current integration into our daily life could therefore encourage adherence to EMAs' protocols. Secondly, the number of daily prompts seems to play a key role both for adherence and dropout. Our results suggest indeed that a high number of daily assessments could be perceived as too invasive and demanding and decrease participants' compliance to the protocol. Finally, studies adopting a prefixed sampling schema reported higher rates of compliance, probably because users were already expecting the time of the prompt. Nevertheless, the use of randomization should always be taken into consideration when investigating variables with high daily fluctuations.

Notably, other variables could play a fundamental role in increasing adherence and decreasing dropout rates to EMA protocols, including the administration of a training before the beginning of the experiment, the ability of researchers/clinicians in motivating patients' participation, data safety issues and the usability/engagement of the adopted device and/or mobile application. In the future, a meta-analysis could help to better clarify the features associated with adherence and dropout in EMA protocols for MDD.

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