



Using Intensive Longitudinal Data to Study Treatment Effects in Patients with Major Depression: A Systematic Review

Cajsa Jonasson

Lund University, Lund, Sweden

Email address:

cajsa.jonason@gmail.com

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Abstract

Depression is a disabling condition, causing suffering worldwide. The purpose of this paper is to review studies that have used Intensive Longitudinal Data (ILD) in research on depression treatment. Intensive longitudinal data in the form of daily diaries, experience sampling method (ESM), and ecological momentary assessment (EMA) are increasingly used in psychotherapy research to gather individualized data. A systematic search was conducted in the research databases PsycINFO, PubMed and Scopus on depression treatment assessed with ILD methods. Seven studies met inclusion criteria; two focused on the effects of cognitive therapy/cognitive behavioral therapy (CBT)/Self-System Therapy (SST); one focused on the effects of physical exercise; and four examined ESM as an add-on intervention to pharmacological treatment. ILD is useful when studying changes in complex patterns of patients' functioning, such as daily affective reactivity, empowerment, daily dose-response effects of physical activity on PA, and associations between activity and depressive symptoms. Results also showed that ESM registration in itself can help patients with major depression (MDD) to engage more in physical and social activities and to spend less time alone or resting.

Keywords: depression; psychological treatment; intensive longitudinal data; systematic review

Many treatments for depression seem to be equally effective (Cuijpers, 2017), even though they are theoretically and clinically disparate. Does this mean that they share the same underlying therapeutic mechanisms, or do treatments work in fundamentally different ways, all initiating different recovery processes?

One way to get a better understanding of what works therapeutically is to use Intensive Longitudinal Data (ILD) in the form of Experience sampling (ESM), Ecological momentary assessment (EMA) and daily diaries (Csikszentmihalyi, Larson & Prescott, 1977). ESM has traditionally been used to assess individuals in their natural environments (Mokros, 1993) by asking participants to carry mobile devices (e.g., smart phone, wristwatch, tablet, or pager) that signals randomly throughout the day. When the device beeps, one is encouraged to rate items on affect, activity and context (Csikszentmihalyi & Larson, 1987).

Ecological momentary assessment is in many aspects synonymous with ESM but has traditionally been used more in the discipline of medicine and for assessing behaviors together with physiological variables (Shiffman, Stone, & Hufford, 2008).

Because of its ability to explore how multiple variables interact dynamically, ILD has become increasingly popular in psychological research (Bolger & Laurenceau, 2013) and is suitable for determining the temporal order of events (Molenaar, 2015) as it can follow changes from moment to moment. ILD offers the possibility to combine between- and within-subjects levels of analysis. The methodological risk with relying only on between-group measurements is otherwise that individual differences can disappear in the aggregated data of means and effect sizes (Molenaar, 2015). On the other hand, studies that only focus on intra-individual variation risk losing generalizability.

ILD has demonstrated good reliability and validity (Csikszentmihalyi & Larson, 1987) and has been useful in multiple areas of psychology (e.g., personality and social psychology) as well as for assessing and treating mental illness (aan het Rot, Hogenelst, & Schoevers, 2012). In an ILD study on a non-clinical sample, Garland, Geschwind, Peeters and Wichers (2015) used ESM to examine how Mindfulness-Based Cognitive Therapy (MBCT) affected the interaction between cognition and positive affect (PA) in individuals with residual symptoms from earlier depressions. Results showed that MBCT participants experienced a significant increase in positive cognition and PA from pre- to post-assessment. The authors concluded that daily positive affect and cognition seemed to be driven by a stable, trait-like component in the form of a self-reinforcing positive affect cycle that might be promoted by mindfulness training. This indicates that ILD is useful for studying dynamic within-person processes involved in treatment and its effects.

There are earlier reviews on depression assessed with ILD (aan het Rot et al, 2012; Ebner-Priemer & Trull, 2009; Pemberton & Tyszkiewicz, 2016; Telford, McCarthy-Jones, Corcoran & Rowse, 2012). Still, aan het Rot et al. (2012) is the only review that has focused on depression treatment assessed with ILD. Their review covers important areas of ESM/EMA-research, such as residual symptoms in remitted patients; pharmacological treatment, bipolar disorder, treatment for the pediatric population and the neuroscience of mood disorder patient's everyday life. To sum up; ILD have been used in many different ways including the study of outcome, the study of predictors of outcome, and the study of processes during treatment. The aim of this current paper is to review studies of treatment effects in patients with major depressive disorder (MDD) that have been conducted with ILD methods.

All ILD studies were considered to be of interest as long as at least one treatment arm is a psychological treatment for depression. Treatment is here defined in a wider sense than only psychotherapy, including physical exercise and self-initiated activities. As measures of treatment effects depressive symptoms or other emotional-cognitive or behavioral aspects of depression were accepted.

Method

Inclusion criteria

The following inclusion criteria were used: (1) Treatment studies where at least one treatment-arm is a psychological intervention; (2) Focus on treatment effects rather than on predictors for treatment effects; (3) Daily assessment, with a minimum of five assessments per week, was chosen to receive enough density of data to model distinct daily change; (4) Patients meeting diagnostic criteria for major depressive disorder (MDD), according to DSM-IV or DSM-V; (5) Original study published in English, from

1995 and onward; (6) Adults (>18 years).

Search strategy

The search was conducted up until September the 24th 2017 in the research databases PsycINFO (EBSCOhost), PubMed and Scopus. The search was executed in blocks containing the terms: (“idiographic” OR “person-oriented” OR “experience sampling” OR “ecological momentary assessment” OR “daily diary” OR “electronic diary” OR “intensive longitudinal” OR “time series” OR “ambulatory monitoring” OR “within-subjects”) AND (“depression” OR “major depression OR depressive disorder OR major depressive disorder”) AND (“treatment” OR “therapeutic process” OR “evaluation” OR “intervention” OR “treatment outcome”) in the title, abstract or as Keywords. Studies were screened by abstract and by full text and included if they contained terms from all three blocks (depression, treatment, and ILD). Additionally, a manual examination of reference lists was conducted as well as a screening on the website Society for Ambulatory Assessment (SAA) to find articles missed in the database search. The search process is presented in figure 1 below.

A total of 62 articles was initially retrieved and screened. After reading title and abstract 29 of these were excluded because they focused on other disorders than depression or did not include any psychological treatment. The remaining 33 articles were examined in full text, and an additionally 28 articles were excluded because they did not reach up to the minimum of five assessment points a week or because they studied predictors rather than outcome.

A second search was done on the 11th of November 2017 that retrieved 51 additional articles. After screening and reading these in full text, two additional articles were added to the five from the earlier search. In total, seven articles are included in the present review. Table 1 shows country, year, population, design, treatment form and main findings.

Results

The seven articles obtained in the searches covers a variety of different interventions. One studies the effects of cognitive therapy; one compares Cognitive Behavioral Therapy (CBT) to Self-System Therapy (SST); and one examines physical exercise as an intervention. Finally, four articles study ESM as an add-on intervention to pharmacological treatment.

Six of the seven papers used ambulatory ESM technology (Eddington et al., 2017; Hartmann et al., 2015; Kramer et al., 2014; Mata et al., 2012; Simons et al., 2015; Snippe et al., 2016), whereas one used nightly diaries (Parrish et al., 2009). Four of the articles were based on the same set of data (Hartmann et al., 2015; Kramer et al., 2014; Simons et al., 2015; Snippe et al., 2016), whereas the three remaining articles were from independent datasets (Eddington et al., 2017; Mata et al., 2012, Parrish et al., 2009).

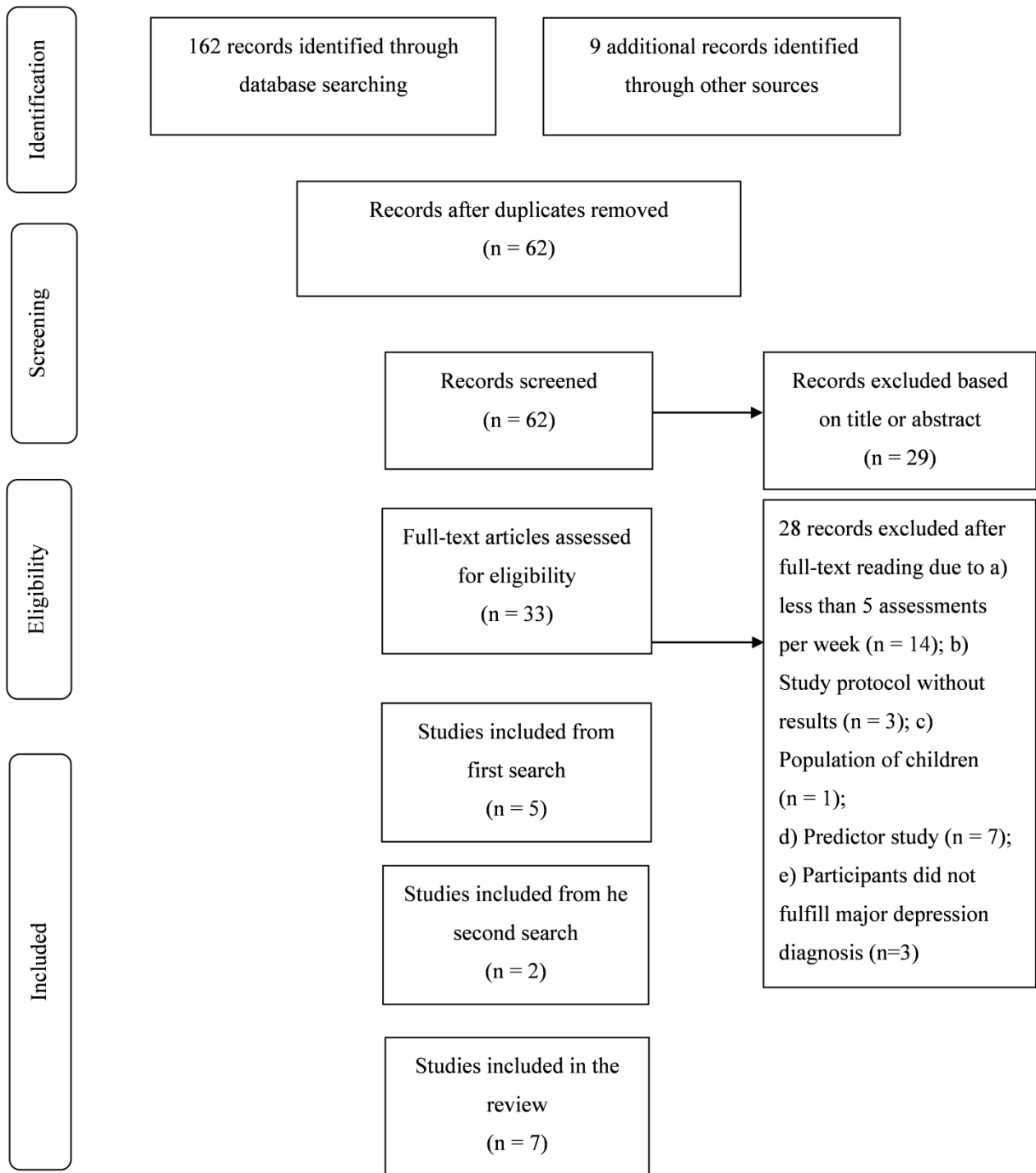


Figure 1. Prisma flowchart

Table 1. *Summary of included articles*

Author and country	Samples	How were ILD data collected?	Treatment	Main findings
Hartmann et al. (2015) The Netherlands, Belgium, UK	Outpatients (n=33), pseudo-experimental group (n=36) and control group (n=33)	ESM device PsyMate signaled at random moments for 6 weeks	ESM self-monitoring with PA feedback for 6 weeks	PA-focused feedback did not significantly impact daily life PA during or shortly after the intervention
Eddington et al. (2017) US	Depressed patients (n=56), SST group (n= 27), CBT group (n =29)	IVR-system (for ESM-data collection) called at 8 random times a day for 7 days pre and post treatment	16 sessions of SST or 16 sessions of CBT	Results after treatment were similar in the SST and CBT groups with broad improvements in all areas (mood and stress reactivity) with the exception of social functioning
Kramer et al. (2014) The Netherlands, UK	Outpatients from mental health care facilities. Experimental group (n=33), pseudo-experimental group (n=36) and control group (n=33)	ESM device PsyMate signaled at random moments for 6 weeks	ESM self-monitoring with PA feedback for 6 weeks	ESM-derived feedback resulted in a decrease in depressive symptoms
Mata et al. (2012) US	Outpatients from around the university, experimental group (n=53) and control group (n=53)	ESM Palm pilot prompted randomly 8 times a day for 7-8 days	Physical activity for 7 days	Depressed participants showed a dose-response effect of physical activity on positive affect, but not on negative affect. Longer duration and higher intensity of physical activity increases PA most
Parrish et al. (2009) US	Outpatients from Beck Institute. Experimental group (n=54)	Daily diary at the end of the day/ 2 weeks	6 sessions of CT	CT showed positive effects on daily measures of PA, NA and stress reactivity
Simons et al. (2015) Australia, the Netherlands, and UK	Outpatients. Experimental group (n=33), pseudo-experimental group (n=36), control group (n=33)	ESM device PsyMate signaled at random moments for 6 weeks	ESM self-monitoring with PA feedback for 6 weeks	ESM registration of affect, context and activity has a positive effect on empowerment, even if feedback is left out
Snippe et al. (2016) Australia and the Netherlands	Outpatients. Experimental group (n=33), pseudo-experimental group (n=36), control group (n=33)	ESM device PsyMate signaled at random moments for 6 weeks	ESM self-monitoring with PA feedback for 6 weeks	Increase in physical activity and talking was associated with reduction in depressive symptoms. Within-person daily fluctuations in talking, physical activity, doing nothing/resting, and being alone predicted end-of-day depressive symptoms

ESM= Experience sampling method; PA = positive affect; CBT = Cognitive Behavioural Therapy; IVR= Interactive voice response system; SST = Self-System Therapy; CT = cognitive therapy; NA = negative affect.

The seven articles were divided into three different groups contingent on intervention method: cognitive therapies, physical exercise, or ESM as an add-on intervention to pharmacological treatment.

Cognitive therapies

Parrish et al. (2009) examined how the daily affective reactivity of 54 adult patients with MDD was changed by six sessions of cognitive therapy. Participants completed nightly diaries via automated phone interviews, using an interactive voice response (IVR) system, on seven consecutive nights before the start of treatment, and on seven consecutive nights after the sixth session. The nightly diaries contained questions from the Positive and Negative Affect Scale - Expanded Form (PANAS-X) (Watson & Clark, 1994), focusing on the subscale “sad affects” (SA) and “positive affects” (PA), and questions about positive and negative daily events, including the day’s most stressful event and negative thoughts. The researchers computed within-person indexes of the relationship between number of negative events and daily affect to get a measure of daily affective reactivity (PA and SA reactivity).

The six weeks of treatment led to considerably decreased depressive symptoms and less dysfunctional attitudes. The daily diaries showed increased average scores on daily PA and a decrease on daily SA, as well as a decrease of daily negative thoughts. On the within-person indexes the results showed a decrease in the participants’ daily SA reactivity to negative events, which the authors interpreted as evidence of an improved ability to regulate SA in the face of daily stress. Interestingly they also found a slight increase in the participants’ daily SA reactivity to negative thoughts – in combination with their decrease in number of event-related negative thoughts. This means that they had stronger emotional reactions to the few negative thoughts that were left. The authors suggested that this increase in the patients’ SA reactivity to daily negative thoughts might be due to their greater attention to these thoughts as they engaged in the cognitive treatment. In contrast to the authors’ hypothesis, participants’ reactivity to positive events did not increase.

Eddington et al. (2017) compared the effects of Self System Therapy (SST) to Cognitive Behavioural Therapy (CBT) in an ESM study. SST was originally developed for individuals with deficits in self-regulation and goal pursuit. It encourages patients to set treatment goals and to implement them in their everyday lives to improve their ability to self-regulate (Vieth et al., 2003). CBT also involves goal setting, together with a broad spectrum of additional cognitive and behavioral interventions (Beck, 2011). Even though SST has a stronger emphasis on self-regulation, both therapies are oriented toward developing skills to solve current problems and concerns (Eddington et al., 2015).

All participants were assessed for MDD before inclusion and randomly assigned to either 16 sessions of SST (n=27) or CBT (n=29). ESM assessments were conducted for a week at baseline and repeated for 7 days post-treatment.

The IVR-system randomly called and prompted them to answer questions about their activities and emotional functioning eight times per day. Participants were asked to rate items about their cognitions, PA, NA, current activity, social and physical functioning and stressful situations. They rated the items by choosing the corresponding number on their mobile-phone key-pads. Results after treatment were similar in the SST and CBT-groups with broad improvements in all areas, with the exception of social functioning, where change on only one item was close to significant: “I am alone right now because people do not want to be with me”. Positive mood items such as “I feel confident” and “I feel good about myself” showed the biggest improvements. Results also showed that participants diminished their reactivity to stressors - which was interpreted as increased resilience - whereas changes in reactivity to positive daily situations were minimal.

Physical exercise

Mata et al. (2012) used ESM (palm-pilots) to examine the association between self-initiated physical activity and affect during a one-week period. Their participants were 53 patients diagnosed with MDD and 53 never-depressed controls who were prompted randomly eight times per day to answer questions about their physical activity and affective state. PA and NA were assessed by asking participants to rate each of 11 statements (seven negative and four positive) on a 4-point scale. The positive affect (PA) items were “happy”, “excited”, “alert” and “active.” Physical activity was assessed by asking the participants at each prompt whether they had been physically active since the last beep. If they answered yes, they were asked to respond to three follow-up questions: (1) “How long were you active?” with options from 5 to 120 minutes; thus, shorter bouts of activity were not counted; (2) “What kind of activity did you engage in?” with options of “mild activity” (e.g., yoga), “moderate activity” (e.g., fast walking), and “strenuous activity” (e.g., running), and (3) “What activity did you engage in?” where the participants could pick from a list activities.

The result showed that, although the depressed participants reported significantly lower PA and significantly higher NA over the experience sampling week than the controls, they did not differ in their overall level of physical activity. Both groups reported higher levels of PA after physical activity than after inactive periods. In line with the authors’ hypothesis, depressed participants showed a dose-response effect of physical activity and PA, where higher intensity and longer duration (measured in METminutes, according to standards in the International Physical Activity Questionnaire; Craig et al., 2003) predicted higher PA. This effect showed much weaker in the healthy controls.

Surprisingly there was no association between exercise and NA in either depressed or non-depressed participants. The authors commented that the association between physical exercise and PA, but not with NA, in MDD patients

“adds to a growing literature documenting the importance of PA in depression, perhaps to an even greater extent than NA” (Mata et al., 2012, p. 305).

ESM as an intervention method

Four articles (Hartmann et al., 2015; Kramer et al., 2014; Simons et al. 2015; Snippe et al., 2016) examined ESM as an ad-on intervention to pharmacological therapy. All four articles were based on the same ESM-assessment study. In total, 102 patients with major depression were randomized into three treatment arms: experimental, pseudo-experimental and a control group. ESM assessments were conducted at baseline, during the six-week intervention period, and at week seven. There were also five follow-up assessments (week 8, 12, 16, 20 and 32). All three groups received pharmacological treatment, but the experimental and pseudo-experimental group also used an ESM-palmtop called PsyMate that gathered information 3 days a week over a 6-week treatment period. PsyMate was programmed to emit a beep 10 times per day at random intervals. At each such beep, participants were to digitally complete a brief questionnaire about current positive and negative affect (four positive and six negative items), as well as current context and activities. The experimental group additionally engaged in weekly feedback sessions, face to face with one of the researchers, where they received information on their personalized patterns of positive affect (PA) verbally, graphically and in writing. This feedback included (1) actual levels of PA in the context of daily life activities, events, and social situations, and (2) changes in PA level and the number of depressive complaints during the six weeks of treatment.

The results showed that getting feedback led to a decline in depressive symptoms. This positive change started three weeks after the end of the intervention and became successively stronger during the follow-up period. After six months there was a significant between-group difference showing a 5.5-point larger reduction on the Hamilton Depression Rating Scale (HDRS; Hamilton, 1960) for the experimental group, as compared to controls (Kramer et al., 2014). Although the pseudo-experimental group (which received a weekly structured conversation with the researcher instead of PA-feedback) showed an initial decrease in depressive symptoms, this did not last. At the end of the study the experimental group showed clinically relevant lower depression scores (more than three points lower on the HDRS) than the pseudo-experimental group. Kramer et al. (2014) concluded that the efficacy of pharmacological treatment of major depression can be enhanced by using personalized PA-feedback.

Hartmann et al. (2015) analyzed the same data as Kramer et al. (2014) with a focus on how PA-feedback affected daily PA levels. Their hypothesis was that the experimental feedback condition, compared to the pseudo-experimental and control condition, would be associated with an increase

in PA both during and shortly after the intervention. The results, however, showed no such effect. In their discussion they acknowledged that the difference in results from Kramer et al. (2014) could be due to the shorter assessment period in which the ESM measurements took place (i.e., during treatment and one-week post-treatment only, in contrast to the effects on depressive symptoms which started three weeks post-treatment and continued to increase during the 6-month follow-up period).

Simons et al. (2015) examined how patient empowerment was affected by ESM-personalized feedback. They used the 40-item self-rating scale Dutch Empowerment questionnaire (Boevink, Kroon, Giesen, 2008) during screening and at post-assessment (week 7). The questionnaire contained items formulated as positive statements about professional help, social support, own wisdom, sense of belonging, self-management, and community inclusion. Participants rated the items from strongly disagree (1) to strongly disagree (5). As described above, the ESM procedure with PsyMate meant that the experimental group engaged in weekly feedback sessions about their personalized patterns of activity, context and affect, while the pseudo-experimental group only got weekly structured conversations with the researcher. The pre- and post-intervention data on empowerment was clustered within participants in the statistical analyzes. Both within- and between-group effects were calculated for the 87 patients (of the 102 that originally entered the study) who completed both pre- and post-empowerment questionnaires. The results were nevertheless inconclusive as the biggest improvement in empowerment was seen in the pseudo-experimental group and not in the experimental group. This may suggest that ESM self-monitoring may enhance empowerment while feedback per se doesn't increase the effect further.

Snippe et al. (2016) used data from the same study as above but with a focus on daily life behaviors. For this purpose, they examined both between-person and within-person associations between daily life behaviors (i.e., social, physical, sedentary, leisure time) and daily depression (as measured by the Symptom Check List-90-Revised [SCL-90-R; Derogatis, 1994] which the participants were asked to complete at the end of each ESM day). Between-person analyses showed that patients with larger treatment effects on HDRS from baseline to post-treatment also tended to show larger increases on the ESM measures of “talking” and physical activity from baseline to post-intervention. Within-person assessments over the course of the 6-week intervention showed that symptoms of depression were lower on days when participants had been more physically active or talked more. As to the effects from baseline to post-treatment, the results showed that self-monitoring (either with or without PA-feedback) significantly increased “talking”, while participants spent less time “doing nothing/resting” or “being alone”.

Although Snippe et al. (2016) found that heightened activity and talking generally predicted less depressive

symptoms, there were also big individual differences. To acquire a better understanding of these individual differences they suggested the future use of individual time-series analyses. They pointed out that such individual differences indicate a need for personalized interventions; that is, not all depressed individuals may benefit equally from the same interventions.

Discussion

ILD have been used to generate outcome measures of daily positive and negative affect (Eddington et al. 2017; Hartmann et al., 2015; Parrish et al., 2009), as well as physical activity and other life behaviors (Mata et al., 2012; Snippe et al., 2016). It has also been used to study changes in more complex patterns of patients' functioning, such as daily affective reactivity, computed as level of affect in relation to number of negative events (Parrish et al., 2009), empowerment (Simons et al., 2015), daily dose-response effects of physical activity on PA (Mata et al., 2012), and associations between life behaviors and depressive symptoms on a daily basis (Snippe et al., 2016).

Two of the seven papers explicitly supported associations between heightened activity and decreased levels of depression (Mata et al., 2012; Snippe et al., 2016). Mata et al. (2012) showed that exercise performed at a higher intensity and frequency was associated with heightened PA. Snippe et al. (2016) showed decreased levels of depressive symptoms when patients engaged in physical activities or talking and increased depressive symptoms when resting or being alone. Interestingly, there seemed to be considerable individuality in how activity affected depressive symptoms (Snippe et al., 2016).

To get a better understanding of individual differences in treatment effects, Snippe et al., (2016) suggested the use of individual time-series analyses. This is something that Lévesque (2004) gives example of in their study on depression in women with breast-cancer. Lévesque et al., (2004) used an interrupted time-series approach where each participant is presented with their own time-series depicted on a graph. This way one can see where in time change occurs and combine this with data about which treatment module or intervention is in progress.

The seven articles in this paper varied in when and how often they conducted ESM assessments. Four articles (Hartmann et al., 2015; Kramer et al., 2014; Simons et al. 2015; Snippe et al., 2016) performed ESM-assessments three times; at baseline, during the six-week intervention period, and at week seven; two studies performed ESM-assessments before and after treatment (Eddington et al., 2017; Parrish et al., 2009) and one study (Mata et al., 2012), only during treatment. A relevant question is if this means that they are measuring two different constructs; treatment effects and processes in treatment? The purpose seem to be similar though, as Mata et al. (2012) who only performed assessments during treatment were examining

which effect the intervention (physical exercise) has on positive and negative affect, just as the other studies aimed to do with their pre- and post-assessments. Even if there is an important methodological difference in assessment methodology, all the gathered assessment-data seems to add knowledge about what works therapeutically.

Several of the studies focused on changes in daily PA, NA and SA after treatment, but the effects did not always converge. Eddington et al. (2017) saw that PA changed the most after treatment while changes in NA were more modest. Parrish et al. (2009) found an increase in daily PA and a decrease in daily SA, as well as a decrease in SA reactivity to daily stressors after treatment; in addition, somewhat surprisingly, they also found an increase in SA reactivity to negative thoughts after treatment. Mata et al. (2012) on the other hand, saw that self-initiated physical activity heightened PA, without any considerable changes in NA. Further, Hartmann et al. (2015) got non-significant results when studying the effects of PA-feedback on daily PA, one-week post-treatment. This suggests that short-term effects on PA and NA are probably not a common underlying process in the successful treatment of major depression but are effects that may vary depending on contextual factors, including type of treatment.

In the study by Kramer et al. (2014) patients engaged in weekly feedback sessions where they received information on how their activities had affected PA. The results showed that an effect appeared a few weeks after the end of treatment which continued to grow during the ensuing 6-month follow-up period. At the same time, it is worth noting that Hartmann et al.'s (2015) analyses of data from the same study did not reveal any positive effects on daily life PA during treatment or directly after treatment as a result of this feedback intervention. In the study by Simons et al. (2017) the biggest improvement (measured as increased empowerment) was seen in the pseudo-experimental group – a group that did not receive feedback, only structured interviews with a researcher. This may suggest that ESM self-monitoring may enhance empowerment while feedback per se doesn't increase the effect further. The authors discuss that "self-monitoring may allow patients to be more mindful of affective states", but they can't exclude that the structured weekly sessions with the researchers were behind the increased feeling of empowerment. This could mean that registration of affect, context and activity can have a positive effect in itself, whereas feedback doesn't add substantially to the ameliorating effect. It could also mean that the support offered in the weekly sessions was enough to affect the individuals positively.

Limitations and need for further research

The most obvious limitation is the small scope of articles, which was a consequence of the strict inclusion criteria. With less strict criteria more studies could have been included; however, this would have produced a more hetero-

geneous group of studies. Another limitation is that only two of the included studies relied on evidence-based forms of psychotherapy (CBT), whereas the other studies focused either on physical exercise or on ESM-derived feedback.

On the other hand, it might be argued that the inclusion criteria could have been even stricter, for example by only including studies that used ESM or EMA. One of the strengths of ILD, compared to cross-sectional research is its ability to catch daily fluctuations and avoid memory bias. Unfortunately, one of the included articles used nightly diaries (Parrish et al., 2009), where participants only answered questions once per day, in the evening. Assessing emotions and behavior in retrospect could lead to recollection bias, especially in depressed individuals (Ebner-Priemer & Trull, 2009) and makes it more difficult to draw conclusions about the order of events. In this sense ESM or EMA with higher density of assessments may be better methodologically, although these methods can be quite time-consuming and more burdensome for the individual.

This review did not include a meta-analysis because the measured constructs were seen as too heterogeneous to combine in a meaningful way. One suggestion for a future meta-analysis is to more fully explore the effects and benefits of “ESM-add-on-tools.” Future research may focus on add-on momentary assessment technology in the form of apps, web-based interventions and online psychotherapy, as it can provide cost-effective alternatives to face to face sessions (Solomon, Proudfoot, Clarke & Christensen, 2015) and fill an important gap for treating patients with unmet needs (Andrews, Cuijpers, Craske, McEvoy & Titov, 2010). Further development of these ambulatory interventions may hopefully contribute to a greater understanding of individual patterns of affect, behavior and context.

Questions based on functional associations between daily activities and depression fit the ambulatory nature of ILD, where fast changes in affect can be tracked and followed in everyday life. Snippe et al. (2016) for instance, found considerable individuality in how heightened activity affected depressive symptoms. The use of ILD to construct indexes of daily patterns of personal functioning represents a line of research that may have potential for the future development of psychotherapy research. Another important line of research could be to use ILD methods and time-series analysis to acquire a better understanding of individual differences, as a basis for the development of person-tailored interventions in the treatment of depression. Although many treatments for depression seem to be equally effective (Cuijpers, 2017), this is a result that is seen at a group level of analysis, and it is quite possible that different kinds of treatments are not at all interchangeable at the level of the individual patient.

Conclusion

These findings suggest that cognitive therapy, CBT and SST are all beneficial for individuals with depression (Ed-

dington, 2017; Parrish et al., 2009). They also indicate that physical and social activity heightens positive affect (Mata et al., 2012) and has an ameliorating effect on depression (Snippe et al., 2016). ESM feedback has showed to be a practical tool for helping MDD patients to engage more in physical and social activities and encouraging them to spend less time resting or being alone. It seems as though ESM registration of affect, context and activity can have a positive effect even if feedback is left out (Simons et al, 2015). This would imply that registration of PA and/or the perception of being supported can be beneficial in itself.

PA and NA are of interest to explore more thoroughly for clinical reasons, as it can be troublesome to change a person's ability to hold on to PA or let go of NA. One clinical challenge in psychotherapy is how to introduce PA and NA to patients in a pedagogical manner without risking to unintentionally encourage the patient to chase after positive affect while avoiding situations associated with negative affect, as this can be counterproductive in therapeutic work. By using ESM-derived feedback one can help patients to see their own personalized patterns of activity and show how different activities affects their PA (NA, empowerment, stress reactivity etc.) without an unnecessary focus on holding on to positive emotions and avoiding negative ones.

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