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Review

# Activity monitoring in patients with depression: A systematic review

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ABSTRACT

*Background:* Altered physical activity is an important feature of depression. It is manifested in psychomotor retardation, agitation and withdrawal from engagement in normal activities. Modern devices for activity monitoring (actigraphs) make it possible to monitor physical activity unobtrusively but the validity of actigraphy as an indicator of mood state is uncertain. We carried out a systematic review of digital actigraphy in patients with depression to investigate the associations between measured physical activity and depression.

*Methods:* Systematic review and meta-analysis. Studies were identified from Medline, EMBASE and Psycinfo databases and included if they were either case control or longitudinal studies of actigraphy in adults aged between 18 and 65 diagnosed with a depressive disorder. Outcomes were daytime and night-time activity and actigraphic measures of sleep.

*Results:* We identified 19 eligible papers from 16 studies (412 patients). Case control studies showed less daytime activity in patients with depression (standardised mean difference −0.76, 95% confidence intervals −1.05 to −0.47). Longitudinal studies showed moderate increase in daytime activity (0.53, 0.20 to 0.87) and a reduction in night-time activity (−0.36, −0.65 to −0.06) over the course of treatment.

*Limitations:* All study participants were unblinded. Only seven papers included patients treated in the community.

*Conclusions:* Actigraphy is a potentially valuable source of additional information about patients with depression. However, there are no clear guidelines for use of actigraphy in studies of patients with depression. Further studies should investigate patients treated in the community. Additional work to develop algorithms for differentiating behaviour patterns is also needed.



**Contents**



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## 1. Introduction

Altered physical activity has long been recognised as a feature of depression (Parker and Brotchie, 1992). Psychomotor retardation is argued to be a cardinal feature of melancholia (Parker et al., 1995) but other forms of altered physical activity in depression include agitation and withdrawal from normal activities of daily living. Reports of activity, either observed or self reported, are features of many validated depression assessment tools (Hamilton, 1960; Kroenke et al., 2001).

Objective measurement of activity (actigraphy) using body-worn accelerometers has been available in research settings for over 20 years and accelerometers have been used extensively in research in a wide range of situations to measure both daytime activity (Matthews et al., 2012) and sleep (Martin and Hakim, 2011). In recent years devices incorporating these technologies have become widely available, and – in the case of smartphones – ubiquitous. Much of their use is currently driven by the health and lifestyle market. While research and commercial applications are beginning to use activity monitoring in patients with depression (Help4 Mood Consortium, 2012; ICT4 Depression Consortium, 2012; Monarca Project, 2012; Optimi Consortium, 2012), we were unable to find a recent systematic review of the extent to which actigraphic measures of activity correspond to clinically meaningful changes in depression. We were also unable to find any guidelines for the use of activity monitoring in depression in order to recommend, for instance, how long patients should wear the actigraphy device or what is the best way of characterising activity patterns during the measurement period.

We carried out a systematic review of published studies in which actigraphy was used to monitor day or night time activity in people with a depressive disorder. We included both case-control studies which examined the difference between people with depression and healthy controls and longitudinal (pre-post) treatment studies to investigate changes over time. The review had two aims:

(1) to examine the association between activity levels and depression;
(2) to identify areas of research that need to be addressed before guidelines for the use of actigraphy in people with depression can be developed.

## 2. Methods

The study was conducted in accordance with PRISMA statement (Moher et al., 2009) and the protocol was agreed by all authors in advance of data collection. As the study included no direct involvement with patients or identifiable data no ethical review was necessary.

### 2.1. Eligibility

We included case-control and longitudinal treatment studies of adults aged between 18 and 65 which used actigraphy. At least one group in the study was required to have a confirmed diagnosis of major depressive disorder, depression in association with bipolar disorder, or Seasonal Affective Disorder (SAD) during the winter season. Eligible studies could include participants treated in hospital or at home.

### 2.2. Search strategy

We searched Medline, PsychInfo and EMBASE databases for publications between 1966 and April 2012 which included the MESH heading depression/ and one or more of the eight terms monitoring, ambulatory/, motor activity/, actigrap$ or actimet$ or actograp$, actomet$ or accelerometer. We also followed references from retrieved publications and searched Google Scholar for relevant grey literature.

### 2.3. Study selection

After removal of duplicates, two authors (CB and MW) reviewed the titles of all publications identified by the searches to identify potentially eligible abstracts. The same two authors independently and then jointly selected studies for detailed extraction based on the full abstract. Studies were eligible if they included appropriate data from adults aged 18–65 with a diagnosis of depression. Studies were excluded if they included only patients with bipolar disorder, or were limited to patients with potentially confounding conditions—mostly cancer. Where two or more publications appeared to relate to the same data, we included both provided they reported on separate measures (for instance sleep in one and daytime activity in another). For each included study two authors (CB plus either AS, ASB, BM or MW) independently extracted data onto a form that had been developed by CB for this review. The data comprised study design and location; characteristics of the sample (patient and where relevant control), actigraphic monitoring parameters (duration of monitoring, quantifications of activity) and relevant outcomes.

As part of the data extraction, studies were assessed for risk of bias in relation to patient recruitment, blinding of analysis, potential confounders, multiple publication, and reporting bias (such as failure to report hypotheses which were tested and over-reliance on post-hoc analysis). Any discrepancies were corrected by referring to original studies and resolved by consensus.