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# **Quality assessment**

We evaluated the quality of measures in accordance with the COnsensus-based Standards for the selection of health Measurement Instruments (COSMIN) initiative (Mokkink *et al.*, 2010). Measurement compliance, measures of reliability and validity were evaluated for ESM and sensor methods.

## **Psychometric quality of ESM measures**

*Compliance*

Overall, one quarter of the included articles (i.e., 27 studies) have not reported on compliance or measurement quality (e.g., psychometric properties) (see Table S2). While some studies defined criteria for a minimum number of completed assessments needed for participants to be included in analytic samples (Collip *et al.*, 2011a, Kuepper *et al.*, 2013, Lataster *et al.*, 2011, Leendertse *et al.*, 2018), the majority of studies reported satisfactory compliance rates with 79% mean compliance across all ESM studies. A similar compliance rate has been reported in a recent meta-analyses of ESM studies (Vachon et al., 2019), in which a smaller number of ESM items and, hence, shorter duration of each ESM assessment period was associated with better compliance, suggesting that keeping assessment burden at a manageable level may ensure good compliance. Investigating compliance in a large, transdiagnostic dataset, Rintala, Wampers, Myin-Germeys, and Viechtbauer (2019) found comparable compliance rates for different clinical samples and the general population (83%) – except for individuals with psychosis, who showed reduced compliance (70%). In addition, the authors reported similar compliance rates irrespective of the number of ESM items used (ranging from 42 to 52 items per measurement).

*Reliability*

About two thirds of the studies included in this review have reported reliability indicators, including measures of internal consistency (see Table S2). No study reported the test-retest reliability. Studies that reported on other types of reliability frequently referred to previously published data (Collip *et al.*, 2011b, Klippel *et al.*, 2017, Lataster *et al.*, 2011, Oorschot *et al.*, 2012, Peerbooms *et al.*, 2012, Reininghaus, Depp, & Myin-Germeys,2016a, Thewissen *et al.*, 2011), or provided information on whether between-person differences were reliably captured (across individual measurements), most commonly expressed as internal consistency by reporting Cronbach's alpha (Becker, Fischer, Crosby, Engel, & Wonderlich,2018, Berg *et al.*, 2017, Engel *et al.*, 2013, Frissen *et al.*, 2014, Glaser, Van Os, Mengelers, & Myin-Germeys, 2010, Goldschmidt *et al.*, 2014b, Hartmann *et al.*, 2015, Haynos *et al.*, 2015, Lavender *et al.*, 2013b, Leraas *et al.*, 2018, Pisetsky *et al.*, 2016, Wonderlich *et al.*, 2015). While the reliability of measurements captured using ESM should be examined separately for the within-person and the between-person level, only a small number of studies (e.g., Scott *et al.* (2017), Smyth *et al.* (2009), Sperry, Walsh, & Kwapil (2020)) provided indicators suitable to reflect within-person reliability (i.e., whether within-person measurements captured the target construct reliably over time).

*Validity*

Approximately half of the studies included in this review provided information on validity of the data collected using ESM (see Table S2).  In the included studies, criterion validity and construct validity were the most reported types of validity. The criterion validity of experience sampling measures that capture affective experiences has been assessed by identifying individual differences in affective variability patterns between specific diagnostic conditions (e.g., Leraas et al.,(2018)). Similarly, criterion validity of experience sampling measures can be determined by whether ESM measures accurately predict the occurrence of specific types of behaviour (e.g., Haynos *et al.* (2017), Tasca *et al.* (2009)). Construct validity of experience sampling measures has been established more frequently through correlation coefficients with established questionnaire measures (Ruscio *et al.*, 2015, Scott *et al.*, 2017, Solhan, Trull, Jahng, & Wood, 2009, Tasca *et al.*, 2009) or interview ratings (Klippel *et al.*, 2017). Eight included studies examined the structural validity, for example, by conducting factor analyses (e.g., Geschwind, Peeters, Drukkker, van Os, & Wichers (2011), Hartmann *et al.* (2015), Thewissen *et al.* (2011), Udachina, Bentall, Varese, & Rowse(2017)).

## **Psychometric quality of sensor measures**

*Compliance*

Passive data acquisition usually comes with high compliance rates. The mean compliance rate in studies applying sensors was 82%, however the majority of studies did not report on compliance. Furthermore, some studies applied minimum criteria for compliance to ensure data quality and reliability, e.g., a minimal wear time of 21 hours per day (Wichniak *et al.*, 2011), 16 hours per day and per night on at least one week day and one weekend day (Difrancesco *et al.*, 2019), or a minimum number of consecutive days (Bergwerff, Luman, & Oosterlaan, 2016, Pillai, Steenburg, Ciesla, Rothm & Drake, 2014, Wallace *et al.*, 2017). With respect to data quality, several studies reported relatively small amounts of missing data of 5.3% (Wallace *et al.*, 2017) and 6.1% (Blake *et al.*, 2018) or exclusion rates of 7% (Pillai *et al.*, 2014). In addition, in ambulatory sleep research, data from the first night are usually excluded from the analysis to avoid potential alterations of sleep given that participants may not be used to wearing a sensor (Pillai *et al.*, 2014).

*Reliability*

No included study reported indicators of reliability of the measures for physical activity or sleep. However, some studies referred to previous literature supporting the reliability and validity of used sensors (e.g., Bergwerff *et al.* (2016), Owens *et al.* (2009), Pillai *et al.* (2014), Sauchelli *et al.* (2015)).

*Validity*

Several studies aimed to investigate construct validity of measures derived from actigraphy. For instance, Bracht et al. (2012) reported an association between actigraphy data and the motor domain of the Bern Psychopathology Scale in individuals with psychosis, while another study (Gregory *et al.*, 2011) revealed associations between sleep items of the Child Behaviour Checklist and sleep onset latency derived from actigraphy in children with affective disorders. There was some evidence for a dose-response relationship as individuals with higher symptom levels of depression and anxiety were less active, slept more, and showed smaller differences between day-, and night-time activity, suggesting good ecological validity of actigraphy-based sleep data (Difrancesco *et al.*, 2019). Similarly, Wichniak et al. (2011) found that higher symptom levels in individuals with psychosis were related to lower activity.

# **Table S1. Search strategy.**

**MEDLINE**

Database: Ovid MEDLINE(R) <1946 to January Week 4 2021>

Search Strategy:

--------------------------------------------------------------------------------

1 depressi\*.tw. (341924)

2 anxi\*.tw. (182280)

3 phobi\*.tw. (10370)

4 psychosis.tw. (32279)

5 psychotic.tw. (29790)

6 schizophrenia.tw. (95956)

7 paranoi\*.tw. (7493)

8 hallucinat\*.tw. (12461)

9 delusion\*.tw. (9660)

10 bipolar\*.tw. (55426)

11 mania.tw. (9122)

12 "personality disorder\*".tw. (17922)

13 "Attention Deficit\*".tw. (25640)

14 "Conduct Disorders".tw. (655)

15 "substance-related disorder\*".tw. (477)

16 "substance disorder\*".tw. (317)

17 "eating disorder\*".tw. (17078)

18 "binge-eating".tw. (5019)

19 bulimi\*.tw. (7750)

20 anorexi\*.tw. (30080)

21 or/1-20 (670022)

22 "mobile health".tw. (2369)

23 mHealth.tw. (1958)

24 "app-based".tw. (336)

25 "mobile app\*".tw. (2670)

26 "mobile-based".tw. (295)

27 "phone-based".tw. (854)

28 smartphone.tw. (6398)

29 "smartphone-based".tw. (1139)

30 smartwatch.tw. (154)

31 wearable.tw. (7506)

32 "mobile device".tw. (786)

33 "digital tool".tw. (66)

34 "mobile-sensing".tw. (43)

35 "mobile sensing".tw. (43)

36 "global positioning system".tw. (1407)

37 "position sens\*".tw. (2002)

38 geotrack\*.tw. (8)

39 "geo track\*".tw. (2)

40 "location track\*".tw. (76)

41 "step count".tw. (805)

42 pedometer.tw. (1796)

43 pulsometer.tw. (11)

44 actigraphy.tw. (3088)

45 accelerometer.tw. (8313)

46 "motion sens\*".tw. (2024)

47 gyroscope\*.tw. (765)

48 "use log\*".tw. (344)

49 logging.tw. (2051)

50 "social media".tw. (8302)

51 facebook.tw. (2699)

52 twitter.tw. (2342)

53 instagram.tw. (374)

54 "text mining".tw. (1858)

55 "optical character recognition".tw. (92)

56 "optical character reader".tw. (4)

57 "character recognition".tw. (257)

58 "word recognition".tw. (4038)

59 "speech recognition".tw. (3282)

60 "voice recognition".tw. (444)

61 "speech to text".tw. (57)

62 sensor.tw. (67538)

63 "digital monitoring".tw. (51)

64 "mood tracking".tw. (12)

65 "digital phenotyping".tw. (53)

66 "experience sampling method".tw. (310)

67 "ecological momentary assessment".tw. (1213)

68 "ecological momentary intervention".tw. (28)

69 "naturalistic assessment".tw. (33)

70 "intensive time series".tw. (14)

71 "intensive longitudinal data".tw. (64)

72 "time series analysis".tw. (4643)

73 or/22-72 (129139)

74 21 and 73 (4250)

75 limit 74 to yr="2007 -Current" (3799)

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# **Table S2. Summary of included studies using the diary methods, ESM or telephone calls.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Number** | **Reference** | **Population** | **Sampling scheme** | **Sampling frequency of random prompts** | **Assessment period** | **Primary outcome is a time intensive measure** | **Data aggregated1** | **Measurement quality (compliance, % data)** | **Psychometric properties**  **(reliability, validity)** |
| **ESM** | | | | | | | | | |
| 1 | Andrewes *et al.* (2017) | Patients [BPD] | Semi-random | 6 | 6 days | Yes (NA, behavior) | Yes | Compliance: 52%  5% of participants were excluded due to failure to complete any reports. Twenty-two participants (21%) were given the phone for another 6 days as they filled < 20 prompts. | *Reliability:* Referred to literature for reliability of positive and negative affect scale.  *Validity:* Referred to the literature for structural characteristics of the measure. |
| 2 | Anestis *et al.* (2010) | Patients [BN] | Hybrid ( semi-random, interval-contingent, event-contingent) | 6 | 14 days | Yes (PA, NA, behavior) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 3 | Becker *et al.* (2018) | Patients [BN] | Semi-random | 6 | 14 days | Yes (PA, NA, eating behaviour) | Yes | *Compliance:* 86% (median = 90%).  75% of the participants responded to 83% or more of the signals. | *Reliability:* Internal consistency reported for NA (Cronbach α=.92) and for anger/hostility (Cronbach α=.89).  *Validity:* Not reported. |
| 4 | Berg *et al.* (2013) | Patients [BN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (NA) | Yes | *Compliance:* 86% (median: 90%). | *Reliability:* Internal consistency reported for NA (Cronbach α=.92). Cronbach alphas for the abbreviated lower-order NA subscales were α=.80 (fear), α=.89 (guilt), α=.79 (hostility), and α=.81 (sadness).  *Validity* reported based on Confirmatory Factor Analysis with ESM data (PANAS negative affect scale). |
| 5 | Berg *et al.* (2017) | Patients [AN; EDNOS-AN; BN] | Hybrid (semi-random, event-contingent) | 10 | 15 | Yes (NA) | Yes | Not reported. | *Reliability:* Internal consistency was reported for NA in study 1 (Cronbach α=.94) and for NA in study 2 (Cronbach α=.92).  *Validity*: Not reported. |
| 6 | Berner *et al.* (2017) | Patients [BN] | Semi-random | 6 | 14 days | Yes (PA, NA, behavior) | Yes | Compliance: 86% | *Reliability:* Internal consistency of NA (Cronbach α=.92), and PA (Cronbach α=.91) reported.  *Validity:* Not reported. |
| 7 | Block *et al.* (2020) | Patients [MDD; social anxiety]; healthy controls | Semi-random | 6 | 7 days | Yes (stress, sleep quality) | Yes | *Compliance:* 93% | *Reliability:* Internal consistency of the openness and engagement items was r= .86.  *Validity:* Not reported. |
| 8 | Blum *et al.* (2015) | Patients [schizophrenia]; healthy controls | Random | 10 | 2 days | Yes (NA) | Yes | *Compliance*: 75% (patients); 89% (controls).  2 % of participants responded to < 30% of reports and their data was excluded. | *Reliability:* Not reported.  *Discriminant validity*: Comparison of real-time (ESM) and retrospective (questionnaire) depressed mood ratings suggested that both indices are valid measures of depressed mood.  *Convergent validity*: Both measures of depressed mood were significantly correlated with social support and quality of life suggesting convergent validity of the depressed mood measures. |
| 9 | Chapman *et al.* (2017) | Patients [BPD; MDD]; healthy controls | Semi-random | 8 | 6 days | Yes (PA, NA) | Yes | *Compliance:* At pre-instruction phase: 66%. At instruction phase: 67%. At post-instruction phase: 60%. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 10 | Collip *et al.* (2011a) | High-risk population [psychotic disorder]; healthy controls | Random | 10 | 6 days | Yes (event stress, psychotic experiences, NA) | Yes | *Compliance*: 68% (high-risk), 76% (controls).  10% of participants filled < 20 reports and their data were excluded. | *Reliability:* Not reported.  *Validity:* Reports were considered valid when subjects responded within 15 min after the beep, as determined by comparing the actual beep time with the reported time of completion. |
| 11 | Collip *et al.* (2014) | Individuals at-risk from the general population [psychosis] | Random | 10 | 5 days | Yes (PA) | Yes | *Compliance:* 77%.  At least 1/3 valid responses required to be included. Number of excluded participants not mentioned. | *Reliability:* Internal consistency reported for PA (Cronbach α=.86).  *Validity:* Not reported. |
| 12 | Collip *et al.* (2011b) | Patients [psychotic disorder]; individuals at-risk from general population [psychosis] | Random | 10 | 6 days | Yes (paranoia) | Yes | *Compliance:* 73%.  16% of participants were excluded from the analyses, of these 22 participants terminated the study prematurely because of severity of psychotic symptoms (n=11), not being able to understand the instructions (n=5) or lack of cooperation (n=6).Three individuals were excluded as they filled <20 prompts. | *Reliability:* Very good reliability for the paranoia measure (Cronbach α= .82), perceived social threat measure (Cronbach α=.70).  *Validity:* Reports were assumed to be valid when participants responded to the beep within 15 min. |
| 13 | Collip *et al.* (2011c) | Patients [psychotic disorder]; healthy controls | Random | 10 | 6 days | Yes (stress reactivity) | Yes | *Compliance:* 73%.  3% of participants were excluded from the analysis as they answered < 20 prompts. | *Reliability:* Internal consistency was reported for NA (Cronbach α=.83), for psychotic symptoms (Cronbach α=.72), for hallucinations (Cronbach α=.77), and for delusions (Cronbach α=.68).  *Validity:* Not reported. |
| 14 | Crosby *et al.* (2009) | Patients [BN] | Hybrid (semi-random, event-contingent) | 6 | 14 days | Yes (NA, eating behaviour) | Yes | Not reported.  10 (out of 143) participants were excluded from analysis due to drop-out (7 participants) and non-compliance with EMA protocol (10 participants). | *Reliability:* Internal consistency was reported for NA (Cronbach α=.92).  *Validity:* Not reported. |
| 15 | De Young *et al.* (2013b) | Patients [BN; AN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (NA) | Yes | Not reported for semi-random prompts. | *Reliability:* High internal consistency for NA (Cronbach α=.91), and of the guilt facet (Cronbach α=.84).  *Validity:* Not reported. |
| 16 | De Young *et al.* (2013a) | Patients [AN; EDNOS-AN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (eating behaviour) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 17 | De Young *et al.* (2014) | Patients [AN; EDNOS-AN] | Hybrid ( semi-random + interval-contingent, event-contingent) | 6 | 14 days | Yes (PA, NA, behavior) | No | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 18 | Engel *et al.* (2013) | Patients [AN; EDNOS-AN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (PA, NA) | Yes | *Compliance:* 77%. | *Reliability:* Internal consistency reported for PA (Cronbach α=.92) and NA (Cronbach α=.94).  *Validity:* Referred to literature. |
| 19 | Engel *et al.* (2007) | Patients [BN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (eating behaviour) | Yes | *Compliance:* 90%. | *Reliability:* Internal consistency reported for profile of mood states (Cronbach α=.89).  *Validity:* Not reported. |
| 20 | Erwin *et al.* (2019) | Patients [PTSD] | Hybrid (semi-random, event-contingent) | 6 | 7 days | Yes (NA) | No | *Compliance:* 33%  (due to mistakenly initiating entries, technical difficulties, and failure to finish entries). | *Reliability:* Internal consistency reported for NA (Cronbach α=.91) and PTSD symptoms (Cronbach α=.87).  *Validity:* Not reported. |
| 21 | Fatseas *et al.* (2018) | Patients [SUD] | Fixed | 4 | 14 days | Yes (NA, behaviour) | No | *Compliance:* 83%. | *Reliability:* Not reported.  *Validity:* Referred to the literature: EMA items have been validated in other studies with a similar same sample. |
| 22 | Fitzsimmons-Craft *et al.* (2015) | Patients [AN; EDNOS-AN] | Hybrid ( semi-random + interval contingent, event-contingent) | 6 | 14 days | Yes (PA, NA) | No | *Compliance*: 87%.  Compliance with end-of-day ratings was 89%.  2% of participants had a compliance < 50% and their data were excluded from analyses. | *Reliability:* Internal consistency was reported for PA (Cronbach α=.92), and for NA (Cronbach α=.94).  *Validity:* Not reported. |
| 23 | Frissen *et al.* (2014) | Patients [non-affective psychotic disorder]; at-risk [first degree relatives of patients]; healthy controls | Semi-random | 10 | 6 days | Yes (NA, stress) | Yes | Not reported.  Exclusion of participants due to not answering >20 prompts: 5 % of patients, 16 % of relatives, and 3% of controls. | *Reliability:* High internal consistency of negative affect scale (Cronbach α= .81). To determine the reliability of the completed reports, the times at which the watch emitted a signal and the times at which subjects completed the reports were compared.  *Validity:* Not reported. |
| 24 | George *et al.* (2018) | Individuals at risk [mental health problems] | Semi-random | 3 | 30 days | Yes (behaviour, symptoms) | No | *Compliance*: 92%. | *Reliability:* Daily depression (ICC = 0.42), anxiety (ICC = 0.37), ADHD (ICC = 0.35) and conduct problem (ICC = 0.22) symptom measures were created by summing the total number of symptoms across the day.  *Validity:* ESM items were derived from validated questionnaires. |
| 25 | Geschwind *et al.* (2011) | High-risk population [MDD] | Semi-random | 10 | 6 days | Yes (PA) | Yes | Compliance: 82%.  559 entries (4 %) were excluded because completion times fell outside the pre-determined window of 15 minutes after the beep. One participant was excluded due to completing < 20 entries. | *Reliability:* Internal consistency was reported for PA (Cronbach α=.89), and for NA (Cronbach α=.86).  *Validity*: PCA was used to generate a factor representing PA and a factor representing NA. One mood item (“I feel relaxed”) was not included in the PA factor due to low factor loadings. |
| 26 | Glaser *et al.* (2008) | Patients [BPD; psychosis spectrum disorder]; healthy controls | Semi-random | 10 | 6 days | Yes (NA) | Yes | *Compliance:* 77%.  Exclusion of participants with less than 20 reports. | *Reliability:* Internal consistency reported for activity related stress (Cronbach α=.69), NA (Cronbach α=.94), and PA (Cronbach α=.97).  *Discriminant validity:* NA and PA, were significantly, but moderately, negatively correlated. *Construct validity:* Event-related stress and activity related stress, were significantly, but low, correlated. |
| 27 | Glaser *et al.* (2010) | Patients [BPD; cluster C personality disorder; psychotic disorder]; healthy controls | Semi-random | 10 | 6 days | Yes (PA, NA, symptoms) | Yes | Not reported.  10% of patients with BPD and 10% of individuals with cluster C personality disorder were excluded because they answered < 20 prompts. | *Reliability:* Internal consistency was reported for PA (Cronbach α=.97), for NA (Cronbach α=.90) and for psychotic experiences (Cronbach α=.86).  *Validity:* Referred to the literature for evidence on validation of measures. |
| 28 | Granholm *et al.* (2013) | Patients [schizophrenia; schizoaffective disorder] | Fixed | 4 | 7 days | Yes (behaviour) | No | *Compliance:* 72%. | *Reliability:* Not reported.  *Validity:* The question content and format, as well as the sampling schedules, were validated in a subsample (n = 56). |
| 29 | Gerritsen *et al.* (2019) | Patients [psychosis]; high-risk population [psychosis] | Semi-random | 10 | 4 to10 days | Yes (stress, anhedonia) | No | *Compliance:* 70%  52 out of 167 participants did not meet the requirements for data inclusion (i.e. reports given within 15 min after a beep and at least 1/3 of the prompts had to be answered. | *Reliability:* Internal consistency was reported for activity related stress (Cronbach α=.73).    *Validity:* ESM Items were developed to maximize face validity, and have been shown to possess construct and discriminant validity. |
| 30 | Goldschmidt *et al.* (2013) | Patients [BN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (NA) | Yes | Not reported. | *Reliability:* High internal consistency for NA (Cronbach α=.92), and for anxiety (Cronbach α=.80).  *Validity:* Not reported. |
| 31 | Goldschmidt *et al.* (2014a) | Patients [AN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (eating behaviour) | Yes | *Compliance:* 87%  77% of all signals were responded to within 45 minutes.  Compliance with end-of-day ratings: 89%. | *Reliability:* Internal consistency was reported for NA (Cronbach α=.94), for guilt (Cronbach α=.86) and for fear (Cronbach α=.92).  *Validity:* Momentary PANAS items were chosen based on high factor loadings, but PCA was not reported. |
| 32 | Goldschmidt *et al.* (2014b) | Patients [BN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (NA, behaviour) | No | *Compliance:* 86%. | *Reliability:* Internal consistency reported for NA (Cronbach α=.92). Stressful events were categorized by two independent raters (kappa=.78).  *Validity:* Not reported. |
| 33 | Goldschmidt *et al.* (2015) | Patients [AN] | Hybrid (semi-random + interval-contingent, event-contingent) | 6 | 14 days | Yes (eating behavior, NA, stress) | Yes | Not reported. | *Reliability*: Not reported.  *Validity:* Not reported. |
| 34 | Hartmann *et al.* (2015) | Patients [MDD] | Semi-random | 10 | 5 days (Baseline),  3 days (over a course of 6 week intervention),  5 days (Post-intervention) | Yes (PA, NA) | Yes | *Compliance:* 79% (at baseline and post-intervention).  ESM periods with < 30% of beeps completed were excluded from the analyses, leading to the exclusion of one baseline ESM period, four post ESM periods, and two periods during the intervention (i.e., exclusion of 83 observations (<1%)). | *Reliability:* Internal consistency was reported for PA (Cronbach α=.74) and for NA (Cronbach α=.54).  *Validity:* PCA of ESM items was conducted: identified two factors accounting for 46% of the variance. |
| 35 | Haynos *et al.* (2015) | Patients [AN; EDNOS-AN] | Hybrid ( semi-random + interval contingent, event-contingent) | 6 | 14 days | Yes (PA, NA, mood) | No | Participants provided EMA recordings on 13 days on average. No further information on compliance reported. | *Reliability:* Internal consistency was reported for PA (Cronbach α=.92), for NA (Cronbach α=.94) and for the profile of mood states (Cronbach α=.92).  *Validity:* Not reported. |
| 36 | Haynos *et al.* (2017) | Patients [AN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (PA and NA, eating behaviour) | Yes | Not reported. | *Reliability:* Internal consistency was reported for joviality (Cronbach α=.91), for self-assurance (Cronbach α=.83), for guilt (Cronbach α=.93), and for fear (Cronbach α=.86).  *Validity:* Multilevel CFA conducted to evaluate factor structure of ESM PA and NA items indicating a 4 factor structure. |
| 38 | Heininga *et al.* (2017) | Individuals at-risk from general population [anhedonia]; healthy controls | Semi-random | 3 | 30 days | Yes (PA) | Yes | *Compliance:* 93%, no difference between groups. | *Reliability:* Internal consistency of PA scale (Cronbach α=.94), and inter-item correlation of the two high-arousal and low-arousal items (r=.90, r=.91) reported.  *Validity:* Not reported. |
| 39 | Jahng *et al.* (2011) | Patients [BPD; MDD] | Semi-random | 6 | 28 days | Yes (PA, NA, mood) | No | *Compliance:* 45% - 100%.  The average number of assessed days was not significantly different between clinical groups. The average number of assessments per day decreased over the course of the study. | *Reliability:* Not reported.    *Validity:* Not reported. |
| 40 | Janssens *et al.* (2012) | Patients [psychotic disorders]; healthy controls | Random | 10 | 6 days | Yes (behaviour) | Yes | *Compliance:* 73% (controls), 65% (patients). | *Reliability:* Not reported.  *Validity:* Referred to the literature. |
| 41 | Jappe *et al.* (2014) | Patients [AN; EDNOS-AN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (stress) | Yes | *Compliance:* 86% (group 1) and 87% (group 2).  End of day report compliance was 90% and 89%. | *Reliability:* Not reported.  *Validity:* Referred to the literature that the ESM questionnaire has shown convergent validity with endocrine stress measures. |
| 42 | Johns *et al.* (2019) | Patients [bipolar disorder; MDD]; healthy controls | Semi-random | 4 | 14 days | Yes (PA, NA, cognitive states) | Yes | Compliance: 82.6%.  Compliance was not different across diagnostic groups. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 43 | Karr *et al.* (2013) | Patients [BN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (NA, PA, behaviour) | Yes | Not reported for semi-random prompts. | *Reliability:* Internal consistency reported for NA (Cronbach α=.92), and for PA (Cronbach α=.91).  *Validity:* Not reported. |
| 44 | Khazanov *et al.* (2019) | Patients [MDD, GAD]; healthy controls | Semi-random | 8 | 6 days | Yes, (PA, NA, cognition, behaviour, symptoms, | No | Compliance: 72%.  Two (out of 151) participants’ data were lost due to technical problems, 1 participant did not return the electronic diary, and 3 participants withdrew due to time conflicts. | *Reliability:* Items were averaged at each time point to form momentary positive affect scale (within-person ω = .63 to.72) and negative affect scale (ω = .75 to .77). Momentary worry scale (within-person α = .84 to .85) and rumination (α =.82 to .85) variables.  *Validity:* Momentary NA and PA correlated highly with trait NA or trait PA, respectively, on the PANAS (.60 to .61). Momentary worry correlated highly with trait worry assessed by the Penn State Worry Questionnaire (.58 to .59). Momentary rumination correlated highly with trait rumination assessed by the Ruminative Responses Scale. |
| 45 | Kimhy *et al.* (2014) | Patients [schizophrenia]; healthy controls | Semi-random | 10 | 2 days | Yes (PA,NA) | Yes | *Compliance:* 80% (patients) and 85% (controls). | *Reliability:* Not reported.    *Validity:* Emotional Granularity Indices were calculated by correlating ESM items. |
| 46 | Klippel *et al.* (2018) | Patients [psychosis], high-risk [first-degree relatives], healthy controls | Semi-random | 10 | 6 days | Yes (NA, stress, psychotic experiences) | No | Not reported (only criteria for data inclusion). | *Reliability:* Not reported.  *Validity:* Referred to prior literature. |
| 47 | Klippel *et al.* (2017) | Patients [psychosis]; high-risk population [psychosis]; healthy controls | Semi-random | 10 | 6 days | Yes (PA, NA, stress) | Yes | Not reported.  15 (out of 165) participants were excluded due to insufficient number of valid responses (≤19). | *Reliability:* Internal consistency was reported for psychotic experience (Cronbach α=.90).  *Validity:* Good concurrent validity of psychotic experiences with negative affect (r=.68). |
| 48 | Kuepper *et al.* (2013) | Patients [psychosis]; healthy controls | Semi-random | 12 | 6 days | Yes (NA, PA) | Yes | *Compliance*: 44% (patients) and 60% (controls).  31% of participants were excluded (< 24 valid reports). | *Reliability:* Internal consistency reported for PA (Cronbach α=.88); NA (Cronbach α=.82); paranoia (Cronbach α=.72), and hallucinations (Cronbach α=.84).  *Validity:* Not reported. |
| 49 | Lataster *et al.* (2011) | Patients [psychotic disorder] | Random | 10 | 6 days | Yes (PA and NA) | Yes | Not reported. | *Reliability*: Internal consistency was reported for PA (Cronbach α=.85), for NA (Cronbach α=.83), for hallucination (Cronbach α=.74), and for delusion (Cronbach α=.66).  *Validity:* Not reported. |
| 50 | Lavender *et al.* (2013a) | Patients [AN; EDNOS-AN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (NA) | Yes | *Compliance:* 87%.  Compliance with end-of-day rating: 90%. | *Reliability:* Internal consistency reported for NA (Cronbach α=.94) and anxiety (Cronbach α=.92).  *Validity:* Significant correlations of ESM affective liability or ESM anxiousness and respective validated questionnaires. |
| 51 | Lavender *et al.* (2013b) | Patients [AN; EDNOS-AN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (NA) | Yes | *Compliance:* 87%.  Compliance with end-of-day rating: 90%. | *Reliability:* Internal consistency reported for anxiety (Cronbach α=.92).  *Validity:* Not reported. |
| 52 | Lavender *et al.* (2013c) | Patients [AN; EDNOS-AN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (eating behaviour) | Yes | *Compliance:* 87%.  Compliance with end-of-day rating: 89%. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 53 | Lavender *et al.* (2013d) | Patients [AN; EDNOS-AN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (NA, PA) | Yes | *Compliance:* 87%. | *Reliability:* Internal consistency reported for NA (Cronbach α=.94), PA (Cronbach α=.92), momentary actual-ideal self-discrepancy (Cronbach α=.86), and actual-ought self-discrepancy (Cronbach α=.83).  *Validity:* Not reported. |
| 54 | Lavender et al., (2016) | Patients [AN; EDNOS-AN] | Hybrid (semi-random + interval contingent, event-contingent) | 6 | 14 days | Yes (PA, NA, mood) | No | *Compliance*: 87%  Compliance for end of day recordings: 89%. | *Reliability:* Internal consistency was reported for PA (Cronbach α=.92), for NA (Cronbach α=.94) and for the profile of mood states (Cronbach α=.92).  *Validity*: Not reported. |
| 55 | Lavender *et al.* (2016) | Patients [AN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (NA, PA, behaviour) | Yes | *Compliance*: 87%  Compliance for end of day recordings: 89%. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 56 | Leahey *et al.* (2011) | Patients [BN; EDNOS]; healthy controls | Semi-random | 6 | 5 days | Yes (self-esteem, appearance, PA, NA) | Yes | *Compliance:* Over 80%, but no actual number reported. Significant time effect: participants made more appearance comparisons at the beginning of the sampling phase | *Reliability:* Reference to the literature.  *Validity:* Not reported |
| 57 | Leendertse *et al.* (2018) | Patients [psychotic disorder]; healthy controls | Semi-random | 10 | 6 days | Yes (PA, NA, activity, quality of life) | Yes | Not reported.  4% of participants provided an insufficient number of ESM reports (< 20 valid reports). | *Reliability:* Not reported.  *Validity:* ESM measure of momentary quality of life has been validated in previous work. |
| 58 | Leraas *et al.* (2018) | Patients [BN] | Hybrid ( semi-random + interval-contingent, event-contingent) | 6 | 14 days | Yes (PA, NA) | Yes | Not reported. | *Reliability:* Internal consistency was reported for NA (Cronbach α=.92) and PA (α=.91).  *Validity:* To assess the external validity of the latent profiles, an ANOVA was used to compare the profiles of co-occurring diagnoses. |
| 59 | Le Grange *et al.* (2013) | Patients [AN; EDNOS-AN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (NA, PA, behaviour) | Yes | *Compliance*: 87%  Compliance for end of day recordings: 89%. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 60 | Mackesy-Amiti and Donenberg (2020) | Patients [drug users] | Semi-random | 4-6 | 15 days | Yes (PA, NA) | Yes | *Compliance:* 44% | *Reliability:* Internal consistency was reported for PA (Cronbach α=.81) and NA (α=.91). The response format did not affect NA or PA intensity.  *Validity:* Not reported. |
| 61 | McKone *et al.* (2019) | Patients [ADHD] | Event-contingent | - | 10 days | Yes (drinking behavior, context) | Yes | Not reported. | *Reliability:* ICCs for outcomes ranged from .06 to .58, indicating that the sample provided sufficient variability. Post-drink reports were limited to a maximum of four drinks per episode to balance comprehensiveness and accuracy.  *Validity:* Not reported. |
| 62 | Mason *et al.* (2017) | patients [BN] | Semi-random | 6 | 14 days | Yes (NA) | Yes | *Compliance:* 86% | *Reliability:* Internal consistency was reported for NA (Cronbach α=.92) and dissociation (Cronbach α=.83).  *Validity:* not reported. |
| 63 | Mason *et al.* (2018) | Patients [AN] | Hybrid (semi-random + interval-contingent) | 6 | 14 days | Yes (stress, anxiety, eating behaviour) | No | *Compliance*: 87%. | *Reliability:* Inter-item-correlations between the three stress items were r=.43, .63, and .64, suggesting consistency without excessive overlap. The anxiety scale showed high internal consistency (Cronbach α=.92).  *Validity:* Not reported. |
| 64 | Muehlenkamp *et al.* (2009) | patients [BN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (PA, NA, behaviour) | Yes | Not reported.  10 out of 143 participants provided incomplete EMA data and their data was excluded. | *Reliability:* Internal consistency was reported for NA (Cronbach α=. 92) and PA (Cronbach α=.91).  *Validity:* Not reported. |
| 65 | Oorschot *et al.* (2012) | Patients [schizophrenia spectrum disorders]; healthy controls | Random | 10 | 6 days | Yes (PA, NA, hallucinations) | Yes | Compliance: 65% to 80% | *Reliability:* Internal consistency was reported for PA (Cronbach α=.84), for NA (Cronbach α=.83) and for hallucinations (Cronbach α=.66).  *Validity:* Not reported. |
| 66 | Oorschot *et al.* (2013) | Patients [schizophrenia; [schizoaffective disorder]; healthy controls | Random | 10 | 6 days | Yes (NA, PA) | Yes | *Compliance:* 70% (low negative symptom patients), 63 % (high negative symptom patients) and 80% (controls).  12 (of 334) participants were excluded due to less than 20 beeps. | *Reliability:* Internal consistency was reported for NA (Cronbach α=.82), and PA (Cronbach α=.81).  *Validity:* Not reported. |
| 67 | Pearson *et al.* (2017) | Patients [BN] | Semi-random | 6 | 14 days | Yes (NA, stress) | Yes | *Compliance:* 86% | *Reliability:* High internal consistency of NA scale (Cronbach α=.92).  *Validity:* Not reported. |
| 68 | Pearson *et al.* (2016) | Patients [BN] | Hybrid ( semi-random, interval-contingent, event-contingent) | 6 | 14 days | Yes (NA, eating behaviour) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 69 | Peerbooms *et al.* (2012) | Patients [psychotic disorder]; healthy controls | Random | 10 | 6 days | Yes (stress, psychotic experiences) | Yes | *Compliance:* 73%.  Two (out of 118) controls and 5 (out of 98) patients were excluded due to < 20 answered prompts. | *Reliability:* Internal consistency was reported for psychotic experiences (Cronbach α=.71).  *Validity:* Not reported. |
| 70 | Pinkham *et al.* (2020) | Patients [schizophrenia; schizoaffective disorder; bipolar disorder; MDD] | Not reported | 3 | Study 1: 30 days Study 2: 10 days | Yes (PA, NA, activity, stress) | Yes | *Compliance:* 78 % (study 1) and 84 % (study 2). | *Reliability:* Not reported.  *Validity:* Stability of ESM scores over time (pre- and post-pandemic) was investigated (correlation). |
| 71 | Pisetsky *et al.* (2016) | Patients [BN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (NA, PA) | Yes | Not reported for random prompts. | *Reliability:* Internal consistency was reported for the four abbreviated lower-order NA subscales (Cronbach α=.80, .89, .79 and .81).  *Validity:* CFA of NA scale was conducted and replicated a four factor structure. However, disgust loaded on the hostility factor. |
| 72 | Reininghaus *et al.* (2016a) | Patients [psychosis]; high-risk population [psychosis]; healthy controls | Semi-random | 10 | 6 days | Yes (NA, stress) | Yes | Not reported (only criteria for data inclusion). | *Reliability:* Internal consistency was reported for NA (Cronbach α=.86), and social stress (Cronbach α=.62).  *Validity:* Good concurrent validity of ESM measures of NA and psychotic experiences, as well as ESM threat anticipation item with anxious mood. The item on outsider status correlated with ESM social and area-related stress measures indicating the item taps a distinct but related aspect of social stress. |
| 73 | Reininghaus *et al.* (2016b) | Patients [psychosis]; high-risk population [psychosis]; healthy controls | Semi-random | 10 | 6 days | Yes (NA, stress) | Yes | *Compliance:* 91%. | *Reliability:* Not reported.  *Validity:* Referred to a previous study with this sample demonstrating the feasibility, reliability, and validity of the approach. |
| 74 | Rintala *et al.* (2019) | Patients [psychosis, MDD]; at-risk [first-degree relatives]; high-risk [psychometric risk for psychosis] | Semi-random | 10 | 4-6 days | No | Yes | *Compliance:* 78%.  Compliance declined across days, reaching a low on the 5th day with 73% and varied significantly across assessments depending on the time within a day, with highest compliance between 12 p.m. and 1.30 p.m. (83) and lowest compliance between 7.30 a.m. and 9 a.m. (56%). | *Reliability:* Referred to prior literature.  *Validity:* Not reported. |
| 75 | Ruscio *et al.* (2015) | Patients [MDD; GAD]; healthy controls | Semi-random | 8 | 7 days | Yes (PA, NA, rumination) | No | *Compliance*: 72%.  The number of assessments completed did not differ by diagnostic group. | *Reliability:* Internal consistency was reported for PA (Cronbach α=.8), for NA (Cronbach α=.8) and for rumination (Cronbach α=.9).  *Validity:* Validity of the ESM rumination scale, negative affect and positive affect scale were supported by strong associations with questionnaires (r =.57 to .62). |
| 76 | Rusby *et al.* (2019) | At-risk population [youths] | Random | 18 in total | 4 days (10 times) | Yes (PA, NA) | No | *Compliance:* 76%.  Retention at each wave of assessment: 92% to 73%. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 77 | Schaefer *et al.* (2020) | Patients [binge eating disorder] | Hybrid (semi-random, interval-contingent) | 5 | 7 days | Yes (PA, NA, eating behaviour) | No | *Compliance*: 76 %.  No interaction between compliance group status and temporal effects | *Reliability:* Internal consistency reported for NA (Cronbach α=.80), PA (Cronbach α=.88) and negative affect facet scales (ranged from α=.81 to α=.91).  *Validity:* Perceived loss of control during eating episodes represents a defining feature of binge-eating episodes underlying construct validity of ESM assessments. |
| 78 | Schreiber-Gregory *et al.* (2013) | Patients [binge eating disorder] | Hybrid (semi-random, interval-contingent) | 7 | 14 days | Yes (eating behaviour) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 79 | Scott *et al.* (2017) | Individuals at-risk from general population [BPD] | Semi-random | 6 | 21 days | Yes (NA, behaviour) | Yes | *Compliance*: 76% (mean); 85% (median) | *Reliability:* Between- / within-person internal constancies were reported for NA (Cronbach α=.98 / α=.71), anger (Cronbach α=.98 / α=.85), and shame (Cronbach α=.98 / α=.83).  *Validity:* Demonstrating the construct validity of the ESM aggression measure, individuals with high trait questionnaire scores, had higher momentary aggression. |
| 80 | Selby *et al.* (2012) | Patients [BN; BPD] | Hybrid (semi-random, event-contingent) | 6 | 14 days | Yes (NA, PA, behaviour) | Yes | Not reported.  75% of responses initiated recording within 20 minutes of being signaled, with an average response time of 12 minutes. | *Reliability:* Internal consistency was reported for NA (Cronbach α=.92), and PA (Cronbach α=.91).  *Validity:* Not reported. |
| 81 | Serre *et al.* (2018) | Patients [SUD] | Fixed | 4 | 14 days | Yes (NA, PA, behaviour) | No | *Compliance*: 80 % (cannabis use disorder), 82% (alcohol use disorder), 83% (opiate users), and 88% (tobacco addicts).  Due to a restricted number of assessments occurring on the starting and ending day of the study, only data collected between days 2 and 13 were analyzed. | *Reliability:* Not reported.  *Validity:* Referred to the literature. |
| 82 | Simons *et al.* (2015) | Patients [MDD] | Semi-random | 10 | 3 days (six times) | Yes (PA, NA, activity, context) | Yes | Not reported.  10 (out of 102) participants partially responded to prompts or withdrew from the study. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 83 | Smyth *et al.* (2009) | patients [BN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (PA, NA, stress, behaviour) | Yes | Not reported.  10 out of 143 participants completed the ESM assessment. | *Reliability:* Internal consistency was reported for the anger-hostility subscale (Cronbach α=.89), PA (Cronbach α=.91) and NA (Cronbach α=.92).  *Validity:* Not reported. |
| 84 | Solhan *et al.* (2009) | Patients [BPD; MDD/ dysthymia] | Semi-random | 6 | 28 days | Yes (NA) | Yes | *Compliance: 9*2%. | *Reliability:* Not reported.  *Validity:* Modest correlation between EMA measure and trait questionnaire. |
| 85 | Sperry *et al.* (2020) | Individuals at-risk from general population [hypomanic personality] | Semi-random | 8 | 7 days, 2 times | Yes (PA, NA) | No | Not reported.  138 out of 147 participants had sufficient number of completed reports at baseline. 77% of participants were assessed at follow-up. | *Reliability:* The NA index showed good within-person reliability (ω=0.74) and excellent between-person reliability (ω= 0.93). The PA index showed good within-person reliability (ω=0.70) and excellent between-person reliability (ω=0.92).  *Predictive Validity:* Within person variance was the most robust predictor of psychopathology at follow up over and above other emotion dynamics. |
| 86 | Tasca *et al.* (2009) | Patients [AN; BN] | Hybrid (semi-random, event-contingent, interval-contingent) | 3 | 7 days | Yes (eating behaviour) | Yes | Not reported. | *Reliability:* Not reported.  *Construct validity* reported based on Exploratory Factor Analysis. |
| 87 | Thewissen *et al.* (2008) | Patients [psychotic disorder]; individuals at-risk from general population [psychosis] | Random | 10 | 6 days | Yes (symptoms) | No | *Compliance:* 74%.  Exclusion of participants with less than 20 filled reports. | *Reliability:* Internal consistency reported for paranoia (Cronbach α=.89), and for self-esteem (Cronbach α=.84).  *Construct validity:* PCA revealed one factor for momentary paranoia which correlated with the PANSS interview rating and paranoia scale. PCA revealed one factor for self-esteem. |
| 88 | Thewissen *et al.* (2011) | Patients [psychotic disorder]; individuals at-risk from general population [psychosis] | Semi-random | 10 | 6 days | Yes (NA, self-esteem, psychotic experiences) | Yes | *Compliance:* 72%.  Twenty-two (out of 183) participants terminated the study prematurely, due to severity of psychotic symptoms (N = 11), cognitive incapability (N = 5), or lack of cooperation (N = 6) and 3 were excluded due to insufficient number of observations. | *Reliability:* Internal consistency was reported for the self-esteem scale (Cronbach α=.84), for paranoia (Cronbach α=.90) and hallucination (Cronbach α=.74).  *Validity:* Factor analysis of self-esteem items showed one factor accounting for 68% of the total variance. Factor analysis of paranoia items revealed one factor accounting for 78% of the total variance and for the hallucination scale one factor explaining 84% of the total variance. |
| 89 | Udachina *et al.* (2017) | Patients [SSD] | Semi-random | 10 | 6 days | Yes (PA, NA, symptoms) | Yes | *Compliance:* 65% (patients), 82% (controls).  16% of participants did not return the booklets and/or failed to comply with the protocol. 15% of data obtained was excluded, as participants completed <20 reports. | *Reliability:* Internal consistency was reported for psychotic experiences (Cronbach α=.94), deservedness (Cronbach α=.90), NA (Cronbach α=.87), PA (Cronbach α=.77) and self-esteem (Cronbach α=.81).  *Validity:* A PCA revealed one factor for psychotic experiences and one self-esteem. PCA identified 2 factors with eigenvalues >1 and explaining 66% of the total variance, thus two factor-based scales (positive and negative affect) were created. |
| 90 | Wichers *et al.* (2007) | Patients [MDD]; high-risk [relatives, i.e. twin siblings] | Random | 10 | 5 days | Yes (NA, stress) | Yes | Not reported.  31 (out of 621) participants were excluded as they answered < 30% prompts. | *Reliability:* Internal consistency reported for NA (Cronbach α=.76).  *Validity:* Not reported. |
| 91 | Wigman *et al.* (2015) | Patients [MDD; psychotic disorder]; healthy controls | Semi-random | 10 | 5-6 days | Yes (mental states) | No | Not reported | *Reliability:* Not reported.  *Validity:* Correlations of all mental states were moderate to substantial, ranging between 0.47 and 0.83. |
| 92 | Williams-Kerver and Crowther (2020) | High-risk population [eating disorders] | Hybrid (semi-random, event-contingent, interval-contingent) | 4 | 7 days | Yes (PA, NA, eating behaviour) | No | *Compliances:* 79%.  A least 20% of prompts had to be completed. | *Reliability:* Not reported.  *Validity:* Referred to literature and argued that validity of affect ESM items is evident from their unique position in a multitude of two-dimensional models. |
| 93 | Wonderlich *et al.* (2007) | Patients [BN] | Hybrid (semi-random, event-contingent, interval-contingent) | 6 | 14 days | Yes (eating behaviour) | Yes | *Compliance:* 92%.  Seven (of 142) participants provided incomplete ESM data. | *Reliability:* Internal consistency reported of profile of mood states (Cronbach α=.89).  *Validity:* Not reported. |
| 94 | Wonderlich *et al.* (2015) | Patients [AN; binge eating disorder; obesity] | Hybrid ( semi-random + interval-contingent, event-contingent) | 6 | 14 days | Yes (NA, eating behaviour) | Yes | Not reported.  Sample 1: Three (out of 121) participants had ESM compliance rates of less than 50% and were excluded from analyses.  Sample 2: 10 (out of 143) participants provided incomplete data in the ESM. | *Reliability:* Internal consistency was reported for NA in the 3 samples (Cronbach α ranged from .91 to .94).  *Validity:* Correlations between retrospective measures and the ESM measures were ranging from r= 0.50 to r= 0.78. |
| 95 | Yaroslavsky *et al.* (2019) | Patients [MDD; dysthymia, personality disorder, anxiety, PTSD, OCD]; at-risk [elevated levels at borderline personality scale]; controls | Semi-random | 5 | 7 days | Yes (NA) | No | *Compliance:* 78%.  Less than 5% of ESM data were missing. | *Reliability:* Items were aggregated to form immediate NA (Cronbach α=.83) and peak  NA (Cronbach α=.66) indices that evidenced acceptable internal consistency. Context information was coded by independent raters (Inter-rater reliability: κ = 0.98).  *Validity:* Not reported. |
| 96 | Zunker *et al.* (2011) | Patients [BN] | Hybrid (semi-random + interval-contingent, event-contingent) | 6 | 14 days | Yes (eating behavior) | Yes | Not reported. | *Reliability:* Not reported.    *Validity:* Not reported. |
| **Telephone calls /emails /online screenings** | | | | | | | | | |
| 97 | Aikens *et al.* (2015) | Patients [MDD] | Not reported | Weekly | 26 weeks | Yes (symptoms) | Yes | *Compliance*: 72%. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 98 | Bilderbeck *et al.* (2016) | Patients [bipolar disorder] | Not reported | Weekly | 12 months | No (symptoms) | No | *Compliance:* 77 % and 71%. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 99 | Duffy *et al.* (2019) | High-risk [offspring of bipolar parents]; healthy controls | Not reported | Daily or weekly | 90 days | Yes (mood) | Yes | *Compliance in the first 30 days*: 78% (high-risk) and 97% (controls).  Compliance over 90 days: 56% (high‐risk) and 69% (controls). | *Reliability*: Not reported.  *Validity:* Not reported. |
| 100 | Fitzsimmons-Craft *et al.* (2019) | Individuals at-risk [eating disorder] | Not reported | Daily | 24 months | Yes (eating behaviour) | Yes | *Compliance*: 86% | *Reliability:* Not reported.  *Validity*: Not reported. |
| 101 | Kordy *et al.* (2016) | Patients [MDD] | Not reported | Every 14 days | 24 months | Yes (symptoms) | Yes | *Compliance*: 69% | *Reliability:* Not reported.  *Validity:* Not reported. |
| 102 | Morgan *et al.* (2017) | Patients [anxiety disorders]; healthy controls | Semi-random | 2-4 | 5 days (5 times) | Yes (PA, context) | Yes | There were no group differences in EMA compliance, with socially anxious youth completing 57.07/70 possible calls (82%), other anxious youth completing 53.71/70 possible calls (77%), and healthy youth completing 54.26/70 (78%) possible calls | *Reliability:* Momentary ratings of happy affect were highly correlated with momentary ratings of cheerful, excited, and interested affect.  *Validity:* Interviews were used to cross-validate ESM. |
| 103 | Perez Arribas *et al.* (2018) | Patients [bipolar disorder; BPD]; healthy controls | Not reported | Daily | 90 days | Yes (PA, NA) | Yes | *Compliance*: 81%.  9 (of 139) participants who withdrew consent or failed to provide at least 2 months of data were excluded. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 104 | Primack *et al.* (2011) | Patients [MDD]; healthy controls | Not reported | 12 calls per weekend | 5 weekends (over the course of 8 weeks) | Yes (behaviour) | Yes | *Compliance*: 89% | *Reliability*: Not reported.  *Validity:* Not reported. |
| 105 | Scott *et al.* (2015) | Individuals at-risk from general population [BPD] | Not reported | 4 | 7 days | Yes (behaviour) | Yes | *Compliance*: 86%. Data were excluded from three girls who completed less than seven calls over the course of the week. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 106 | Schlam *et al.* (2020) | Smokers (nicotine) at risk for substance use | Not reported | 3 | 7 days (2 times) | Yes (NA) | Yes | Not reported | *Reliability:* Not reported.  *Validity:* Not reported. |
| 107 | Silk *et al.* (2018) | Patients [anxiety disorders] | Not reported | 2 to 3 | 5 days | Yes (PA,NA) | Yes | *Compliance*: 98% | *Reliability:* Not reported.  *Validity:* Not reported. |
| 108 | Tsanas *et al.* (2016) | Patients [bipolar disorder; BPD]; healthy controls | Not reported | Daily and weekly | 3 months to 12 months | Yes (mood) | Yes | *Compliance:* 81% for weekly assessment, 86% for daily assessment. | *Reliability:* Not reported.  *Validity:* Validity of the daily questionnaire was confirmed by satisfactory correlation with standard scales. |

*Note:* 1 Data aggregated refers to the calculation of a mean over the assessment period. ADHD: Attention Deficit Hyper Disorder;AN: Anorexia nervosa; AUD: Alcohol Use Disorder; GAD: Generalized Anxiety Disorder; BN: Bulimia Nervosa; BPD: Borderline Personality Disorder; ESM: Experience Sampling Methodology; MDD: Major Depressive Disorder; SSD: Schizophrenia Spectrum Disorders; OCD: Obsessive Compulsive Disorder; EDNOS-AN: eating disorder not otherwise specified; ICC: Intra-Class Correlation; PCA: Principal components analysis; PA: positive affect, NA: negative affect, mean compliance for ESM studies: 79%, mean compliance for studies collecting data via Telephone calls /emails /online screenings: 83%.

# **Table S3. Summary of included studies using sensors.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Number** | **Reference** | **Population** | **Sensor type /**  **Sampling** | **Prompts per day / sampling frequency** | **Assessment period** | **Primary outcome is a time intensive measure** | **Data aggregated1** | **Compliance and data quality** | **Psychometric properties (Reliability,**  **Validity)** |
| 1 | Baerg *et al.* (2011) | Patients [developmental coordination disorder and ADHD]; healthy controls | Accelerometry at waist / continuous | 30-s epochs | 7 days | Yes (physical activity) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 2 | Banihashemi *et al.* (2016) | Patients [affective disorders]; healthy controls | Actigraphy / continuous | 30-s or 1-min epochs | 5 to 22 days | Yes (physical activity) | No | Not reported | *Reliability:* Not reported.  *Validity:* Not reported. |
| 3 | Benard *et al.* (2019) | Patients [BPD]; healthy controls | Actigraphy at non-dominant wrist / continuous | 1-min epochs | 21 days | Yes (sleep) | Yes | Not reported | *Reliability:* Not reported.  *Validity:* Not reported. |
| 4 | Bergwerff *et al.* (2016) | Patients [ADHD); healthy controls | Actigraphy at non-dominant wrist/ continuous | 15-s epochs | 3 days | Yes (sleep) | Yes | Only data derived from nights prior to school days were used to control for shifts in sleep patterns during weekends. Data was available from 48 (out of 124) participants for 3 school nights, and of 42 (out of 124) participants of two school nights and of 34 (out of 124) participants for one school night. | *Reliability:* The use of data from one to three nights was mentioned as a limitation, as commonly data collection from 5 nights is recommended in terms of reliability.  *Validity:* Not reported. |
| 5 | Blytt *et al.* (2018) | Patients [dementia; MDD] | Actigraphy at dominant wrist / continuous | 1-min epochs | 14 days | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 6 | Bracht *et al.* (2012) | Patients [schizophrenia; schizophreniform disorder] | Actigraphy at non-dominant hand/ continuous | 2-s epochs | 24h | Yes (physical  activity) | Yes | Not reported.  Nocturnal activity was excluded. | *Reliability:* Inter-rater reliability of scale was reported to be satisfactory.  *Validity:* Study aimed to validate the Bern Psychopathology Scale by using objective measure of motor behavior. |
| 7 | Bratland-Sanda *et al.* (2011) | Patients [eating disorder]; healthy controls | Actigraphy at hip / continuous | Not reported | 7 days | Yes (physical activity) | Yes | Not reported.  Nocturnal activity and sequences >10 min of consecutive zero counts were excluded. | *Reliability:* Not reported.    *Validity:* Referred to other studies that validated the actigraphy sensor. |
| 8 | Chen *et al.* (2016) | Patients [schizophrenia]; healthy controls | Actigraphy at non-dominant wrist / continuous | Not reported | 7 days | Yes (physical activity) | Yes | Participants were excluded if the accelerometers were not worn for at least 10 h per day (excluding sleep period) for at least 5 days (n = 38 out of 199). The mean wear time was 13.9 (S.D. = 2.1) h per day for the schizophrenia group and 16.3 (S.D. = 1.4) h per day for the healthy controls. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 9 | Choi *et al.* (2019) | Patients [MDD]; healthy controls | Accelerometry at wrist/ continuous | Not reported | 3 days | Yes (physical activity) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
|  |  |  |  |  |  |  |  |  |  |
| 10 | Difrancesco *et al.* (2019) | Patients [MDD; anxiety]; healthy controls | Actigraphy at dominant wrist / continuous | 1-min epochs | 14 days | Yes (sleep) | Yes | Not reported.  Data were included in the analyses if at least 1 week day and 1 weekend day of data was available, with at least 16h recorded per day and per night. | *Reliability*: Not reported.  *Validity:* Expected between-group differences in movement patterns were found and interpreted as a criterion for the ecological validity of the actigraphy measure. |
| 11 | Duncan *et al.* (2017) | Patients [schizophrenia, schizoaffective disorder] | Actigraphy at hip / continuous | Not reported | 7 days | Yes (physical activity) | Yes | Data-quality was considered acceptable when accelerometer recorded at least 600 min wear time per day, for at least four days within seven days. For a week: at least four days of the 7-day wear period were required. | *Reliability:* Not reported.  *Construct validity:* There was agreement between accelerometry and the 24 hour recall of physical activity. |
| 12 | Faedda *et al.* (2016) | Patients [bipolar disorder, ADHD; MDD]; healthy controls | Actigraphy at non-dominant wrist / continuous | 1-min epochs | 3-5 days | Yes (physical activity) | Yes | Not reported, only that actigraphy was easily obtained. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 13 | Fang *et al.* (2016) | Patients [schizophrenia]; healthy controls | Actigraphy at non-dominant wrist / continuous | Not reported | 7 days | Yes (sleep) | Yes | Sleep indices had missing data for 26.6% in the original dataset which exceeded the acceptable criteria (< 10%). | *Reliability:* Not reported.  *Validity:* Not reported. |
| 14 | Goodlin-Jones *et al.* (2009) | Patients [autism, developmental delay without autism]; healthy controls | Actigraphy at non-dominant wrist / continuous | Not reported | 7 days | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 15 | Gregory *et al.* (2011) | Patients [anxiety disorders; MDD]; healthy controls | Actigraphy / continuous | 1-min epochs | 7 days | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Child  Behavior Checklist sleep items validated based on objective measures of sleep. |
| 16 | Hensch *et al.* (2019) | Individuals at-risk from general population [BPD] | Actigraphy / continuous | Not reported | 5 to 7 days | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 17 | Keyes *et al.* (2015) | Patients [AN, GAD]; healthy controls | Actigraphy / continuous | Not reported | 7 days | Yes (physical activity) | Yes | *Compliance:* 41% (healthy controls), 44% (AN-inpatients), 47% (GAD), 62%, AN (out-patients)  (criteria: worn for at least 6 days and for at least 3 consecutive hours each day) | *Reliability:* Not reported.  *Validity:* Not reported. |
| 18 | McKenna *et al.* (2014) | Patients [bipolar disorder]; healthy controls | Actigraphy at non-dominant wrist / continuous | 1-min epochs | 7 days | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 19 | Pagani *et al.* (2016)) | Patients [bipolar disorder]; at-risk [relatives of bipolar patients] | Actigraphy at dominant wrist / continuous | 1-min epochs | 14 days | Yes (physical activity) | Yes | Not reported.  80 recordings (out of 636) were excluded (due to data quality (42), device failures (8), participant illness (10), irregular schedule (14), mood crisis (6)). | *Reliability:* Not reported.  *Validity:* Not reported. |
| 20 | Piette *et al.* (2011a) | Patients [type 2 diabetes and MDD] | Pedometry/ continuous | During waking hours | 7 days | Yes (physical activity) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 21 | Piette *et al.* (2011b) | Patients [diabetes and MDD] | Pedometry/ continuous | During waking hours | 7 days | Yes (physical activity) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 22 | Ranum *et al.* (2019) | Individuals from general population at-risk [stratified for emotional and behavioral problems] | Actigraphy / continuous | Not reported | 7 days | Yes (sleep) | Yes | *Compliance:* 100% on at least 1 day. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 23 | Sauchelli *et al.* (2015) | Patients [AN]; healthy controls | Accelerometry / continuous | 1-min epochs | 6 days | Yes (physical activity) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 24 | Shou *et al.* (2017) | Patients [bipolar disorder,MDD]; High-risk [relatives of patients]; controls | Actigraphy at non-dominant wrist / continuous | 1-min epochs | 14 days | Yes (physical activity) | No | Not reported.  Missing data within a day: 18.4%, average length of consecutive missing interval was ~2 h. | *Reliability:* Not reported.  *Validity:* Not reported. |
|  |  |  |  |  |  |  |  |  |  |
| 25 | Smagula *et al.* (2018) | Patients [seasonal affective disorder]; healthy controls | Actigraphy / Not reported | Not reported | 7 to 14 days | Yes (physical activity) | No | Not reported.  Adequate actigraphy data (defined as at least 3 days of recording) was available from 70 (out of 78) participants at time point 1 and from 84 (out of 90) participants at time point 2. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 26 | Stubbs *et al.* (2017) | Patients [schizophrenia]; healthy controls | Actigraphy at non-dominant wrist / continuous | Not reported | 7 days | Yes (physical activity) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 27 | Walther *et al.* (2014) | Patients [psychosis spectrum disorder] | Actigraphy / continuous | 2-sec epochs | 24 h | Yes (physical activity) | No | *Compliance:* 88 % (between 10:00–11:00 am) and 95% between 3:00–4:00 pm. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 28 | Wichniak *et al.* (2011) | Patients [schizophrenia spectrum disorder]; healthy controls | Actigraphy at wirst/ continuous | 10-s epochs | 7 days | Yes (sleep) | Yes | Not reported.  Minimal wear time of actigraphy was 21h/ day. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 29 | Zebin et al., (2019) | Patients [severe mental illness]; healthy controls | Actigraphy at wrist / continuous | 100 Hz | 7 days | Yes (physical activity) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |

*Note:*1 Data aggregated refers to the calculation of a mean over the assessment period. ADHD: Attention Deficit Hyper Disorder;AN: Anorexia nervosa; AUD: Alcohol Use Disorder; GAD: Generalized Anxiety Disorder; BPD: Borderline Personality Disorder; MDD: Major Depressive Disorder; OCD: Obsessive Compulsive Disorder; mean compliance in studies collecting sensor data: 82%.

# **Table S4****. Summary of included studies using mobile sensing.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Number** | **Reference** | **Population** | **Data type** | **Prompts per day / sampling frequency** | **Assessment period** | **Primary outcome is a time intensive measure** | **Data aggregated1** | **Compliance and data quality** | **Psychometric properties (Reliability,**  **Validity)** |
| 1 | Birnbaum *et al.* (2017) | Patients [schizophrenia - self-disclosed]; healthy controls | Twitter timeline | Not applicable | Not reported | Yes (linguistic characteristics) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 2 | Eichstaedt *et al.* (2018) | Patients [MDD]; individuals at-risk [help-seeking in an emergency department] | Social media usage | Not applicable | 6 years | Yes (linguistic characteristics) | Yes | Not reported. | *Reliability:* Not reported.  *Predictive validity:* Facebook language-based prediction models perform similarly to screening surveys in identifying patients with depression. |
| 3 | Fitzsimmons-Craft *et al.* (2019) | Individuals at-risk [eating disorder] | Online platform for screening and intervention | 24h epochs for symptom assessment | 2 years | Yes (restrictive eating) | Yes | Data included if at least 3 symptom reports available.  85.8% of participants engaged in intervention, 60.4% completed at least 2 sessions, average time spent in the intervention: 47 days | *Reliability:* Not reported.  *Validity:* Screening  algorithm was validated in other studies. |
| 4 | Friedmann *et al.* (2020) | Patients [PTSD]; high-risk population | GPS | 5-sec epochs when smartphone was moved | 7 days | Yes (physical activity) | No | 16% excluded due to entirely missing data (technical problems). | *Reliability:* Not reported.  *Validity:* Not reported. |
| 5 | Hswen *et al.* (2017) | Patients [schizophrenia - self-disclosed]; healthy controls | Twitter timeline | Not applicable | Not reported | Yes (linguistic characteristics) | Yes | Selection of target words did not include slang | *Reliability:* Not reported.    *Validity:* Not reported. |
| 6 | Hswen *et al.* (2018) | Patients [schizophrenia - self-disclosed]; healthy controls | Twitter timeline | Not applicable | 200 days | Yes (linguistic characteristics) | Yes | Not reported. | *Reliability*: Not reported.  *Validity*: Not reported. |
| 7 | Pratap *et al.* (2019) | Individuals at-risk from general population [psychometric risk: Patient Health Questionnaire and/or self-rated impairment social functioning) | ESM; Phone usage (mobility, phone usage logs, and missed calls) | ESM: daily mood ratings  Phone usage aggregated over 24h epochs | 12 weeks | Yes (mood) | Yes | Not reported. Participant was considered “active” during the week if any passive or active data were recorded at least once. No direct association between attrition and assessment incentives reported. Missing data was imputed using participant`s weekly median. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 8 | Reece *et al.* (2017) | Patients [MDD, PTSD]; healthy controls | Twitter timeline | Not applicable | Twitter history up to most recent 3200 posts | Yes (twitter activity) | Yes | Applied quality  assurance measures in data collection process: MTurk workers who have completed at least 100 tasks, with a minimum 95% approval rating, have been found to provide reliable, valid survey responses | *Reliability:* Not reported.  *Validity:* Stratified five-fold cross-validation was used to optimize Random Forests hyper-parameters. |

*Note:* 1 Data aggregated refers to the calculation of a mean over the assessment period. MDD: Major Depressive Disorder; PTSD: Post Traumatic Stress Disorder; GPS: Global Positioning System;

**Table S5. Summary of studies using active and passive data acquisition methods combined**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Number** | **Reference** | **Population** | **Sampling scheme** | **Sampling frequency** | **Assessment period** | **Primary outcome is a time intensive measure** | **Data aggregated1** | **Measurement quality (compliance, % data)** | **Psychometric properties**  **(reliability, validity)** |
| 1 | Blake *et al.* (2016) | Individuals at risk from general population [psychometric risk: high levels of anxiety and sleeping difficulties] | Diary2;  Actigraphy on non-dominant wrist / continuous | Daily;  Not reported | 7 days  (2 times, i.e. baseline and post-intervention) | Yes (sleep) | Yes | Not reported. | *Reliability:* Bedtimes and rest times were determined by visually screening the actograms using collective information of the actigraphy (algorithm/movement, light, event markers) and sleep diary.  *Validity:* To cross-validate the actigraphy variables, participants completed a paper sleep diary. However, no numbers were reported. |
| 2 | Blake *et al.* (2017) | Individuals at risk from general population [psychometric risk: high levels of anxiety and sleeping difficulties] | Diary2;  Actigraphy at wrist / continuous | Daily;  Not reported | 5 days | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 3 | Blake *et al.* (2018) | Individuals at risk from general population [psychometric risk: high levels of anxiety and sleeping difficulties] | Diary2;  Actigraphy on non-dominant wrist / continuous | Daily;  Not reported | 6 days  (3 times, i.e., at baseline, post-intervention) | Yes (sleep) | Yes | *Compliance with sleep diary:* 75%  *Compliance with actigraphy:* 90%.  Missing data: 6.1% for actigraphy, 14.6% for sleep diary. Missing data was imputed.  Focused on sleep occurring on week days. | *Reliability:* Bedtimes and rest times were determined by visually screening the actograms using collective information of the actigraphy (algorithm/movement, light, event markers) and sleep diary.  *Validity:* Referred to the literature that visual inspection has a good correlation with polysomnography and is superior to automated actigraphy algorithms. | |
| 4 | Becker *et al.* (2019) | Patients [ADHD] | Diary2;  Actigraphy on non-dominant wrist / continuous | Daily;  1-min epochs | 14 days | Yes (sleep) | Yes | *Compliance with sleep diary:* 94% of participants provided data on 5 days.  *Compliance with actigraphy:* 60% of participants provided data on 5 days.  Data exclusion: Participants with <5 nights of weekday data and <3 nights of weekend data were excluded from analyses. | *Reliability:* Not reported.  *Validity:* Data were first validated using the wear-time sensor and a validation algorithm. Diaries were used to aid in adding sleep periods by verifying sleep and wake times. | |
| 5 | Chung *et al.* (2015) | Patients [insomnia and lifetime MDD] | Diary2;  Actigraphy on non-dominant wrist / continuous | Daily;  1-min epochs | 7 days  (3 times, i.e. baseline, post-intervention and 5-week follow-up) | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. | |
| 6 | de Bruin *et al.* (2018) | Patients [insomnia] | Diary2;  Actigraphy at wrist/ continuous | Daily;  1-min epochs | 7 days | Yes (sleep) | Yes | At 2-month follow-up: 95 to 97% of participants provided data; at 6-month follow-up the range was between 44 to 59%. At 12-month follow-up compliance was 47%. | *Reliability:* Not reported.  *Validity:* Not reported. | |
| 7 | Geoffroy *et al.* (2019) | Patients [bipolar disorder] | Diary;  Actigraphy on non-dominant wrist / continuous | Daily;  1-min epochs | 21 days | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. | |
| 8 | Hvolby *et al.* (2008) | Patients [ADHD, ODD, affective disorder, anxiety disorders OCD); healthy controls | Diary2;  Actigraphy at dominant wrist / continuous | Daily;  Not reported | 7 days/ 5 nights | Yes (sleep) | Yes | Not reported.  No missing data for passively assessed sleep variables. | *Reliability:* Not reported.  *Validity:* Not reported. | |
| 9 | Kaplan *et al.* (2019) | Patients [bipolar disorder] | Diary2;  Actigraphy on wrist / continuous | Daily;  Not reported | 14 days | Yes (sleep) | Yes | Compliance with sleep diary was confirmed in a subset of participants by calls to a voicemail. | *Reliability:* Not reported.  *Construct validity* of new questionnaire was demonstrated by small to moderate correlations with sleep diary and actigraphy total sleep time and time in bed.  Referred to previous literature validating actigraphy. | |
| 10 | Kaufmann *et al.* (2018) | Patients [bipolar disorder]; healthy controls | Diary;  Actigraphy on non-dominant wrist / continuous | Daily;  Not reported | 8 weeks (study 1)  3 weeks (study2) | Yes (sleep) | Yes | Compliance with sleep diary: 90%.  Compliance with actigraphy: | *Reliability:* The authors report that objective (actigraphy-derived) sleep interval midpoint values yielded reliable estimates comparable to self-reported chronotype.  *Validity:* Not reported. | |
| 11 | Krane-Gartiser *et al.* (2019) | Patients [bipolar disorder]; healthy controls | Diary;  Actigraphy / continuous | Daily;  1-min epochs | 21 days | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. | |
| 12 | Langberg *et al.* (2019) | Patients [ADHD]; healthy controls | Diary2;  Actigraphy / continuous | Daily;  1-min epochs | 14 to 30 days | Yes (sleep) | Yes | Mean number of days for actigraphy: 14 days. Mean number of days for dairy: 15 days.  Actigraphy data: 8 participants did not have at least five schooldays and 15 participants did not have at least two weekend days.  Diary data: 12 participants did not have at least five schooldays and seven participants did not have at least two weekend days. | *Reliability:* Not reported.  *Validity:* Wear-time sensor built into the device was used in combination with a validation algorithm to maximize the accuracy of when the actigraph was physically being worn by finding the nonwear -times of based upon a threshold of consecutive zeros. | |
| 13 | Lovato *et al.* (2014) | Patients [insomnia] | Diary2;  Actigraphy on non-dominant wrist / continuous | Daily;  30-s epochs | 7 days  (5 times, i.e., screening, pretreatment, during treatment, post-treatment, follow-up) | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. | |
| 14 | McMakin *et al.* (2019) | Patients [GAD; social anxiety disorder; separation anxiety disorder] | ESM;  Diary2;  Actigraphy / continuous | Not reported;  Daily;  Not reported; | 5 days  (5 times, i.e., baseline, 4 week, 8 week, 12 week, and post-treatment) | Yes (sleep) | Yes | *Compliance with diary*: 84% of diary sampling included five nights, 14% included four nights, 1% included three nights, and 1% included one night.  *Compliance with a*ctigraphy: The majority (66%) of actigraphy sampling included five nights, 18% included four nights, 7% included three nights, 5% included two nights, and 4% had one night. | *Reliability:* Not reported. Sleep diary and actigraphy analyses included the number of school nights during which data were collected as a covariate to account for differences in sleep patterns.  *Validity:* Not reported. | |
| 15 | McCrae *et al.* (2019) | Patients [fibromyalgia and insomnia] | Diary2;  Ambulatory polysomnography;  Actigraphy on non-dominant wrist / continuous | Daily to twice a day;  Not reported;  30-s epochs | 14 days  (3 times, i.e., baseline, post-treatment, and follow-up) | Yes (pain, sleep) | No | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. | |
| 16 | Merikangas *et al.* (2019) | Patients [bipolar I, bipolar II, MDD]; healthy controls | ESM with fixed sampling;  Actigraphy / continuous | 4 times / day;  1-min epoch | 14 days | Yes (mood, physical activity) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. | |
| 17 | Owens *et al.* (2009) | Patients [ADHD]; healthy controls | Diary2;  Actigraphy at non-dominant wrist / continuous | Daily;  Not reported | 5 to 12 days | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. | |
| 18 | Palmer *et al.* (2018) | Patients [GAD]; healthy controls | Diary2;  Actigraphy at wrist/ continuous | Daily;  Not reported | 7 days | Yes (sleep) | Yes | Compliance: 97 %.  Actigraphy data of participants with less than 5 days were excluded. | *Reliability:* Not reported.  *Validity:* Sleep diary used as a validation check for actigraphy data | |
| 19 | Prunas *et al.* (2019) | Patients [bipolar disorder] | Diary;  Actigraphy on non-dominant wrist / continuous | Daily;  1-min epochs | 21 days | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* No correlation was found of ADHD symptoms and actigraphy parameters. | |
| 20 | Robillard *et al.* (2014) | Patients [MDD; bipolar disorder] | Diary2;  Actigraphy / continuous | Daily;  30-s and 1-min epochs | 4 to 22 days | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. | |
| 21 | Robillard *et al.* (2015) | Patients [anxiety disorder, MDD, bipolar disorder, psychotic disorder]; healthy controls | Diary2;  Actigraphy / continuous | Daily;  3-s and 1-min epochs | 4 to 22 days | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. | |
| 22 | Robillard *et al.* (2016) | Patients [anxiety, MDD, bipolar disorder] | Diary2;  Actigraphy / continuous | Daily;  1-min epochs | 7 to 22 days | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. | |
| 23 | Slyepchenko *et al.* (2019) | Patients [bipolar disorder; MDD] | Diary2;  Actigraphy at non-dominant wrist / continuous | Daily ;  1-min epochs | 15 days | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. | |
| 24 | Soreca *et al.* (2016) | Patients [bipolar disorder] | Diary2;  Actigraphy on wrist / continuous | Daily;  Not reported | 7 days | Yes (sleep) | Yes | *Compliance for diary:* 88% of participants had at least diary data on 4 days.  *Compliance for actigraphy:* Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. | |
| 25 | Titone *et al.* (2020) | High-risk population [bipolar disorder] | Diary;  Actigraphy on non-dominant wrist / continuous | Daily;  1-min epochs | 20 days | Yes (sleep, activity) | Yes | *Compliance*: 79%.  (Of 150 included participants, data of 118 was presented) | *Reliability:* Referred to the literature.  *Validity:* Referred to the literature that sleep parameters from actigraphy is moderately to strongly correlated with those derived from polysomnography. Actigraphy-measured sleep efficiency was positively correlated with self-reported sleep efficacy. | |
| 26 | Troxel *et al.* (2010) | Patients [insomnia]; healthy controls | Diary2;  Actigraphy at non-dominant wrist/ continuous | Daily;  1-min epochs | 14 days | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. | |
| 27 | Verkooijen *et al.* (2017) | Patients [BPD]; healthy controls | Diary2;  Actigraphy at non-dominant wrist / continuous | Daily;  1-min epochs | 14 days | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. | |
| 28 | Von Korff *et al.* (2012) | Patients [arthritis pain and insomnia] | Diary2;  Actigraphy at wirst / continuous | Daily;  1-min epochs | 7 days | Yes (sleep) | Yes | Response rate for post-intervention: 96.7%; for 9 month assessments: 92.9%. | *Reliability:* Not reported.  *Validity:* Not reported. | |
| 29 | Wallace *et al.* (2017) | Patients [GAD; social anxiety disorder; separation anxiety disorder] | ESM;  Diary2;  Actigraphy on non-dominant wrist / continuous | 2 (weekdays) to 4 (weekends)  Daily;  Not reported. | 5 days | Yes (PA,NA, sleep) | Yes | *Compliance with ESM*: 92%  1 (of 113) participants did not have any ESM data.  *Compliance with sleep diary*: 82% had data of 5 nights, 15% had data only for 1-4 nights and 4% had no sleep diary entries.  *Compliance with actigraphy:* 5 nights captured for 79% of participants; 1-4 nights for 16% and 0 nights for 5%. | *Reliability:* Referred to literature and used data of 5 nights only.  *Validity:* Referred to previous literature for validation of actigraphy. | |
| 30 | Wallen *et al.* (2019) | Patients [AUD] | Diary2;  Actigraphy at non-dominant wrist / continuous | Daily;  Not reported | 30 days | Yes (sleep) | Yes | *Compliance:* 84 % had six or more full nights of actigraphy recorded during the first seven days; 9% provided between one and five nights’ worth of data. 6% did not have any actigraphy data.  Only first 7 days used for analysis. | *Reliability:* Not reported.  *Validity:* Not reported. | |

*Note:* 1 Data aggregated refers to the calculation of a mean over the assessment period. 2 The study collected daily diary data over the course of actigraphy sampling, e.g., using paper diaries. However, the number of diary entries was too low in order to fulfill the criteria for a mixed study design (with at least 20 data points per modality). ADHD: Attention Deficit Hyper Disorder; AN: Anorexia nervosa; AUD: Alcohol Use Disorder; GAD: Generalized Anxiety Disorder; BN: bulimia nervosa; BPD: Borderline Personality Disorder; ESM: Experience Sampling Methodology; MDD: Major Depressive Disorder; SSD: Schizophrenia Spectrum Disorders; OCD: Obsessive Compulsive Disorder; EDNOS-AN: eating disorder not otherwise specified; mean compliance with diary method: 86%, mean compliance with actigraphy: 76%.

# **Table S5. Summary of studies from low and middle income countries (China, Brazil) with less than 100 participants.**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Number** | **Reference** | **Population** | **Data type** | **Sampling scheme** | **Prompts per day / sampling frequency** | **Assessment period** | **Primary outcome**  **is a time intensive measure** | **Data aggregated1** | **Measurement quality**  **(compliance, % data)** | **Psychometric properties (Reliability,**  **Validity)** |
|  | **Sensor or mobile sensing** | | | | | | | | |  |
| 1 | Cheng et al., (2017) | Individuals at-risk from general population [suicidality, emotional distress] | ESM | Random |  | 12 months | Yes (affect) | Yes | Not reported. | *Reliability*: Not reported.  *Validity:* Not reported. |
| 2 | Yin *et al.* (2017) | Patients [insomnia] | Actigraphy | continuous |  | 4 weeks | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
|  | **Combination of active and passive methods** | | | | | | | | |  |
| 3 | Chung et al., (2018) | Patients [insomnia] | Diary2; Actigraphy | time-contingent; continuous | Daily  Actigraphy: 1-min epochs | 6 days | Yes (sleep) | Yes | Dropout rate: 8.9%. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 4 | D’Aurea et al., (2019) | Individuals at-risk from general population [insomnia] | Diary2; Actigraphy | time-contingent; continuous | Actigraphy: 1-min epochs | 15 days | Yes (sleep) | Yes | Not reported. | *Reliability:* Not reported.  *Validity:* Not reported. |
| 5 | Yueng et al., (2011) | Patients [MDD, insomnia] | Diary2; Actigraphy | time-contingent; continuous | Actigraphy: 1-min epochs | 6 days  Actigraphy: 3 days | Yes (sleep) | Yes | Drop-out rate: 9%; 3.8% withdrew from study at 4 week follow-up. | *Reliability:* Actigraphy: Not reported, scales: very good.  *Validity*: Not reported. |

*Note:* 1Data aggregated refers to the calculation of a mean over the assessment period. 2The study collected daily diary data over the course of actigraphy sampling. However, the number of diary entries was too low in order to fulfill the criteria for a mixed study design (with at least 20 data points per modality). ESM: Experience Sampling Methodology; MDD: Major Depressive Disorder.

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