AMERICAN PSYCHOLOGICAL ASSOCIATION

Psychological Assessment

© 2022 American Psychological Association
ISSN: 1040-3590

2023, Vol. 35, No. 2, 115–126
https://doi.org/10.1037/pas0001197

Participation and Compliance in a 6-Month Daily Diary Study Among Individuals at Risk for Mental Health Problems

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Intensive longitudinal (IL) measurement, which involves prolonged self-monitoring, may have important clinical applications but is also burdening. This raises the question who takes part in and successfully completes IL measurements. This preregistered study investigated which demographic, personality, economic, social, psychological, or physical participant characteristics are associated with participation and compliance in an IL study conducted in young adults at enhanced risk for psychopathology. Dutch young adults enrolled in the clinical cohort of the TRacking Adolescents' Individual Lives Survey (TRAILS) were invited to a 6-month daily diary study. Participant characteristics came from five earlier TRAILS assessment waves collected from Age 11 onwards. To evaluate participation, we compared diary study participants ($N = 134$) to nonparticipants ($N = 309$) and a sex-matched subsample ($N = 1926$) of individuals from the general population cohort of TRAILS. To evaluate compliance, we analyzed which characteristics were related to the proportion of completed diary entries. We found that participants (23.6 ± 0.7 years old; 57% male) were largely similar to nonparticipants. In addition, compared to the general population, participants reported more negative scores on nearly all characteristics. Internalizing problems predicted higher compliance. Externalizing problems, antisocial behavior, and daily smoking predicted lower compliance. Thus, in at-risk young adults, who scored lower on nearly every positive characteristic and higher on every negative characteristic relative to the general population, participation in a diary study is unbiased. Small biases in compliance occur, of which researchers should be aware. IL measurement is thus suitable in at-risk populations, which is a requirement for its usefulness in clinical practice.

Public Significance Statement
Diary studies, in which participants monitor their mood daily for several consecutive weeks or months, are increasingly popular in psychological science. It is possible, however, that such studies only attract specific types of individuals. We had the unique possibility to compare individuals, who participated in a diary study to individuals who did not, and found no evidence for selection bias, suggesting that diary studies can be broadly applied.

Keywords: intensive longitudinal designs, daily diary, selection bias, compliance, psychopathology

Supplemental materials: https://doi.org/10.1037/pas0001197.supp

This article was published Online First December 19, 2022.

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The authors thank everyone who participated in this study. Further, the authors would like to thank Bianca Gorter and the TRacking Adolescents' Individual Lives Survey (TRAILS) data management team for their valuable help with data collection. The infrastructure for the TRAILS is funded by the Netherlands Organization for Scientific Research (NWO), ZonMW, GB-MaGW, the Dutch Ministry of Justice, the European Science Foundation, the European Research Council (ERC), Biobanking and BioMedical Research resources Infrastructure-the Netherlands, and the participating universities. Additionally, this research was supported by the NWO (Grants 406.16.507 and 016.156.019) awarded to Robin N. Groen and Johanna T. W. Wigman and the ERC under the European Union's Horizon 2020 research and innovative program (Grant 681466) awarded to Marieke Wichers.

The authors have no conflict of interest to disclose.

Marieke J. Schreuder and Robin N. Groen contributed equally to this work.

Marieke J. Schreuder and Robin N. Groen conceived the study, collected data, preregistered the study, performed analyses, and wrote the original draft. Johanna T. W. Wigman, Marieke Wichers, and Catharina A. Hartman supervised the project and provided critical feedback. Marieke Wichers acquired funding. All authors read and approved the final version of this article.

Marieke J. Schreuder played an equal role in conceptualization, formal analysis, investigation, methodology, project administration, visualization, writing of original draft, and writing of review and editing. Robin N. Groen played a lead role in funding acquisition and an equal role in conceptualization, formal analysis, investigation, methodology, project administration, visualization, writing of original draft, and writing of review and editing. Johanna T. W. Wigman played a lead role in funding acquisition, a supporting role in writing of review and editing, and an equal role in conceptualization and supervision. Marieke Wichers played a lead role in funding acquisition; a supporting role in conceptualization, methodology, and writing of review and editing; and an equal role in supervision. Catharina A. Hartman played a lead role in funding acquisition; a supporting role in data curation, methodology, project administration, and writing of review and editing; and an equal role in conceptualization and supervision.

Data are available upon request (www.trails.nl).

This study was preregistered (www.osf.io/6yvc9).

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Intensive longitudinal designs (ILDs), such as daily diary studies, are increasingly conducted to study the dynamics of psychological processes. Key to these designs is that individuals are repeatedly measured, once a day or multiple times a day, for multiple weeks or months. This results in sufficient observations per person to assess within-person processes of change. Improved understanding of within-person change in psychological processes may offer (in the longer run) important opportunities for individuals in clinical practice (Bos et al., 2019; Piccirillo et al., 2019; van os et al., 2013; Wright & Woods, 2020). For example, repeatedly monitoring mental states and experiences may shed light on the circumstances that trigger symptoms, which may in turn inform therapeutic interventions. Ultimately, such feedback on psychological dynamics may lower symptom severity in persons with psychiatric problems (Kramer et al., 2014).

ILDs thus hold great promise, which together with the increasing availability of mobile internet has made the use of these designs widely popular (Hamaker & Wichers, 2017). However, ILDs might be experienced as more intrusive and demanding in comparison to a one-time survey. Particularly, ILDs with longer questionnaires are burdening, which increases participants' tendency to skip assessments (Eisele et al., 2022). In contrast, the number of assessments per day and study duration do not influence participants' commitment (Eisele et al., 2022; Jones et al., 2019; Wen et al., 2017; Wrzus & Neubauer, 2022). Besides design characteristics (e.g., questionnaire length, sampling frequency, and duration), involvement in ILDs might depend on participant characteristics. For instance, it is possible that individuals, who are relatively agreeable, conscientious, highly educated, and have more time on their hands, are especially likely to take part in ILDs (Ohly et al., 2010; Scollon et al., 2003; Wilhelm et al., 2004). Empirically verifying the extent of self-selection is difficult, since information on individuals who decline to participate is often lacking. However, several studies showed that females with higher education levels are generally overrepresented in diary studies (Arndt & Rose, 2022; Rönkä et al., 2014; van der Krieke et al., 2016). Such self-selection of certain types of individuals into ILDs raises the question whether findings of these studies are generalizable to all individuals who are part of a specific target group (e.g., nonconscientious individuals with a depressive disorder).

Aspects of the ILD that are believed to influence self-selection in participation may likewise determine who, once started, does well in such a study. Good compliance requires, for instance, that individuals remember to participate (answer questions daily) and complete every question even when they do not feel like it (Larson et al., 2002; Mulligan et al., 2000). Possibly, individuals scoring higher on certain traits such as being conscientious or well-organized find it less of an effort to comply with the protocol than individuals who score lower on these traits. Indeed, meta-analyses reported that compliance is lower in individuals with substance abuse (Jones et al., 2019) and psychosis (Vachon et al., 2019) compared to individuals without these diagnoses. However, many studies reported no effect of person characteristics (e.g., personality, mental health, demographics) on compliance (Courvoisier et al., 2012; Soyster et al., 2019; Wen et al., 2017; Wrzus & Neubauer, 2022), which perhaps follows from self-selection: if only motivated, well-functioning individuals participate, compliance might seem unbiased. In conclusion, whether findings from ILDs generalize to the broader (clinical) population has remained an open question.

While the question to whom ILDs generalize is of high clinical relevance, knowledge about which participant characteristics relate to self-selection and compliance is scarce. Both self-selection and compliance are difficult to evaluate because the required information is often unavailable. In the case of self-selection, we lack information on the individuals who did not respond to the invitation to participate in ILD studies. Additionally, characteristics of respondents are seldomly compared to population norms. It is therefore hard to tell to what extent findings may generalize beyond the specific sample under investigation. In the case of compliance characteristics, we lack information because researchers may limit the number of additional questionnaires on background characteristics, balancing the participation burden toward the repeated assessments. Even if many characteristics are available, the findings of studies that relate person characteristics to compliance (Courvoisier et al., 2012; Jones et al., 2019; Rintala et al., 2019; Soyster et al., 2019; Vachon et al., 2019; Wen et al., 2017) are hard to interpret without insight in self-selection that may occur during study enrollment: if only certain types of individuals enroll in ILDs, compliance might erroneously appear unaffected by characteristics like socioeconomic status, personality, or physical health (Wrzus & Neubauer, 2022).

In sum, the key question is whether ILDs—which are more burdening than traditional cross-sectional designs—are a suitable method of data collection for everyone, or instead, consistently over- or underrepresent certain individuals. Such over- or underrepresentation could occur because of selection bias (e.g., more conscientious individuals are more likely to enter the study) or because of compliance bias (e.g., more conscientious individuals complete more assessments and are therefore overrepresented; van Berkel et al., 2020). It is important to evaluate sources of over- as well as underrepresentation because they directly impact the generalizability of findings from ILDs. While representativeness of a sample in relation to the population from which it is drawn is a prominent theme in epidemiology, it has been neglected in the context of ILDs. The present study therefore aimed to establish a more comprehensive profile of who decides to participate and does well in ILD studies. Our primary aim was to provide a detailed, empirical characterization of individuals who participated in a 6-month diary study by comparing ILD participants to nonparticipants and to the general population. Our second aim was to investigate which participant characteristics were associated with compliance.

For both aims, we investigated which demographic, economic, social, psychological, and physical characteristics were associated with participation and compliance in a 6-month diary study that was conducted in a sample of Dutch young adults with heightened risk for psychopathology. Participants in the diary study were recruited within the ongoing TRacking Adolescents' Individual Lives Survey clinical cohort study (TRAILS CC). The TRAILS CC respondents are at higher risk for psychological and psychiatric problems based on having been in contact with psychiatric services at any time before the age of 11 when TRAILS CC started (Oldehinkel et al., 2015, see also sample and design). Around Age 22, TRAILS CC participants were invited to participate in a diary study. Parallel to TRAILS CC, TRAILS includes a representative population sample (TRAILS PC) of Dutch young adults for whom the same instruments were used at the same ages. We compared diary participants (TRAILS CC participants who enrolled in the diary study) to both (a) diary nonparticipants (TRAILS CC participants who did not

enroll in the diary study) and to (ii) a sex- and age-matched sample from the general population (TRAILS PC) on a wide range of characteristics that were measured in TRAILS during the five waves prior to the diary study. The first comparison allowed to investigate which characteristics were associated with enrollment into a diary study. The second comparison, in combination with analyses of diary participants' compliance, allowed to determine whether ILDs are also representative of individuals who compared to the general population score lower on positive and higher on negative demographic, personality, economic, social, psychological, and physical characteristics.

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Method

Participants

This study is based on data collected as part of the TRAILS. TRAILS is an ongoing, prospective cohort study with bi- or triennial follow-up assessments investigating the development of mental health from preadolescence into adulthood in both a clinical (TRAILS CC) and a general population cohort (TRAILS PC). Both cohorts have been extensively described elsewhere (Huisman et al., 2008; Oldehinkel et al., 2015). Briefly, children born between 1994 and 1995 who had been referred to a child psychiatric outpatient clinic in the Northern Netherlands any time before the age of 11 were eligible to participate in the clinical cohort (TRAILS CC). At 11 years old, participants either met criteria for a current psychiatric disorder (mostly externalizing domains), a lifetime diagnosis without a current disorder (mostly internalizing domains), or did not have a lifetime diagnosis (Dietrich et al., 2013). Due to the referral to mental health services before the age of 11, individuals participating in this cohort are considered to have heightened risk for psychiatric symptoms. This is supported by previous findings in this cohort, which showed that TRAILS CC participants experienced more mental health problems (Hartman et al., 2013) and more often met criteria for a psychiatric diagnosis at age 16 compared to the general population (Oldehinkel et al., 2015). In line with this, other longitudinal studies consistently showed that childhood mental health problems—which are often recognized as attention-deficit hyperactivity disorder (ADHD), autism spectrum disorder, or behavioral problems—are important precursors of both internalizing (e.g., anxiety) and externalizing (e.g., antisocial personality) disorders in young adulthood (Caye et al., 2016; Feehan et al., 1995; Loth et al., 2014; Meinzer et al., 2013). For instance, more than half of the individuals with autism spectrum disorder meet criteria for mood and anxiety disorders later in life (Lever & Geurts, 2016). Similarly, a history of ADHD and externalizing behavioral problems increases the risk for future mood and anxiety disorders (Caye et al., 2016; Loth et al., 2014; Meinzer et al., 2013).

Of the eligible individuals, 543 (43%) participated in the first measurement wave (M_{age} = 11.1, SD = 0.5, 34% girls) in 2004–2005. The general population cohort of the TRAILS (TRAILS PC) study preceded the clinical cohort, and its baseline assessment (T1) ran from March 2001 through July 2002. Children born between October 1st 1989 and September 30th 1991 in five municipalities in the North of the Netherlands were eligible for inclusion in TRAILS PC. Of the eligible individuals who met inclusion criteria and whose schools agreed to participate, 2,230 (76%) participated (M_{age} = 11.1, SD = 0.6, 51% girls). Each assessment wave of TRAILS was approved by Dutch Central Committee on Research Involving Human Subjects (CCMO; www.ccmo.nl), and adolescents (and at earlier waves also the parents) provided informed consent prior to participating in each wave. Data are available upon request (www.trails.nl).

After the fifth assessment wave, when young adults were approximately 22 years old, all TRAILS CC participants who had not formally declined further participation in the TRAILS CC study (n = 443) were invited to participate in an add-on study called TRAILS TRANS-ID (transitions in depression). This study included a 6-month daily diary period and aimed to investigate the day-to-day fluctuations in symptoms in individuals at increased risk for psychopathology. Of the 443 individuals who were invited for TRAILS TRANS-ID, 134 (30.2%) were included. Every evening, for a period of 6 consecutive months, these participants received a link to a questionnaire on their mobile phone—yielding up to 183 assessments per person. The questionnaire included 58 questions on participants' mood and experiences during the past day (e.g., to what extent did you feel anxious today?). Participants could answer on a visual analogue scale ranging from 0 (*not at all*) to 100 (*very much*). After completing the diary study, participants received a financial compensation and an overview of their own data. The TRAILS TRANS-ID study was approved by the local Medical Ethical Committee (ref. 207/103), and all participants provided written informed consent. Further details on the data collection procedures for TRAILS TRANS-ID are described elsewhere (Schreuder et al., 2020).

The present study used data of the 443 individuals invited to TRAILS TRANS-ID collected during the five assessment waves of TRAILS CC prior to TRAILS TRANS-ID and data on compliance obtained during the diary period of TRAILS TRANS-ID. Additionally, we used data of 1,926 TRAILS PC participants collected during the first five waves of TRAILS PC. To account for the fact that the majority of TRAILS TRANS-ID participants (57%) are male, the 1926 individuals reflect a sex-matched subset of the total number of TRAILS PC participants (N = 2,230). Matching was achieved by randomly selecting women from the sample, resulting in a subsample with 57% men to match the TRAILS TRANS-ID sex distribution (as opposed to 51% in the full TRAILS PC cohort). Matching on age was not necessary, as participants of the clinical and general population cohorts had the same age at each assessment wave.

Measures

We identified variables that could be associated with participation or compliance in the diary study from five domains: (a) personality and cognitive functioning, (b) economic characteristics, (c) social characteristics, (d) psychological health, and (e) physical health. These domains provided a broad coverage of individuals' functioning (Ormel et al., 2017) or had been suggested to be relevant to the choice of participation specifically (Scollon et al., 2003). Specific variables for each domain were preregistered prior to conducting the analyses (Groen & Schreuder, 2020). In case of multiple variables with similar content were available for specific domains, we selected variables that were (a) measured across multiple waves and (b) were likely to be relevant to the larger part of the sample. For instance, "young parenthood" (having a child before the age of 18 years old) was not selected because it would apply only to a very small subset of individuals. All variables were assessed in TRAILS prior to the

start of the TRANS-ID study. If variables were assessed at multiple waves, they were aggregated by calculating either the sum (i.e., lifetime adverse events, chronic social stressors, and financial difficulties) or mean (e.g., social problems and family functioning) across waves. The instruments or questions used to assess each characteristic are listed below, with the timing between brackets (T1 = first assessment wave, when participants were 11 years old; T2 = second assessment wave, when participants were 13–14 years old, etc.). A summary of instruments can also be found in Supplemental Table S1.

Personality and cognitive functioning were assessed by the Wechsler Intelligence Scale for Children–Revised (T1; Wechsler, 1974) and the NEO Personality Inventory–Revised (T3, T5; Costa & McCrae, 1992). Both have good psychometric properties (De Fruyt et al., 2009; Silverstein, 1975).

Economic characteristics were reflected by parental educational attainment (T1, T4), household income (T1, T4), most recent parental occupation (T1), educational attainment (T5), social participation (work/education/neither; T5), and financial difficulties in family (T2–T4) or personally (T4–T5).

Social characteristics were measured by the Social Problems subscale of the Youth and Adult Self-Report (YSR, ASR; T1–T5; T. M. Achenbach, 1995), the parent-reported Child and Adult Behavior Checklist (CBCL, ABCL; T1–T3, T5; T. M. Achenbach, 2001), and the Teacher Report Form (TRF; T1–T3; T. M. Achenbach & Rescorla, 2001), which all have good psychometric properties (T. M. Achenbach & Rescorla, 2001; T. Achenbach & Rescorla, 2003).

Psychological health was reflected by internalizing problems, externalizing problems, and symptoms of ADHD assessed by the YSR and ASR (T1–T5), the CBCL and ABCL (T1–T3, T5), and the TRF (T1–T3). Additionally, symptoms of autism spectrum disorder were assessed by the validated Children's Social Behavior Questionnaire (T1–T4; Hartman et al., 2006), and antisocial behavior was assessed by the Antisocial Behavior Questionnaire (T1–T5; Moffitt & Silva, 1988). We also included parent-reported absenteeism due to psychological ill-health (no. of days; T2–T3) and self-reported psychotropic medication use (T5) as indicators of psychological health.

Physical health was reflected by substance use (cigarettes, alcohol, cannabis, illicit drugs; T2–T5), body mass index (BMI; T1–T2, T4–T5), absenteeism due to physical ill-health (no. of days; T2–T3), and subjective physical health (T1–T5). The latter was assessed by asking participants (T1–T3, T5) and their parents (T1–T4) how they would rate their (child's) physical health on a 5-point Likert scale ranging from *bad* to *very good*.

Analyses

The analyses of this study were preregistered on the Open Science Framework (Groen & Schreuder, 2020). When deviations from the preregistered analyses occurred, reasons for this are explained in the footnotes. An overview of all changes made relative to the preregistration is provided in the Supplemental Materials (p. 2). Analyses were conducted in R (Version 4.0.2).

To evaluate characteristics related to participation in a diary study and to compare them with reference values from the general population cohort, we conducted a series of regression analyses.[1] In these analyses, characteristics were predicted by participant group (diary participant vs. diary nonparticipant vs. general population). We used linear regression for continuously measured characteristics (including ordinal/interval variables with >5 categories) and (multinomial) logistic regression for categorical variables. We applied a Bonferroni–Holm correction (Holm, 1979) to maintain a family-wise error rate of 0.05 within each global characteristic (i.e., personality and cognitive functioning, economic, social, psychological health, and physical health). Adjusted p values were calculated as follows: given a significance level a (α; which in our case was 0.05), and rank order k (i.e., the rank when ordering the p values according to their size from smallest to largest), and number of tests m (i.e., the number of tests per global characteristic), the adjusted p value equals: $p = a/(m + 1 - k)$. Furthermore, we calculated Cohen's d[2] effect sizes from the continuous estimates[3] (Cohen, 1988) and from the log-odds ratios[4] (Sánchez-Meca et al., 2003), to compare characteristics that were measured using different scales and to be able to compare effects across comparisons (i.e., participants vs. nonparticipants and participants vs. general population). These effect sizes were interpreted post hoc using the benchmarks (small, $d = 0.2$; medium, $d = 0.5$; and large, $d = 0.8$) suggested by Cohen (1988).

Finally, in order to ensure that potential group differences were not due to a general lack of interest in continued participation in TRAILS rather than the daily diary study, we ran an attrition analysis,[5] in which we excluded individuals who had not participated in the fifth assessment wave (T5). Results of the attrition analyses, where we compared groups of individuals who completed T5 (i.e., participants who completed T5 vs. nonparticipants who completed T5 and vs. TRAILS PC participants who completed T5), can be found in the Supplemental Material Table 3. All discrepancies between the main and the attrition analyses are noted in the main text.

To evaluate whether personality and cognitive functioning, economic, social, physical health, and psychological health characteristics were associated with compliance in a diary study, we conducted a series of univariate linear regressions.[6] To facilitate comparison to previous studies on compliance in ILDs (Vachon et al., 2019), compliance was treated as outcome variable and

[1] The comparison with the population cohort is a deviation from the preregistration. It was added so we could evaluate whether the at-risk diary participants indeed scored lower on characteristics that were suggested to be associated with enrollment and good compliance. Given that we changed from a two-group to a three-group comparison, we changed our analytical approach. Instead of conducting a series of t tests for continuous variables and chi-square test for categorical variables, we ran a series of regression analyses in which group membership was a dummy-coded predictor. The latter approach is equivalent to an analysis of variance with three groups.

[2] This is a deviation from the preregistration.

[3] According to formula: Cohens' $d = \frac{M_2 - M_1}{\sqrt{\frac{(n_1 - 1)SD_1^2 + (n_2 - 1)SD_2^2}{n_1 + n_2 - 2}}}$ in which $M_2 - M_1$ is substituted for the regression coefficient b, which in a linear regression with dummy-coded predictors represents the mean difference between groups.

[4] According to the formula: Cohens' $d = \log \mathrm{OR} \times \frac{\sqrt{3}}{\pi}$.

[5] This is a deviation from the preregistration. The attrition analysis was added to verify whether our findings with respect to characteristics related to participation were driven by participation in research in general or, instead, specific to participation in a daily diary study. If differences between participants and nonparticipants would disappear when only including those who participated in the fifth assessment wave, this implies that the aforementioned differences relate to research participation in general, as opposed to participation in a daily diary study.

[6] This a deviation from the preregistration, in which we had specified that we would use a Pearson correlation to evaluate the relationship between continuous characteristics and compliance. However, as we used linear regression with dummy-coded predictors to evaluate the relationship between categorical variables and compliance, we changed the Pearson correlation to a linear regression model to make the analyses more congruent.

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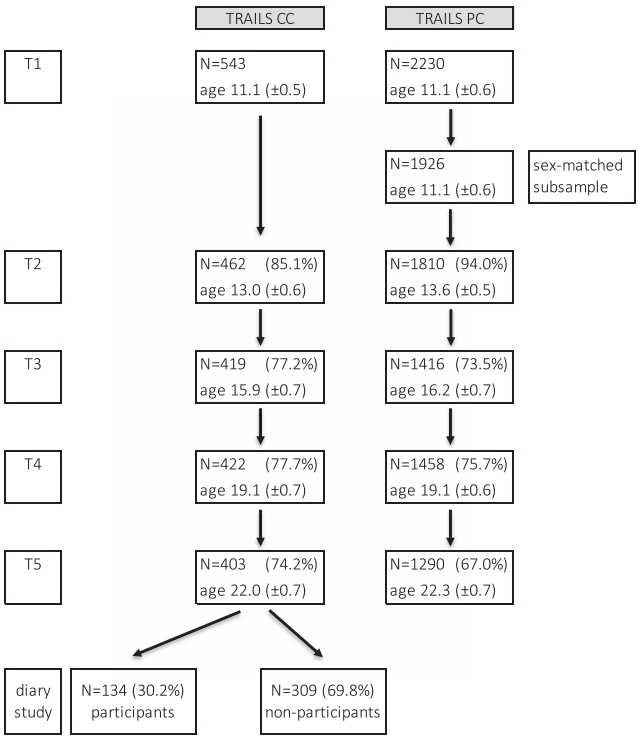
expressed as the percentage completed daily diaries (i.e., number of completed daily diary entries divided by the number of diaries sent to that participant). Compliance and continuous predictors were standardized by subtracting the mean and dividing by the standard deviation. Similar to the participation analyses, a Bonferroni–Holm correction (Holm, 1979) was applied to adjust for multiple testing.

Results

Figure 1 displays a flow diagram showing the number of participants that completed each TRAILS assessment wave and the age and gender distribution for each wave. Of the 134 individuals who participated in the diary study (referred to as participants), nine (6.7%) had not participated in T5. Of the 309 individuals who declined participation in the diary study (referred to as nonparticipants in the remaining text), 123 (39.8%) had also not participated in T5. This difference indicates that nonparticipants are partly characterized by a more general lack of interest in continued participation in TRAILS than specifically in the diary study as such, showing the relevance of the attrition analysis for drawing correct conclusions. Attrition was not specific to TRAILS CC (30% overall), as a similar proportion of participants in the general population cohort (TRAILS PC) had not participated in T5 (33% overall, $n = 636$). Table 1 shows the demographic characteristics of the research sample. Supplemental Table S2 shows descriptive statistics for all reported variables.

Figure 1

Flowchart of the Number of Participants Assessed Per Wave



Note. CC and PC refer to the clinical and population cohorts of TRAILS, respectively. The diary study central to TRAILS TRANS-ID is an add-on study in TRAILS CC. Of the original sample in 2004 ($N = 543$), 100 individuals dropped out. Hence, 443 participants were eligible for participation in the diary study. Of these 443 eligible participants, 132 (29.8%) had not participated in the fifth assessment wave of TRAILS. In sensitivity analyses, we excluded these participants. Numbers behind rows that denote the TRAILS assessment waves (T1–T5) refer to the percentage of the initial sample at T1 (TRAILS CC) or the sex-matched subsample (TRAILS PC) and mean age (±*SD*). We selected this sex-matched subsample in order to obtain equal sex distributions between TRAILS TRANS-ID participants ($N = 134$) and individuals from the general population. TRAILS = TRacking Adolescents' Individual Lives Survey; TRANS-ID = transitions in depression.

Associations Between Participant Characteristics and Participation

Women were more likely to participate in the diary study than men (43.3 vs. 31.4% female), $\chi^2(1) = 5.30$, $p = .02$. Figure 2 shows the comparison between participants and nonparticipants on the other characteristics (see Table S3 in Supplemental Material, for a numeric representation). Participants had a higher IQ than nonparticipants ($M_P = 100.3$, $M_{NP} = 96.0$; $B = -4.32$, $p_{corrected} = .04$, $d = -0.28$, 95% CI [−0.48, −0.07]). Additionally, there was a moderate difference in number of reported adverse events ($M_P = 10.4$, $M_{NP} = 7.7$; $B = -2.76$, $p_{corrected} < .001$, $d = -0.51$, 95% CI [−0.72, −0.29]). However, after excluding individuals who had not participated in T5, both differences became smaller and nonsignificant (Supplemental Material Table S4). This suggests that individuals with lower IQ scores and individuals experiencing less negative life events may be less likely to continue participation in research in general and are not necessarily uninterested in a diary study per se.

Generally, effect sizes of other characteristics were small (average Cohen's $d = 0.14$). Notable exceptions were as follows: a moderate difference between participants and nonparticipants in the extent to which they reported financial debts ($d = -0.45$, 95% CI [−0.90, −0.01], $OR = 2.2$, $p_{corrected} = 0.53$) and small-to-moderate differences in the likelihood of being enrolled in education ($d = -0.31$, 95% CI [−0.56, −0.05], $OR = 1.75$, $p_{corrected} = 0.25$; less likely for nonparticipants) and in antisocial behavior ($d = 0.30$, 95% CI [0.09, 0.50], $p_{corrected} = 0.20$; slightly higher in nonparticipants). These effects, however, became smaller in the attrition analysis. This suggests that if these effects would have been significant in a larger sample, these differences might not be specific to the decision to participate in the diary study but related to study attrition in general. Hence, none of the assessed characteristics seemed specifically associated with participation in the diary study itself.

Reference Values for Participant Characteristics

A reason for the absence of differences between participants and nonparticipants could be that the invited individuals, despite being sampled from an at-risk cohort, did not actually display characteristics that were hypothesized to be related to participation in diary studies (e.g., self-discipline, enrollment in education). To evaluate this, we compared the diary participants with the general population (see Supplemental Table S3 and Figure 2). With the exception of socioeconomic status characteristics, which did not differ between diary participants and nonparticipants, diary participants scored higher on negative characteristics (e.g., worse psychological ill-health or more social problems) and scored lower on positive characteristics (e.g., lower family functioning or self-discipline). Effects sizes of the differences between diary participants and the

Table 1
Demographics Research Sample

Variable	Participants (N = 134)	Nonparticipants (N = 309)	General population (N = 1,926)
	M (SD)/n (%)	M (SD)/n (%)	M (SD)/n (%)
Age in years at start TRAILS TRANS-ID	23.62 (0.67)	23.53 (0.71)	27.2 (0.55)[a]
Sex (% males)	76 (56.7)	212 (68.6)	1,098 (57.0)
Non-Dutch ethnicity parents	0 (0)	7 (2.3)	264 (13.7)

Note. TRAILS = TRacking Adolescents' Individual Lives Survey; TRANS-ID = transitions in depression.
[a] General population cohort of TRAILS started approximately 4 years before the clinical cohort of TRAILS (from which diary participants were sampled).

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sex- and age-matched general population sample (average Cohen's d = 0.38) were higher than for the differences between participants and nonparticipants (average Cohen's d = 0.14). The majority of significant differences found in main analysis remained significant in attrition analysis (except for differences in antisocial behavior and BMI; see Supplemental Material Table S4). Diary participants thus consistently scored less "favorably" (i.e., higher on negative characteristics and lower on positive characteristics) than the general population on characteristics that were hypothesized to influence who signs up for an ILD.

Associations Between Participant Characteristics and Compliance

On average, participants completed 84.9% (SD = 15.3) of the daily diaries. Table 2 shows the associations between participant characteristics and compliance. Figure S1 in the Supplemental Materials provides a visual summary of the results. The majority of characteristics were not associated with participants' compliance. Characteristics that were negatively associated with compliance were teacher-reported externalizing symptoms (β [95% CI] = −.28 [−0.44, −0.11], $p_{corrected}$ = 0.02), antisocial behavior (β [95% CI] = −.29 [−0.46, −0.13], $p_{corrected}$ = 0.01), and daily smoking (β [95% CI] = −.64 [−1.08, −0.21], $p_{corrected}$ = 0.04). In contrast, self-reported internalizing symptoms were positively associated with compliance (β [95% CI] = .25 [0.08, 0.42], $p_{corrected}$ = 0.04). A few other effects related to substance use (i.e., cannabis) and psychological health (i.e., ADHD and medication use) had comparable or larger associations with compliance (>.30 in case of cannabis use) but were not significant after correcting for multiple testing.

Discussion

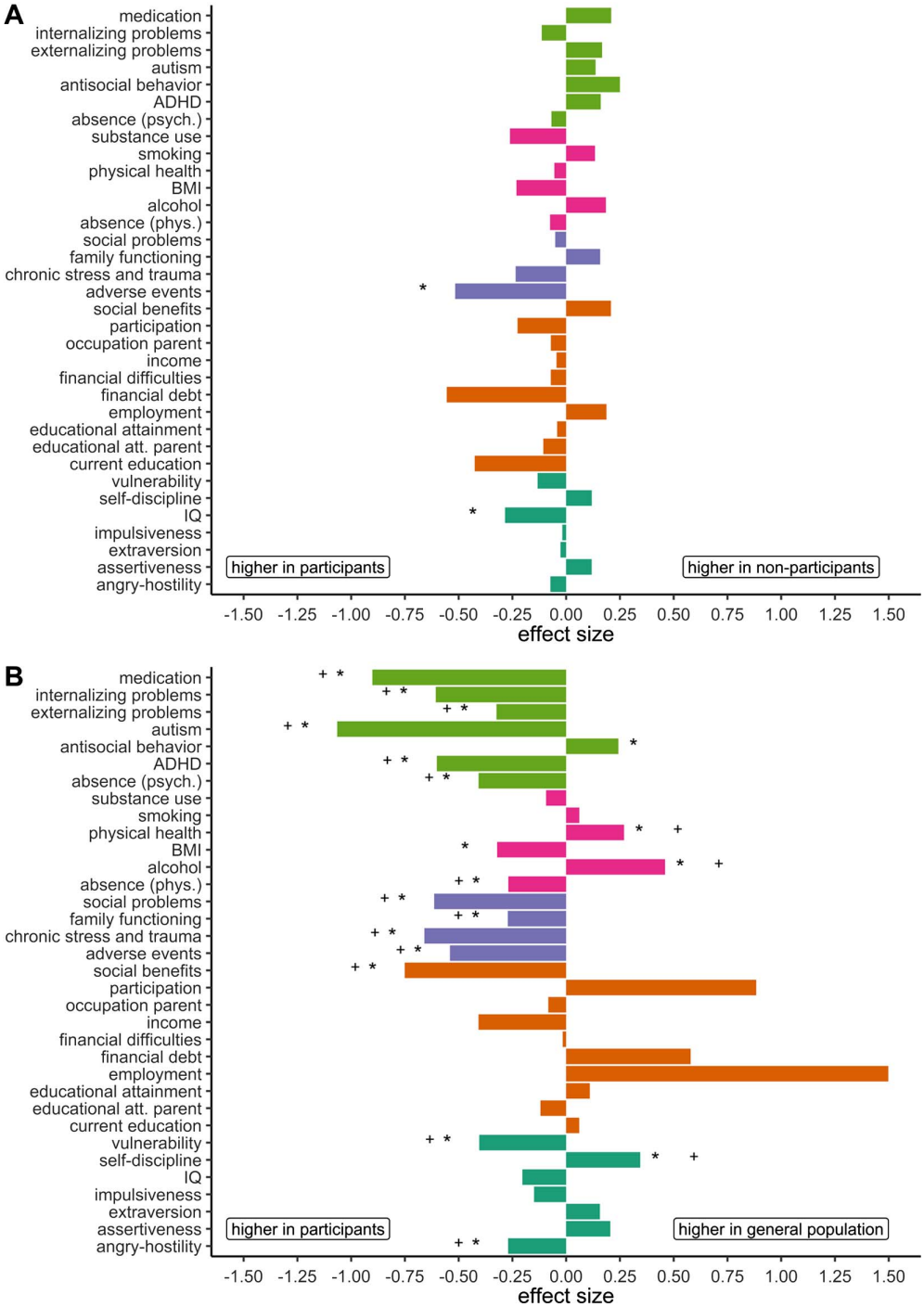
The present study investigated who participates in ILDs, and, when enrolled in such a study, who does well in terms of compliance. From our empirical, descriptive characterization of a cohort of at-risk individuals who were invited for a 6-month daily diary study, it seems that participation in ILDs is not reserved for relatively healthy, high-functioning individuals, as previously suggested (Scollon et al., 2003). Rather, individuals who are vulnerable for mental health problems participate and are compliant. First, comparing the diary participants and the cohort participants who decided not to participate in the diary study, we observed that the diary participants were not necessarily the better functioning part of the cohort. After ruling out differences (e.g., higher IQ scores and less behavioral problems for participants than nonparticipants) that were likely due to selective attrition effects in TRAILS CC rather than a specific lack of interest in the diary study, there were no differences in characteristics (e.g., personality, family socioeconomic status, physical health, or mental health problems) that suggested participants functioned better than nonparticipants. This was not due to TRAILS CC participants functioning well, illustrated by the finding that participants scored higher on nearly every negative characteristic (e.g., more social problems) and lower on nearly every positive characteristic (e.g., less self-discipline) compared to the general population. Finally, with the exception of behavioral problems, none of these characteristics negatively affected compliance. In fact, compliance in this study was excellent (on average 84.9%). We conclude therefore that daily diary studies are neither hindered by self-selection bias nor by compliance bias. It follows that ILDs can be successfully applied to study individuals with psychiatric problems and do neither overrepresent nor underrepresent certain characteristics (e.g., personality types or socioeconomic backgrounds).

As argued in the introduction, individuals for whom participation is no effort are thought to be overrepresented in ILDs (Scollon et al., 2003). These individuals are conscientious, self-disciplined, prosocial, and have relatively few health problems that could interfere with participation. Such characteristics are of particular importance for participation in ILDs, due to their higher burden and the lengthy commitment that is requested (Gable et al., 2000; Litt et al., 1998). However, there is also an opposing view on the profile of research participants that may typically take part in ILDs (Courvoisier et al., 2012; Scollon et al., 2003): individuals with reduced mental health. Individuals with mental health problems may be more motivated to contribute to studies into mental health, for instance, because such studies may improve self-understanding or help others with similar problems (Bos et al., 2019; Zullino et al., 2003). They may also have more time on their hands (i.e., no job or not enrolled in education) and more interest in the renumeration provided to participants (Scollon et al., 2003). Both profiles imply a selection bias, and for ILDs with clinical implications, the first profile ("happy and healthy") is most detrimental. We found no support for this profile: diary participants did not report more self-discipline nor were they healthier than nonparticipants. Importantly, compared to the general population, participants of the diary study scored less "advantageous"[7] on practically all characteristics (including self-discipline and health), indicating that this first profile does not fit the average TRAILS TRANS-ID participant. In favor of the second profile, we observed that diary participants had experienced more stressors and traumatic events compared to nonparticipants and reported

[7] Higher on negative characteristics and lower on positive characteristics.

Figure 2

Differences Between Participants of an Intensive Diary Study (TRAILS TRANS-ID) and (A) Individuals Who Were Invited, but Declined to Participate and (B) Individuals From the General Population



Note. For readability, variables were merged if they were assessed in multiple informants (e.g., financial difficulties, social problems, physical health, and internalizing and externalizing problems) or if they were conceptually similar (e.g., cannabis, illicit drug use). If any of the lower level variables was significantly different between groups, the averaged effect size is accompanied with a sign. Asterisks mark effects that were statistically significant after correcting for multiple testing (Holm's procedure); plus signs mark effects that were statistically significant in sensitivity analyses. The illustrated data are also provided in a table (i.e., see Supplemental Tables S3–S4). TRAILS = TRacking Adolescents' Individual Lives Survey; ADHD = attention-deficit hyperactivity disorder; BMI = body mass index; TRANS-ID = transitions in depression. See the online article for the color version of this figure.

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Table 2

General Linear Model Results for Compliance (i.e., % of Completed Daily Diary Assessments) of Diary Participants (n = 133[a]) Who Started the Daily Diary Study

Variable	*B*	β [95% CI]	*SE*	*p* value	Adjusted *p* value
Age	3.28	0.14 [−0.03, 0.32]	1.96	.10	.19
Sex[b]					
Male (vs. female)	−0.84	−0.05 [−0.4, 0.29]	2.69	.78	.76
Personality and cognitive functioning					
Assertiveness	−0.52	−0.18 [−0.36, 0]	0.27	.06	.39
Extraversion	−0.35	−0.11 [−0.29, 0.08]	0.30	.25	1.00
Self-discipline	0.40	0.14 [−0.05, 0.32]	0.27	.14	.84
Angry-hostility	−0.05	−0.01 [−0.19, 0.16]	0.33	.89	1.00
Impulsiveness	−0.45	−0.11 [−0.28, 0.07]	0.36	.22	1.00
Vulnerability	0.07	0.02 [−0.15, 0.2]	0.32	.82	1.00
IQ	0.00	0 [−0.17, 0.17]	0.09	1.00	1.00
Economic characteristics					
Financial difficulties (self)	−3.70	−0.17 [−0.34, 0]	1.87	.050	.81
Educational attainment	0.27	0.02 [−0.16, 0.2]	1.33	.84	1.00
Financial difficulties (parent)	−1.75	−0.07 [−0.24, 0.1]	2.19	.43	1.00
Employment[b]					
Employed (vs. unemployed)	6.78	0.44 [−0.24, 1.13]	5.19	.20	1.00
Social benefits[b]					
Yes (vs. no)	−0.65	−0.04 [−0.45, 0.36]	3.15	.84	1.00
Societal participation[b]					
Yes (vs. no)	4.74	0.31 [−0.21, 0.83]	4.03	.24	1.00
Current education[b]					
Yes (vs. no)	0.12	0.01 [−0.36, 0.37]	2.84	.97	1.00
Financial debt[b]					
Yes (vs. no)	−2.28	−0.15 [−0.66, 0.36]	3.97	.57	1.00
Educational attainment of mother	−0.57	−0.03 [−0.21, 0.14]	1.521	.71	1.00
Educational attainment of father	−1.51	−0.11 [−0.29, 0.08]	1.333	.26	1.00
Income[c]					
Middle (vs. low, <1,150)	4.85	0.32 [−0.47, 1.11]	6.11	0.43	1.00
High, >3,500 (vs. low, <1,150)	4.85	0.32 [−0.6, 1.23]	7.09	.49	1.00
Occupation mother[c]					
Middle (vs. low)	−1.02	−0.07 [−0.67, 0.54]	4.65	.83	1.00
High (vs. low)	−5.32	−0.35 [−0.99, 0.29]	4.94	.28	1.00
Occupation father[c]					
Middle (vs. low)	4.09	0.27 [−0.23, 0.77]	3.86	.29	1.00
High (vs. low)	−1.69	−0.11 [−0.58, 0.36]	3.60	.64	1.00
Social characteristics					
Social problems (self)	3.26	0.06 [−0.11, 0.23]	4.74	.49	1.00
Social problems (parent)	−8.12	−0.2 [−0.37, −0.03]	3.40	.018	**.11**
Family functioning	4.10	0.09 [−0.08, 0.26]	3.99	.31	1.00
Adverse events	−0.18	−0.07 [−0.24, 0.1]	0.23	.42	1.00
Chronic stress	0.20	0.03 [−0.14, 0.2]	0.53	.71	1.00
Trauma	−0.17	−0.02 [−0.19, 0.15]	0.69	.81	1.00
Physical health characteristics					
Physical health (self)	−2.22	−0.08 [−0.25, 0.09]	2.39	.35	1.00
Physical health (parent)	−1.02	−0.04 [−0.21, 0.14]	2.51	.68	1.00
BMI	0.31	0.07 [−0.1, 0.24]	0.37	.41	1.00
Alcohol	−0.34	−0.07 [−0.24, 0.11]	0.46	.46	1.00
Absence (phys.)	0.25	0.02 [−0.15, 0.2]	1.02	.81	1.00
Drugs[b]					
Yes (vs. no)	−5.38	−0.35 [−0.75, 0.05]	3.12	.09	.61
Cannabis[c]					
Experimenter (vs. never)	−6.86	−0.45 [−0.80, −0.1]	2.72	.013	.10
Regular user (vs. never)	−12.10	−0.79 [−1.40, −0.18]	4.69	.011	.10
Smoking[c]					
Occasional (vs. never)	−3.04	−0.2 [−0.63, 0.24]	3.36	.37	1.00
Daily (vs. never)	−9.83	−0.64 [−1.08, −0.21]	3.36	**.004**	**.04**
Psychological health characteristics					
Internalizing problems (self)	19.06	0.25 [0.08, 0.42]	6.49	**.004**	**.04**
Internalizing problems (parent)	9.72	0.13 [−0.04, 0.3]	6.31	.13	.63
Internalizing problems (teacher)	7.16	0.16 [−0.01, 0.33]	3.91	.07	.42
Externalizing problems (self)	−12.66	−0.13 [−0.3, 0.04]	8.62	.14	.63
Externalizing problems (parent)	−15.47	−0.24 [−0.41, −0.07]	5.53	.006	.06
Externalizing problems (teacher)	−12.65	−0.28 [−0.44, −0.11]	3.88	**.001**	**.02**

(*table continues*)

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Table 2 (*continued*)

Variable	*B*	β [95% CI]	*SE*	*p* value	Adjusted *p* value
ADHD (self)	−1.79	−0.04 [−0.21, 0.14]	4.41	.69	.81
ADHD (parent)	−6.58	−0.2 [−0.37, −0.03]	2.88	.024	.19
ADHD (teacher)	−7.37	−0.24 [−0.41, −0.07]	2.61	.006	.06
Autism	−0.89	−0.11 [−0.28, 0.06]	0.71	.21	.64
Antisocial behavior	−27.52	−0.29 [−0.46, −0.13]	7.86	**.001**	**.01**
Absence (psych.)	−1.35	−0.07 [−0.25, 0.1]	1.62	.40	.81
Medication[b]					
Yes (vs. no)	−6.05	−0.4 [−0.79, 0]	3.09	.052	.37

Note. CI = confidence interval; *SE* = standard error; BMI = body mass index; ADHD = attention-deficit hyperactivity disorder.
[a] One diary participant completed the first interview but did not start the daily diary period, hence no data on compliance were available for this participant. [b] These variables were categorical with two levels, and therefore a binary predictor was used. Bolded *p* values were significant after using the Bonferroni–Holm procedure to correct for multiple testing. [c] These variables were categorical with more than two levels (e.g., smoking seldomly, regularly, or often) and therefore analyzed using dummy variables.

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somewhat higher behavioral problems. However, the attrition analysis, in which individuals who had not participated in the fifth assessment wave (T5) were excluded, revealed that this effect might have been driven by a lack of interest in participating in research in general, as opposed to the diary study per se. Moreover, diary study participants did not display more psychological or physical health problems than those who decided not to participate. We thus conclude that ILDs are not necessarily biased in terms of the physical, psychological, and social characteristics of individuals that self-select into these kinds of studies, making it possible to study individuals at risk for psychopathology. That said, we observed three characteristics associated with participation that could be paid attention to during recruitment of at-risk participants. Like previous ILDs, we found that women were more likely to participate in the diary study than men (Messiah et al., 2011; Rintala et al., 2019; Vachon et al., 2019). Moreover, a slight underrepresentation of at-risk individuals with lower IQ scores or who have experienced more life events may occur. These biases are not specific to ILDs but rather apply to longitudinal designs in general (Galea & Tracy, 2007). Hence, it is worth considering that results of ILDs in at-risk samples may not be representative of individuals with these characteristics (i.e., being male, having a lower IQ, and reporting more adverse events).

Once enrolled in the diary study, internalizing problems were positively associated with compliance. This contrasts with a finding from a previous study, where depression severity was negatively associated with college students' study compliance (Silvia et al., 2013). A recent meta-analysis on predictors of compliance in ILDs found no effect (i.e., neither positive or negative) of depression severity on compliance (Vachon et al., 2019). Hence, no conclusions can be drawn yet. Compliance was, however, lower in individuals with more behavioral problems (i.e., antisocial behavior and teacher-reported externalizing problems) and in those who smoked daily, which is in line with the finding that substance users generally complete fewer assessments compared to nonusers (Jones et al., 2019). Some of the other associations between behavioral problem domains and substance use with compliance had a similar effect size but were nonsignificant, likely due to reduced power given a low number of extreme values (i.e., only 12 of 122 individuals were regular cannabis users). Although intrinsic motivation or conscientiousness has been considered an important determinant of compliance in diary studies (Palmier-Claus et al., 2011; Piasecki et al., 2007; Scollon et al., 2003), we found no association between self-discipline and compliance in this study. This supports two earlier empirical studies (Courvoisier et al., 2012; Soyster et al., 2019). It thus seems that the effect of personality characteristics on compliance is not straightforward. Similarly, it remains unclear whether males more often miss assessments than females: We found no sex-related differences in compliance, which supports some meta-analyses (Jones et al., 2019; Wen et al., 2017) but contradicts others (Rintala et al., 2019; Vachon et al., 2019). Perhaps these inconsistencies arise because differential compliance across sexes may be specific to designs with particular sampling durations or sampling frequencies (Wen et al., 2017; Wrzus & Neubauer, 2022). Taken together, while a wide range of personality and sociodemographic characteristics are represented in ILDs, it is good to be aware that individuals with regular substance use or behavioral problems may be less compliant, and therefore, they might be underrepresented.

Strengths and Considerations

Ultimately, for whom ILDs are suitable does not depend on just self-selection and compliance. Instead, a particular research question or treatment goal may require the inclusion of precisely those individuals who are typically underrepresented due to self-selection or limited compliance (e.g., males with frequent substance use and externalizing problems). Consequentially, the finding that some individuals are underrepresented in ILDs is not meant discourage ILDs in populations with lower compliance rates, but rather may inform recruitment efforts and inferences drawn from ILDs. A major strength of this study is that extensive information was available for both individuals who participated and individuals who did not participate in the diary study, not only in terms of types of characteristics (e.g., psychological, physical, economic, social, and demographic characteristics) but also in terms of repeated assessment of these characteristics, which yielded reliable estimates. An additional strength is that all characteristics were compared to normative scores from the general population (TRAILS PC), a study identical in setup as TRAILS CC. This allowed us to confirm the at-risk status of our participants and thus rule out that the overall absence of pronounced differences between participants and nonparticipants was due to floor effects (i.e., little mental health problems in both groups, despite their at-risk status). Additionally, the comparison with the general population showed that individuals who displayed relatively few positive and more negative characteristics across a range of domains

(e.g., psychological problems, financial difficulties, somatic complaints) had no trouble with participating in an ILD study.

The most important consideration for interpreting our results is that this study aimed to provide a first empirical and descriptive characterization of who participates and does well in ILD studies. Although our findings could contribute to developing a prediction model of participation, this was not the goal of this study. Instead, we provided a detailed overview of possible differences in characteristics between participants and nonparticipants, and between participants and the general population. In these analyses, we did not adjust for potential confounders.

A second consideration is that our results are not necessarily generalizable to (a) other ILDs or (b) the broader at-risk population. With respect to the first point, it should be noted that selection and compliance bias might be different in designs with alternative sampling frequencies (e.g., multiple times per day vs. once per day) or durations (e.g., 1 or 2 weeks vs. 6 months). With respect to the second point, although diary participants clearly had more mental health problems as compared to the general population, we cannot guarantee that they are representative of the broader at-risk population. This is due to three reasons. First, our sample had a narrow age range and included only white Dutch youth, potentially limiting generalizability to older adults of other ethnicities. The second reason is that the diary participants were recruited within a prospective cohort consisting of individuals at increased risk for mental health problems (TRAILS CC). The members of this cohort might be more motivated to participate in research than at-risk individuals in general (Pietilä et al., 1995; Zunzunegui et al., 2001). This could imply that associations between the investigated characteristics and the decision to participate, which would exist in the full at-risk population, could not be observed in our sample. However, we think the impact of this study being embedded in TRAILS on current findings is limited, as the decision to enter the cohort study was made by parents rather than participants, who were aged 10–11 at the time. The decision to participate in the diary study, in contrast, was made by the participants themselves. Finally, we defined the at-risk status of participants based on their childhood (i.e., having been in contact with mental health care services at Age 11) rather than their current functioning. This means that participants in the present study did not necessarily experience current problems (see also Hartman et al., 2013). Hence, further research is needed to confirm whether the current findings generalize to individuals who are considered to be at risk for psychopathology for other reasons, for instance, those with current mental health problems (e.g., ultra-high-risk criteria for psychosis; Fusar-Poli et al., 2014) or individuals whose parents were diagnosed with a psychiatric disorder.

A third consideration when interpreting our results is that due to a lack of prior research on participation in ILDs, it was impossible to specify minimum clinically important differences for any of the outcomes a priori. We could therefore only interpret effect sizes post hoc. However, by including effect sizes, we could compare effects across contrasts (i.e., participants vs. nonparticipants and participants vs. general population) and across characteristics measured with different instruments. A final consideration is that due to the Holm–Bonferroni correction we applied, statistical power may have been compromised (Perneger, 1998; Rothman, 1990). Specifically, it is possible that we incorrectly considered some associations with participation and compliance—which were significant without correction—not statistically significant (e.g., effects of social problems, cannabis use, and ADHD on compliance). A further reason for limited power may have been the relatively small sample sizes involved in the comparison between participants ($N = 134$) and nonparticipants ($N = 309$). Although this could have played a role in finding fewer significant differences between participant and nonparticipants than between participants and the general population sample ($N = 1{,}926$), effect sizes of the differences were much smaller in the participant versus nonparticipant comparison, indicating that reduced power did not confound our conclusions. Thus, we do not think that finding fewer differences between participants and nonparticipants than between participants and the general population was due to differential power.

Conclusions

Often, we do not know much about those individuals who were *not* included in our studies. This means we can only speculate about the selection bias that results from the fact that particular types of individuals might be more likely to participate. We had the unique possibility to compare participants to nonparticipants on a wide variety of traits and found no selection bias toward highly conscientious, motivated, and healthy individuals nor toward disadvantaged individuals. Instead, individuals who decided to participate in the diary study were largely similar to those who did not participate in terms of personality, psychological health, and physical health. However, researchers should be aware that females, those with higher IQ and those who experienced more adverse events, may be overrepresented in their study (due to self-selection), while individuals with more externalizing and less internalizing problems and daily smokers might be underrepresented (due to lower compliance). This is not specific to intensive longitudinal designs but applies to research participation in general. Individuals who took part in the diary study were disadvantaged relative to the general population in a broad variety of domains but showed excellent study compliance, confirming that diary studies are suitable for at-risk populations. Taken together, we found that diary participants were disadvantaged in several domains relative to the general population, but this did not affect their decision to participate in a 6-month diary study nor their compliance. We conclude therefore that intensive longitudinal designs can be broadly applied and are not only suitable "for the happy few."

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Received April 22, 2022
Revision received October 7, 2022
Accepted October 10, 2022 ■

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