



The dynamics of social support among suicide attempters: A smartphone-based daily diary study



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ABSTRACT

Decades of research suggest that social support is an important factor in predicting suicide risk and resilience. However, no studies have examined dynamic fluctuations in day-by-day levels of perceived social support. We examined such fluctuations over 28 days among a sample of 53 adults who attempted suicide in the past year (992 total observations). Variability in social support was analyzed with between-person intraclass correlations and root mean square of successive differences. Multi-level models were conducted to determine the association between social support and suicidal ideation. Results revealed that social support varies considerably from day to day with 45% of social support ratings differing by at least one standard deviation from the prior assessment. Social support is inversely associated with same-day and next-day suicidal ideation, but not with next-day suicidal ideation after adjusting for same-day suicidal ideation (i.e., not with daily *changes* in suicidal ideation). These results suggest that social support is a time-varying protective factor for suicidal ideation.

1. Introduction

Suicidal thoughts and suicide attempts are major public health problems, with a global lifetime prevalence of 9.2 and 2.7% respectively (Nock et al., 2008). Despite decades of research on these problems, our ability to predict and prevent them remains relatively poor (Franklin et al., 2017). One factor contributing to this difficulty is the field's emphasis on identifying risk factors while largely ignoring potential protective factors (Glenn & Nock, 2014). Protective factors are not just the inverse or absence of risk factors, but instead are factors associated with decreased odds of some negative outcome among those at risk for that outcome (Kraemer et al., 1997). Indeed, a recent meta-analysis of all prospective studies of self-injurious thoughts and behaviors found that only 12.6% of all studies published over the past 50 years examined protective (vs. risk) factors (Franklin et al., 2017). Obtaining a better understanding of resilience has the potential to improve prevention and inform evidence-based treatments (Patel & Goodman, 2007). A second contributing factor making it difficult to predict and prevent suicide is that few studies assess suicidal thoughts repeatedly within short periods of time (e.g. hours) (Kleiman & Nock, 2018; Nock, 2016). In the same meta-analysis of prospective studies, 0.10% of effect sizes had follow-up lengths that were less than one

month (Franklin et al., 2017). This is important because suicidal ideation can change rapidly from day-to-day (Kleiman et al., 2017; Witte, Fitzpatrick, Warren, Schatschneider, & Schmidt, 2006) and studies that assess suicidal ideation at longer intervals may miss meaningful increases or decreases in suicidal ideation that can only be captured with more frequent assessment.

Social support has been long considered to be an important factor for suicide risk and resilience. Social support has been defined as interactions that lead someone to “believe that he is cared for and loved, esteemed, and a member of a network of mutual obligations” (Cobb, 1976, p. 300). Scholars since the time of Durkheim (1897) have postulated that social support may play a key role in the prediction of suicide risk. More recently, the Interpersonal Theory of Suicide argues that social support increases feelings of belongingness, which reduces suicide risk (Van Orden et al., 2010). Notably, the Interpersonal Theory of Suicide conceptualizes of social support as malleable.

Importantly, a rich history of theoretical work on social support suggests that it is a construct that likely fluctuates over short periods of time (House, Umberson, & Landis, 1988; Kessler, Price, & Wortman, 1985; Thoits, 1982) and inherent in the definition of social support is the perceived (and potentially dynamic) nature of the construct. Few studies, however, have examined the day-by-day variability of

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perceived social support. In most of those studies, however, social support was only tested as a moderator (Nezlek & Allen, 2006; Stein & Smith, 2015) or predictor of other variables (Bisconti, Bergeman, & Boker, 2006; Cook, McElwain, & Bradley-Springer, 2016; Gerteis & Schwerdtfeger, 2016). For example, baseline social support moderated the relationship between daily negative life events and daily negative affect (Nezlek & Allen, 2006). Only one previous study has provided data on the variability of perceived social support. This two week daily diary study was among participants with a history of non-suicidal self-injury and reported only overall within-person variability in social support (i.e., intraclass correlations) (Turner, Cobb, Gratz, & Chapman, 2016). This suggests that social support varies over time, but does not provide insight into the degree to which social support fluctuates from one observation to the next or may be associated with suicidal thoughts or behaviors.

Several empirical studies have demonstrated that social support is associated with reduced risk for suicidal ideation and suicide attempts in both adults (Chioqueta & Stiles, 2007; Kleiman & Liu, 2013) and adolescents (Mackin, Perlman, Davila, Kotov, & Klein, 2017; Miller, Esposito-Smythers, & Leichtweis, 2015). However, this prior research has assessed these associations either cross-sectionally (Kleiman & Liu, 2013), not allowing for any assessment of variability, or with weeks or months between assessment points (Mazza & Reynolds, 1998), not allowing for assessment of short-term variability. Moreover, most of the commonly used self-report measures of social support do not readily assess this dynamic nature. For example, the Multidimensional Scale of Perceived Social Support (Zimet, Dahlem, Zimet, & Farley, 1988), a widely-used measure of social support, is either agnostic about time frame or asks about broad interpersonal scenarios (e.g. “when things go wrong”). Interpersonal relationships, however, are constantly changing (van Tilburg, 1998). Furthermore, interpersonal conflict is common among clinical populations, especially those at risk for suicide (Beautrais, Joyce, & Mulder, 1997; Turecki & Brent, 2016). In summary, previous research on social support and suicidal thoughts and behaviors does not reflect theoretical work and lacks ecological validity. More accurate measurement of social support has the potential to clarify its relationship to suicidal thoughts and behaviors and better identify treatment targets.

The purpose of this study was to use smartphone-based daily diaries over 28 days among a group of individuals at high-risk for suicidal ideation (i.e., past-year suicide attempters) to answer two fundamental questions about social support. First, how much does social support fluctuate over a short period of time? This first aim was exploratory and we had no a priori hypotheses on the nature and extent of variability. Second, is social support associated with same-day and/or next-day levels of suicide ideation? We hypothesized that social support would be associated with lower same-day and lower next-day levels of suicidal ideation.

2. Method

2.1. Participants

Participants were 53 adults ($M = 23.52$ years of age, $SD = 4.31$, Range = 18–39 years, 77.1% female) who attempted suicide in year before data collection began (18% attempted suicide in the month before data collection began). Among all participants, 75% identified as White, 8.3% Asian, 1.8% Black or African American, and the rest identified as more than one or another race. Participants were recruited from forums relating to self-harm or suicide on the website Reddit (www.reddit.com). A total of 854 people completed the study screener, 103 of whom qualified, 90 of whom expressed further interest in the study, 56 of whom began the study and completed at least one daily-diary entry during the study period. Of those 56 participants, we excluded three participants who only provided one day of data, because the analyses used in this paper (described below) generally required

more than one data point.

2.2. Procedure

Participants completed a 28-day smartphone-based daily diary study using the mEMA software (www.ilumivu.com) as part of a larger study on real-time and day-to-day variability in suicidal ideation among previous suicide attempters (Kleiman et al., 2017). Participants were prompted once per day before bedtime (9:00 p.m.) to complete daily diary logs regarding a range of factors, including perceived social support and suicidal ideation. Participants were compensated with a \$40 gift card to Amazon.com, plus an additional \$10 bonus if they completed more than 75% of all study prompts.

2.3. Measures

2.3.1. Suicidal ideation

We used three items to assess daily suicidal ideation (SI), based upon the Beck Suicide Scale (Beck & Steer, 1991). Participants were asked to rate their: (1) wish to live, (2) wish to die, and (3) desire to die by suicide on a three point scale (moderate to strong, weak, none) similar to that used in the Beck Suicide Scale. For example, to assess wish to die, participants could select one of three statements: (0) “I have no wish to die”, (1) “I have a weak wish to die”, and (2) “I have a moderate to strong wish to die.” We reverse-scored participants’ wish to live ratings and then summed the three items to create scores that ranged from 0 to 6. Scores were keyed such that higher scores represented higher levels of suicidal ideation.

2.3.2. Social support

We asked participants to rate how supported they felt from friends and family (in two separate items) that day compared to a typical day. Scores were on a 1 (felt much less supported than usual) to 5 (felt much more supported than usual) scale. We estimated models using each form of support individually and the models with the social support variables entered individually did not significantly improve model fit above models with the composite only ($\chi^2 [df = 1]$ range = 0.03–3.86, all $p > .05$). Thus, in the goal of parsimony (and to be consistent with prior work that combines all sources together, e.g., Endo et al., 2014), we report the models using social support as a composite.

2.3.3. Covariates

We assessed the presence of several a priori covariates, which were included to test whether the association between social support and suicidal ideation remains after adjusting for the presence of known risk factors of ideation. Specifically, we assessed sadness, burdensomeness, and thwarted belongingness by asking participants to rate how much they felt each respective construct on a 0 (not at all) to 4 (very much scale). Thwarted belongingness was specifically measured the label of “lonely” to facilitate participants’ understanding of the construct.

2.4. Analytic strategy

To examine variability in social support we used two statistics: between-person intraclass correlation (*ICC*) and root mean square of successive differences (*RMSSD*; von Neumann, Kent, Bellinson, & Hart, 1941). The *ICC* is an index of the proportion of variance due to between-person versus within-person differences. Higher scores indicate more between-person variance. The *RMSSD* is a measure of variability from one observation to the next. Higher *RMSSD* scores correspond to a time-series plot that would appear more saw-tooth like, indicating more variability. These statistics were all calculated using raw (i.e., un-centered) data.

To examine whether social support is associated with same-day and next-day suicidal ideation, we tested three sets of multi-level models where observations (level 1) were nested within people (level 2). The

three models differed in their dependent variables (i.e., all three models used social support as the independent variable). The first set of models used same-day suicidal ideation as the dependent variable, the second set of models used next-day suicidal ideation, and the third set of models used next-day suicidal ideation but controlled for same-day suicidal ideation (i.e., to allow us to assess for *changes* in suicidal ideation). For the second set and third set of models, missing data were handled with pairwise deletion. Each set of models was tested in two steps. The first step examined the main effect of social support where social support was entered as the independent variable (along with same-day suicidal ideation as a covariate in one model). The second step added as control variables sadness, burdensomeness, and thwarted belonging. This allowed us to test whether social support is associated with suicidal ideation above and beyond well-known (and conceptually related) risk factors for suicidal ideation.

All models used fixed slopes (i.e., random intercepts only) and person-mean centered predictors and outcome variables. We used participant-mean centering because we were interested in capturing the individual within-person fluctuations in our variables of interest. We used two indices of fit for each model. First, we calculated pseudo R^2 values (Snijders & Bosker, 2012) to approximate the total amount of variance in the dependent variables accounted for by the independent variables. Second, we calculated χ^2 change statistics that compared each step in each model to a more parsimonious model. Specifically, we compared the step with only social support (or social support and same-day suicidal ideation) to a null/unconditional model (i.e., no predictors specified) and compared the step with covariates to the step with only social support. This provided an index of whether the addition of extra predictors served to increase model fit. All analyses were conducted in R (R Core Team, 2016) using the EMAtools (Kleiman, 2017), Psych (Revelle, 2016), sjPlot (Lüdtke, 2016), lme4 (Bates, Mächler, Bolker, & Walker, 2015) and ggplot2 (Wickham, 2009) packages.

3. Results

Participants reported on a total of 992 days, averaging 20.06 days each ($SD = 11.37$ days, Range = 2–42 days [seven participants continued to complete surveys after the payment period ended and all data were included]). Regarding compliance, 67% of the sample completed at least 14 days of responses and 44% completed at least 21 days of responses. Participants reported some level of suicidal ideation (i.e., a non-zero score) on 78.6% of all study prompts.¹

Levels of perceived social support varied considerably from day-to-day (Fig. 1). When examining between-person ICCs, we found that approximately 43% of the variability in social support ratings was explained by between-person differences ($ICC = 0.44$, $95\% CI = 0.35, 0.55$). The RMSSD showed that there was a saw-tooth pattern in visualizing the variability for social support (mean RMSSD = 0.98, $SD = 0.39$, individual RMSSDs range = 0.22 to 2.14). Moreover, we found that 45.4% of social support ratings differed by at least one standard deviation from the prior assessment.

The multilevel modeling results are shown in Table 1. Social support was associated with same-day suicidal ideation and next-day suicidal ideation, even after adjusting for the effects of sadness, burdensomeness, and thwarted belonging. However, social support was unassociated with next-day suicidal ideation when adjusting for the effect of same-day suicidal ideation. This was true of all of the covariates as well. That is, sadness, burdensomeness, and thwarted belonging were unassociated with next-day suicidal ideation adjusting for same-day suicidal ideation.

¹ When examining responses that indicated some level of suicidal ideation, 77.1% of responses indicated a non-zero (reverse-scored) score on the wish to live, 69.1% of responses indicated a non-zero score on the wish to die, and 79.3% of responses indicated a non-zero score on the desire to die.

4. Discussion

This study provides new information about the daily variability of social support and the daily (real-time) association between social support and suicidal ideation. We found substantial within-person daily variability in social support, which had a significant negative association with same-day suicidal ideation, and with next-day suicidal ideation, but not next-day suicidal ideation adjusting for same-day suicidal ideation. Thus, social support seems to exert a protective effect against suicidal ideation but does not seem to contribute to daily *changes* in it.

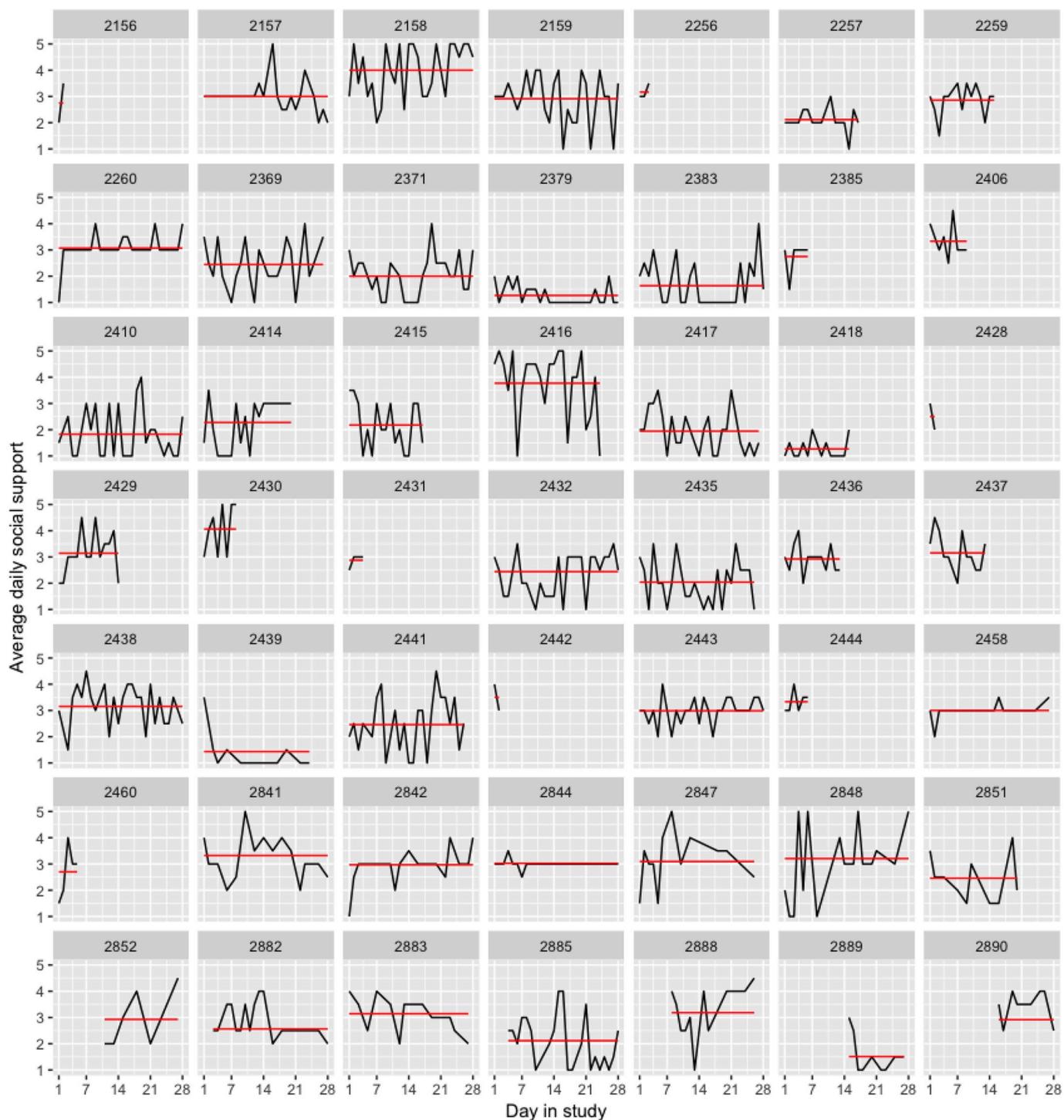
These results suggest that social support should not be conceptualized as a static construct that can be easily captured with a single assessment. Even on a relatively coarse 5-point scale over a short period of time, participants demonstrated considerable variability in perceived social support. If social support were measured monthly or weekly, these fluctuations in perceived social support would not have been captured.

The variability in social support that we detected may help us better understand and predict suicidal ideation. Whereas there are no other studies on daily fluctuations in social support and suicidal ideation, related research suggests that understanding fluctuations in psychological states may be especially helpful for predicting various domains of mental health. For instance, a recent meta-analysis examined the short-term dynamics of the associations between emotional variability (i.e., within-person variability of emotions across time), emotional stability (i.e., magnitude of consecutive emotional changes), and psychological well-being and reported that poor psychological well-being is characterized by high emotional variability and low emotional stability, which suggests that fluctuations in psychological constructs have meaningful clinical implications (Houben, Van Den Noortgate, & Kuppens, 2015).

These results build on prior studies of variability of suicidal ideation and the role of social support in predicting ideation. For instance, Kleiman et al. (2017) found considerable variability within participants in risk factors for suicidal ideation, such as loneliness, using real-time monitoring where participants were assessed on these factors multiple times per day. Taken together, methods like real-time monitoring and daily diary appears to be a promising method to capture accurate risk and protective factors for suicidal ideation. The results pertaining to predicting suicidal ideation with social support compliment a burgeoning literature on the prediction of suicidal thoughts and behaviors. Social support's protective effects on same day suicidal ideation align with previous cross-sectional findings (Kleiman & Liu, 2013). Furthermore, given that these effects remained after adjusting for potential third variables (e.g. sad mood), this study provides support for the incremental predictive validity of social support and distinct effects relative to related constructs, such as burdensomeness (Bell et al., 2017). The mechanism through which social support has this protective effect remains unanswered and warrants further investigation.

There are several potential explanations for why we did not find a prospective relationship between social support and suicidal ideation above and beyond the effect of same-day suicidal ideation. First, it is possible that there is such an effect, but we were underpowered to detect it in this study. Indeed, the effect of same-day suicidal ideation on next-day suicidal ideation was large ($d = 5.20$) making the detection of day-to-day changes more difficult to predict than overall level of daily ideation severity. Second, it is possible that problems with our definition and measurement of social support (e.g., low internal consistency) limited our ability to detect this effect. Future high-resolution studies with more in-depth measurements of social support are needed.

There are several important limitations to the current study. First, it is unknown to what extent participants might have been reactive to the multiple assessments. These potential reactive effects could have led to artificial changes in perceived social support, which is a limitation for all real-time monitoring studies (Wray, Merrill, & Monti, 2014). Second, the present study also only assessed social support daily as opposed to



Note. ID numbers do not correspond to actual participant IDs. Participants with fewer than 3 responses not pictured here.

Fig. 1. Individual plots of raw social support data.

Note. ID numbers do not correspond to actual participant IDs. Participants with fewer than 3 responses not pictured here.

multiple assessments in the same day. Perceptions of social support may fluctuate within the same day, but the measurement approach we used was not able to capture that. This remains an important direction for future research. Third, the study was underpowered to test a potential bidirectional prospective association between social support and suicidal ideation. A future study could use a panel-design to test such associations. Fourth, this study did not examine whether social support also is inversely associated with the presence of other self-harm related

outcomes, such as non-suicidal self-injurious urges or suicidal ambivalence. Fifth, this study period was only 28 days and some participants had relatively low rates of completion/compliance, and it is unclear if similar patterns would have been detected over a longer study period (e.g., months) and across all levels of compliance. Sixth, it is also important to note the limited generality of these findings and it's unclear if social support would fluctuate as much for a non-clinical population. A future study with a control group (e.g. non-suicide

Table 1
Multilevel models showing the relationship between social support and suicidal ideation (SI).

	DV: Same-day SI				DV: Next-day SI				DV: Next-day SI, controlling for same-day SI			
	B (95% CI)	R ² /d	χ ² Δ	p	B (95% CI)	R ² /d	χ ² Δ	p	B (95% CI)	R ² /d	χ ² Δ	p
Main effects		.05	55.3	< .001		.04	40.3	< .001		.86	1687.2	< .001
SI (same-day)									0.95 (0.93–0.98)	5.20		< .001
Social support	−0.41 (−0.52, −0.30)	−0.48		< .001	−0.35 (−0.46, −0.24)	−0.41		< .001	0.00 (−0.04, 0.05)	0.01		.859
Control variables		.27	260.2	< .001		.21	184.1	< .001		.87	4.40	.219
SI (at T1)									0.95 (0.93–0.98)	4.60		< .001
Sadness	0.45 (0.36, 0.54)	0.62		< .001	0.36 (0.27, 0.45)	0.50		< .001	−0.03 (−0.07, 0.02)	−0.08		.235
Burdensomeness	0.15 (0.07, 0.24)	0.22		< .001	0.12 (0.03, 0.21)	0.18		.006	−0.02 (−0.06, 0.02)	−0.08		.250
Thwarted belonging	0.15 (0.06, 0.25)	0.20		.002	0.17 (0.08, 0.27)	0.23		< .001	0.04 (−0.00, 0.08)	0.13		.066
Social support	−0.22 (−0.32, −0.12)	−0.28		< .001	−0.18 (−0.28, −0.08)	−0.23		< .001	0.01 (−0.04, 0.05)	0.02		.797

Note. All variables are mean-centered. $\chi^2 \Delta$ for main effects models = comparison to null model, $\chi^2 \Delta$ for control variables model = comparison to main effects model. R^2 for overall model effect size (see Snijders & Bosker, 2012), d is for individual effect sizes.

attempters) would help clarify the generalizability of fluctuations in social support. Seventh, limited demographic and clinical variables were collected in the current sample. A future study with more in-depth data on the sample may aid in testing the generality of the findings.

Although we found that social support fluctuates over a short period of time, we are not able to answer the question of *why* it fluctuates. The factors influencing this fluctuation are an important target for future research. Future studies could also examine how social support is distinct or interacts with related constructs, such as burdensomeness and connectedness. Some preliminary work has been done in this area (Bell et al., 2017), which found that burdensomeness, connectedness, and social support may have distinct relationships with suicide attempt history. It is unclear, however, how these relationships would function in a real-time monitoring study. Overall, our results suggest that among suicide attempters, measuring social support at a single time point does not reflect how frequently social support fluctuates over time. More accurate measurement of social support has the potential to allow for more precise prediction of resilience and efficient interventions to improve support.

Conflicts of interest

The authors have declared that they have no potential or competing conflicts of interest.

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