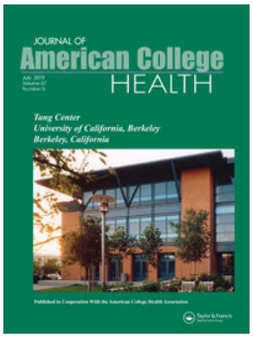

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MAJOR ARTICLE

A person-centered analysis of sleep and emotion dysregulation: Short- and long-term links with depression and alcohol use

Thalia Semplonius, MA* and Teena Willoughby, PhD

Department of Psychology, Brock University, St. Catharines, ON, Canada

ABSTRACT

Objective: Our objective was to examine the co-occurrence of sleep problems and emotion dysregulation and its short- and long-term links to depressive symptoms and alcohol use in a sample of university students. **Method**: Participants included 1132 first-year university students from Southern Ontario (70.5% women). Time 1 data were collected in February/March, 2010, and Time 2 data ($n = 746$) were collected in February/March, 2014. Participants were surveyed about sleep problems and emotion dysregulation (Time 1), and depressive symptoms and alcohol use (Times 1 and 2). **Results:** A latent class analysis revealed four groups: (1) Low Co-Occurrence, (2) Sleep Problems Only, (3) Emotion Dysregulation Only, and (4) High Co-occurrence. Group 4 had more depressive symptoms than all other groups in both the short- and long-term. **Conclusions:** First year university students with high co-occurrence of sleep problems and emotion dysregulation may be a target group for programs focused on reducing adjustment difficulties.

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Young adulthood in Western culture often is a transitional period of identity exploration (eg, career exploration, discovering the self),[1] instability (eg, multiple residential moves), and feeling "in-between".[2] These characteristics may be especially true for university students as they often leave home for the first time to attend university, experience multiple residential moves, and spend an extended period of time furthering their formal education and exploring career options. Although many students navigate this transitional period successfully, others experience adjustment difficulties throughout their university experience, such as sleep problems[3] and emotion dysregulation.[4] By using Developmental theories as a framework, (eg, Theory of Psychosocial Development[1]) it can be suggested that difficulties during this transitional period can set the foundation for long-term problems.[5] There is limited research, however, about whether difficulties in adjustment during the first year of university are long lasting (ie, can lead to negative health outcomes over time). The purpose of this study was to examine emotion dysregulation and sleep problems in first-year university students, and their short- and long-term associations with depressive symptoms and alcohol use.

Sleep problems and emotion dysregulation

Two adjustment difficulties common among first-year university students are sleep problems and difficulties with emotion regulation.[3,4] Findings from past research indicate that sleep problems often are associated with difficulties in emotion regulation.[6] For example, individuals who experience sleep problems display more difficulty in regulating their emotions in general than individuals not experiencing sleep problems, and this is evident among both adults[7] and university students who experience post-traumatic stress disorder.[8] Similarly, Ready et al[9] found that young adults who indicate having sleep problems and/or who experience sleep duration that is too short (or long) tend to have increases in negative affect the next day. Individuals who report sleep problems also tend to use less cognitive reappraisal strategies when regulating their negative emotions.[10] Sandru and Voinescu[7] suggested that difficulties with emotion regulation can lead to sleep problems. For example, when individuals cannot regulate their emotions, they may become more aroused and, therefore, unable to sleep.[11] While these previous researchers predominately have used cross-sectional designs, Tavernier and

CONTACT Thalia Semplonius ts11jy@brocku.ca Department of Psychology, Brock University, 1812 Sir Isaac Brock Way, St. Catharines, ON L2S 3A1, Canada.

Willoughby[12] found a longitudinal bidirectional association between emotion regulation and sleep problems, such that higher levels of emotion dysregulation predicted greater sleep problems over time, and higher levels of sleep problems predicted greater emotion dysregulation over time.

Both sleep problems and emotion dysregulation are considered to be transdiagnostic; that is, they tend to be common underlying factors of multiple health problems.[13] Aldao and Dixon-Gordon[14] found that indicators of psychopathology such as symptoms of depression, anxiety, borderline personality disorder, anorexia nervosa and bulimia all were associated with maladaptive emotion regulation strategies (eg, self-criticism, suppression, rumination). Fairholme et al[13] found (in a clinical sample) when emotion dysregulation is controlled for, symptoms of insomnia still are associated with anxiety, depression, PTSD, and alcohol dependence (similar results were found for emotion dysregulation, controlling for symptoms of insomnia). These findings suggest that although sleep problems often are linked to difficulties with emotion regulation (and thus, may co-occur within the same individual), they also may be independent predictors of health outcomes, such that some individuals may display only sleep problems, others only emotion dysregulation, others both sleep problems and emotion dysregulation, and the remaining individuals none of these problems.

One method that can be used to test this hypothesis is a person-centered latent class analysis (LCA), which specifically accounts for heterogeneity (ie, individual differences) among individuals in the pattern of these behaviors[15,16]; that is, is there a group of students who exhibit co-occurring sleep problems and emotion dysregulation, a group of students who exhibit sleep problems only, a group of students who exhibit emotion dysregulation only, and a group that display neither sleep problems nor emotion dysregulation? An examination of this potential heterogeneity is critical for prevention/intervention efforts. The first goal of this study, therefore, was to conduct a LCA to examine the co-occurrence of sleep problems and emotion dysregulation.

Short and long-term effects on depressive symptoms and alcohol use

The second goal of this study was to examine whether the co-occurrence of sleep problems and emotion dysregulation was associated with disturbances in depressive symptoms and alcohol use both in the short-term (ie, during the first year of university) and/or in the long-term (ie, a 5-year study). Depressive symptoms and alcohol use are of major concern in universities around the world. For example, the highest levels of binge drinking often occur among university students,[17–19] and youth/young adults tend to report the highest rates of mental illness such as depression.[20,21] Importantly, researchers have found that both sleep problems and emotion dysregulation are related to depressive symptoms[22–26] and alcohol use.[27–31]

Sleep problems

Insomnia is thought to increase the risk of developing depression over time.[22] Additionally, experimental work has demonstrated that sleep deprivation is associated with individuals rating neutral stimuli more negatively (in comparison to a control group),[32] increases in negative mood,[32] and increases in anxiety, depression, and distress.[23] Short-term longitudinal work also has indicated that this relationship may be bidirectional.[24] Furthermore, sleep problems are associated with alcohol use. Individuals who consume alcohol throughout the day tend to have poor sleep quality and sleep less that night than individuals who do not consume alcohol throughout the day.[27] Additionally, developmental researchers have indicated that individuals who experience sleep problems in adolescence tend to have a higher risk of developing alcohol abuse in adulthood. For example, Wong et al[28] found that individuals who experienced overtiredness throughout childhood were more likely to have problems with alcohol use in adulthood.

Emotion dysregulation

Like sleep problems, emotion dysregulation is associated with depressive symptoms.[25] Hopp et al[33] found that participants who scored higher on the implicit valuing of emotion regulation displayed better psychological health (ie, fewer depressive symptoms and better wellbeing and social adjustment than those scoring lower on the implicit valuing of emotion regulation); however, this was seen only for participants who frequently used cognitive reappraisal strategies and not for those who did not frequently use these strategies. Additionally, in comparison to effective emotion regulation strategies (eg, cognitive reappraisal), less effective emotion regulation strategies (eg, suppression) were found to be associated with increases in depressive symptoms,[26] less positive affect, lower levels of self-esteem, and poor psychological adjustment.[34] Emotion dysregulation also is associated with alcohol

Table 1. Descriptive statistics for study variables.

Measure	Time 1 *M* (SD) *N* = 1,132	Time 2 *M* (SD) *N* = 746
Sleep Problems		
Problems falling sleeping	2.55 (1.13)	NA
Problems staying asleep	1.89 (1.07)	NA
Wake up too early	2.13 (1.22)	NA
Problems staying awake	2.02 (1.00)	NA
Sleep pattern satisfaction	3.11 (1.02)	NA
Sleep interference	2.70 (1.06)	NA
Emotion Dysregulation		
Feel bad about oneself	2.49 (1.22)	NA
Difficulty concentrating	3.41 (1.14)	NA
Can't get things done	3.05 (1.10)	NA
Can't feel better	2.39 (1.10)	NA
Can't think about anything	3.41 (1.18)	NA
All I can do is wallow	1.94 (0.97)	NA
Depressive symptoms	19.88 (10.75)	17.63 (9.88)
Alcohol Use	3.84 (1.36)	3.47 (1.01)
Covariates		
Sex	70.5% women	
Parent education	3.71 (1.27)	
Born in Canada	84.9%	

Note. Time 2 data only are provided for depressive symptoms and alcohol use as Time 2 data for all other measures are not applicable in this study.

use.[29] Dvorak et al[30] found that when individuals were unable to accept or control their emotional responses, more problematic outcomes from alcohol use were likely. Similarly, Kuvass et al[31] found that problematic drinking was related to difficulties regulating emotions. Overall, while both sleep problems and emotion dysregulation have been shown to be related to depressive symptoms and alcohol use, limited longitudinal research with university students has been conducted looking at these associations in the short and long-term.

This study

The purpose of this study was twofold. The first goal was to conduct a LCA to examine individual differences in the pattern of self-reported sleep problems and emotion dysregulation among first-year university students. The second goal was to examine whether this co-occurrence was related to both short- and long-term depressive symptoms and alcohol use.

Methods

Participants

Participants in this study were 1132 students (70.5% women) enrolled at a mid-sized university in southwestern Ontario, Canada, who were part of a larger longitudinal study. At the first assessment, all participants were in their first year of university.

Procedure

First-year university students from various academic disciplines were invited to complete a survey examining factors related to stress, coping, and adjustment to university life. Four years later, all students who participated in the first assessment were invited to participate again. Participants' ID numbers were linked with names only for re-contacting purposes; these links were never included with their survey responses and were kept in a locked file separate from the survey files. Participants were given the option to select either course credit or monetary compensation ($10) at Time 1 and were given $50 for compensation at Time 2. Depressive symptoms and alcohol use were assessed again in this wave. The University Ethics Board approved the study, and all participants provided informed consent prior to participation.

Missing data analysis

Missing data occurred within each assessment time point because some students did not answer every question (average missing data at Time 1 and Time 2 were 5.80% and 3.02%, respectively) and because some students did not complete both waves of the survey. The number of participants at Time 1 was 1132 and the number of participants at Time 2 was 746 (note that missing data were imputed – see below). The participant retention rate was 65.9%.

The multivariate results of a MANOVA examining whether participants who participated in the study at both time periods differed from participants who completed only the first time period on Time 1 study variables, indicated there was a significant effect, Pillai's trace = .04, $F(17, 949) = 2.23$, $p = .003$, $\eta^2 = .04$. Specifically, participants who completed both time periods were more likely than participants who completed the survey only at Time 1 to be women, $F(1,965) = 9.05$, $p = .003$, $\eta^2 = .01$, and drink less alcohol, $F(1,965) = 17.73$, $p < .001$, $\eta^2 = .02$. Missing data were imputed using the EM (expectation-maximization) algorithm with all study measures included in the imputation process.[35] Methodological research has demonstrated that this method of dealing with missing data is preferable to more common methods such as pairwise deletion, list-wise deletion, or mean substitution.[36]

Measures

This study included measures of demographics, emotion dysregulation and sleep problems at Time 1, and depressive symptoms and alcohol use at Times 1 and 2 (see Table 1 for descriptive statistics). Demographic

variables included: sex (1 = men or 2 = women), parental education (one item per parent, $r = 0.43$, $p < .001$, with response options of 1 = did not finish high school; 2 = finished high school; 3 = some college, university, or apprenticeship program; 4 = completed a college/apprenticeship and/or technical diploma; 5 = completed a university undergraduate degree; 6 = professional degree), and whether participants were born in Canada ("Were you born in Canada?" 1 = yes or 2 = no). Demographic variables were used as covariates in all analyses.

Sleep problems

Sleep problems were assessed at Time 1 using six items from an adapted version of the Insomnia Severity Index.[37] Participants indicated the extent to which they experienced difficulty (1) falling asleep, (2) staying asleep, (3) waking up too early, (4) staying awake, (5) satisfaction with their sleep patterns, and (6) whether their sleep patterns interfered with daily functioning. Response options for items 1–4 ranged between 1 and 5 (1 = no problem; 2 = mild; 3 = moderate; 4 = severe; 5 = very severe problems), item 5 response options ranged from 1 to 5 (1 = very satisfied; 2 = satisfied; 3 = neither satisfied nor dissatisfied; 4 = dissatisfied; 5 = very dissatisfied), and item 6 response options ranged from 1 to 4 (1 = rarely interferes; 2 = sometimes interferes; 3 = often interferes; 4 = very often interferes). Item 6 was recoded to have a range of 1–5 so all variables were on the same scale. Cronbach's alpha for the sleep items was .77. Higher scores indicated more sleep problems.

Emotion dysregulation

Emotion dysregulation was assessed at Time 1 with six items from the Difficulties in Emotion Regulation Scale (eg, "When I'm upset or stressed, I have difficulty concentrating").[38] The responses were based on a five-point Likert scale ranging from 1 to 5 (1 = almost never; 2 = sometimes; 3 = about half the time; 4 = most of the time; 5 = almost always). Cronbach's alpha was .73. Higher scores indicated more emotion dysregulation.

Depressive symptoms

Depressive symptoms were measured using 19 items from the Center for Epidemiological Depression –Revised Scale (eg, "I thought my life had been a failure").[39–41] Although there were originally 20 items, one item ("My sleep was restless") was excluded so that the association between depressive symptoms and sleep problems was not inflated thereby resulting in the final 19 items. Response options for these items ranged from 1 to 5 (1 = none of the time; 2 = rarely; 3 = some of the time; 4 = occasionally; 5 = most of the time). Ratings were rescored so that the CESD-R had the same range (0–60) as the original CESD[39] and summed such that higher scores indicated greater depressive symptoms. Cronbach's alphas at Time 1 and Time 2 were .91 and .93, respectively.

Alcohol use

Alcohol use was assessed with one item by asking participants how many drinks they consume, on average, when they are drinking alcohol. Responses options were as follows: 1 (less than 1 drink), 2 (1 drink), 3 (2–3 drinks), 4 (4–6 drinks), 5 (7–10 drinks), and 6 (over 10 drinks). Higher scores indicate more alcohol use.

Results

At the first assessment, participants were, on average, 19 years of age ($M_{age} = 19.06$ years, SD =11.16 months, range 17.8–25.5 years). The sample consisted predominantly of students who were born in Canada (84.9%). SES data indicated that the mean level of education for mothers was, $M = 3.73$, SD =1.46, and the mean level of education for fathers was, $M = 3.68$, SD =1.58; these two measures were correlated at, $r = 0.43$, $p < .001$. An average score for parental education was used in this study. The mean level of education for the combined mother and father education variable fell between "some college, university, or apprenticeship program" and "completed a college/apprenticeship and/or technical diploma" ($M = 3.71$, SD =1.27, range 1–6). Note that the pattern of results did not differ if parental education was used as two separate variables (ie, one for mothers and one for fathers), or the composite measure.

Statistical analyses were carried out using MPlus 7[42] and SPSS version 23. All variables displayed acceptable levels of skewness and kurtosis. To identify individual differences in the pattern of emotion dysregulation and sleep problems, a LCA[43] was conducted. The six sleep problem items and the six emotion dysregulation items from Time 1 were entered as class indicators into the LCA. Sex, whether participants were born in Canada or not, and parental education also were included as covariates. In order to

Table 2. LCA fit indices.

Number of Classes	BIC	Entropy	LMR-LRT	Loglikelihood *p*-value
2 Classes	36791.68	.813	−19214.80	<.001
3 Classes	36094.15	.837	−18256.24	.003
4 Classes	35786.24	.848	−17852.13	.031
5 Classes	35635.96	.813	−17641.84	.399

determine the number of groups best represented by the data, several criteria were considered: (1) interpretability of the classes, (2) Bayesian information criterion (BIC), such that smaller values of BIC indicated a better fit model, (3) significance of the Lo-Mendell-Rubin Adjusted Likelihood Ratio Test (LMR-LRT) and/or the Bootstrap Likelihood Ratio Test, which compares a particular model to a model with one fewer classes (ie, a significant p value indicates that the estimated model provides a better fit to the data than the model with fewer classes), and 4) average latent class posterior probabilities close to 1.00.[44] Entropy (an index of confidence that individuals belong to the correct class and that adequate separation between latent classes exists) also was examined; scores of .80 and higher are good but there is no set cutoff criterion for entropy.[45]

Fit indices for the LCA indicated that the four-class solution was considered the optimal model (see Table 2). The LMR-LRT became nonsignificant at five classes, indicating that adding the fifth class did not significantly improve the model. Furthermore, the entropy value for four classes was .85 (whereas it was .81 for five classes), and the average latent classes posterior probabilities ranged from .86 to .94, indicating that a high proportion of participants were correctly classified. There also was good distinction among the four classes. Finally, the drop in the BIC from four to five classes was much smaller than the drop from three to four classes, again suggesting that the four-class solution best fit the data.

The four groups were: (1) Low Co-Occurrence (low sleep problems/low emotion dysregulation; 29.1% of the sample) (2) Sleep Problems Only (moderate sleep problems/low-moderate emotion dysregulation; 11.4% of the sample), (3) Emotion Dysregulation Only (low-moderate sleep problems/moderate-high emotion dysregulation; 42.4% of the sample), and (4) High Co-occurrence (high sleep problems/high emotion dysregulation; 17.0% of the sample). To ensure groups were classified appropriately, a MANOVA with Bonferroni correction was conducted using group membership as the independent variable and each of the class indicators (ie, sleep problem and emotion dysregulation items) as dependent variables. Results supported our class characterizations and group differences are presented in Table 3. Guidelines for clinical cutoff scores (adjusted for the number of scale items in this study) also supported our classes.[46,47] According to the cutoffs from Bastien et al.,[46] the High Co-Occurrence group had levels of insomnia scores in line with "clinical insomnia (moderate severity)", $M = 14.81$. The Sleep Problems only group had scores in line with subthreshold insomnia, $M = 11.86$, whereas the Emotion Dysregulation Only fell between subthreshold insomnia and no clinically significant insomnia, $M = 7.38$. The Low Co-Occurrence group was consistent with no clinically significant insomnia, $M = 4.91$. The only groups that attained emotion dysregulation scores consistent with clinical populations were the Emotion Dysregulation Only and High Co-Occurrence groups ($M = 18.24$ and 21.81, respectively; emotion dysregulation scores for Sleep Problems Only and Low Co-Occurrence were consistent with the general population; means were 13.94 and 12.45, respectively).

The second purpose of this study was to assess whether these distinct groups of individuals appeared to be at differential risk for short- and long-term problems in depressive symptoms and alcohol use. To address this question, we examined group differences on depressive symptoms and alcohol use at Time 1 and Time 2 (4 years later). Means and standard deviations are shown in Table 4 and these results also are displayed in Figure 1.

A repeated-measures ANCOVA indicated a significant multivariate effect for a three-way interaction between time (Time1, Time2), class (Group 1, 2, 3, 4) and type (depressive symptoms, alcohol use), Pillai's trace = .08, F (3, 1068) = 31.55, $p < .001$, $\eta^2 = .08$. The three-way interaction was followed up with two MANCOVAS. For short-term results, a MANCOVA at Time 1 indicated that the multivariate effect of class was significant, Pillai's Trace = .30, $F(6,2136) = 68.93$, $p < .001$, $\eta^2 = .15$, with group differences on depressive symptoms, $F(3, 1068) = 148.72$, $p < .001$, $\eta^2 = .30$, and alcohol use, $F(3, 1068) = 2.70$, $p = .04$, $\eta^2 = .01$ (see Table 4). For depressive symptoms, Games-Howell pairwise comparisons indicated that the Low Co-Occurrence Group reported fewer symptoms than all other groups whereas the High Co-Occurrence Group reported more symptoms than all other groups. The Sleep Problems Only and the Emotion Dysregulation Only Groups did not differ significantly from each other. For alcohol use, Hochberg's GT2 pairwise comparisons indicated that the Sleep Problems Only Group reported higher number of drinks per drinking session than the Emotion Dysregulation Only Group. There were no other significant differences.

Table 3. Group means and standard deviations of items used in the LCA.

Measures	Group 1 Low co-occurrence *M* (SD)	Group 2 Sleep problems only *M* (SD)	Group 3 Emotion dysregulation only *M* (SD)	Group 4 High co-occurrence *M* (SD)
Problems falling asleep	1.81_a (0.76)	3.47_c (0.82)	2.29_b (0.90)	3.93_d (0.87)
Problems staying asleep	1.24_a (0.46)	2.84_c (1.04)	1.56_b (0.71)	3.22_d (1.10)
Wake up too early	1.80_a (1.03)	2.66_b (1.30)	1.94_a (1.11)	2.83_b (1.43)
Problems staying awake	1.54_a (0.74)	2.15_b (0.98)	1.97_b (0.89)	2.90_c (1.19)
Sleep pattern satisfaction	2.47_a (0.85)	3.85_c (0.68)	2.92_b (0.85)	4.25_d (0.72)
Sleep interference	2.04_a (0.88)	2.89_b (0.93)	2.70_b (0.96)	3.68_c (0.97)
Feel bad about oneself	1.81_a (0.87)	2.25_b (1.09)	2.52_b (1.14)	3.71_c (1.16)
Difficulty concentrating	2.20_a (0.62)	2.39_a (0.70)	4.09_b (0.63)	4.48_c (0.59)
Can't get things done	2.64_a (1.11)	$2.91_{a,\ b}$ (1.10)	$3.19_{b,\ c}$ (1.04)	3.42_c (1.13)
Can't feel better	2.12_a (1.11)	2.38_a (1.15)	2.31_a (1.02)	2.97_b (1.08)
Can't think about anything	2.26_a (0.83)	2.41_a (0.88)	4.06_b (0.69)	4.46_c (0.65)
All I can do is wallow	1.40_a (0.65)	1.60_a (0.74)	2.06_b (0.92)	2.78_c (1.12)

Note. Means within the same row that share subscripts are not significantly different. Individuals were assigned to their highest probability class, but it is important to note that there is error involved with assigning individuals into groups based solely on posterior probabilities.

Table 4. Means and standard deviations of depressive symptoms and alcohol use as a function of class at Time 1 and Time 2.

Measures	Group 1 Low co-occurrence *M* (SD)	Group 2 Sleep problems only *M* (SD)	Group 3 Emotion dysregulation only *M* (SD)	Group 4 High co-occurrence *M* (SD)
Depressive Symptoms Time 1	13.02_a (7.31)	19.07_b (8.70)	19.83_b (9.53)	31.87_c (10.37)
Depressive Symptoms Time 2	15.24_a (8.96)	17.66_a (9.04)	16.66_a (9.39)	23.66_b (10.62)
Alcohol Use Time 1	$3.97_{a,b}$ (1.50)	4.10_b (1.26)	3.68_a (1.31)	$3.92_{a,b}$ (1.34)
Alcohol Use Time 1	3.60_b (1.70)	3.59_a (1.08)	3.36_a (0.94)	3.49_a (1.01)

Note. Means within the same row that share subscripts are not significantly different. Individuals were assigned to their highest probability class, but it is important to note that there is error involved with assigning individuals into groups based solely on posterior probabilities.

Results of a MANCOVA at Time 2 (four years after Time 1) indicated that the effect of class was significant, Wilk's Lamda = .91, $F(6,2134) = 18.23$, $p < .001$, $\eta^2 = .05$, with group differences on self-reported depressive symptoms, $F(3, 1068) = 35.94$, $p < .001$, $\eta^2 = .09$, but not on self-reported alcohol use, $p = .36$, (see Table 4). In regard to depressive symptoms, Games-Howell pairwise comparisons indicated that the High Co-Occurrence group displayed more depressive symptoms at Time 2 than all other groups.

Comment

This study is among the first in which heterogeneity in the long-term effect of adjustment difficulties (ie, sleep problems and emotion dysregulation) in first-year university students was examined. Overall, our results indicated that the co-occurrence of self-reported sleep problems and emotion dysregulation was evident in this sample of undergraduate students. Importantly, the High Co-Occurrence Group displayed depressive symptoms that were above or at clinical cutoffs at Time 1 ($M = 31.87$, SD $=10.37$) and Time 2 ($M = 23.66$, SD $=10.62$).[48] In addition, our results indicate that the co-occurrence of sleep problems and emotion dysregulation was related to depressive symptoms both in the short- and long-term. That is, individuals with high co-occurrence of sleep problems and emotion dysregulation experienced the most depressive symptoms among their peers at Time 1 and 4 years later, indicating that individuals with two highly co-occurring problems are at risk for long-term negative health outcomes, and are a target group that would benefit from programs that specifically address adjustment difficulties in first-year university students. This finding indicates that it is critical for researchers to pay attention to long-term effects.[49]

In contrast, the group differences about alcohol use (ie, number of drinks) were less robust. The minimal differences at Time 1 and the lack of group differences at Time 2 may be due to the fact that levels of drinking for many students elevate throughout the person's years at the university (and are higher than individuals aged 25 years and older).[50] In this study, self-reported alcohol use at Time 1 was around 4–6 drinks per drinking session (ie, at binge drinking levels). Even at Time 2 (4 years later), the group means were between 2–3 drinks and 4–6 drinks per drinking session. Thus, drinking habits across student years at the university tended to remain relatively stable, regardless of what group participants were in, which may be why no group differences on alcohol use were found. However, a second potential reason that group differences may not have been present may be because

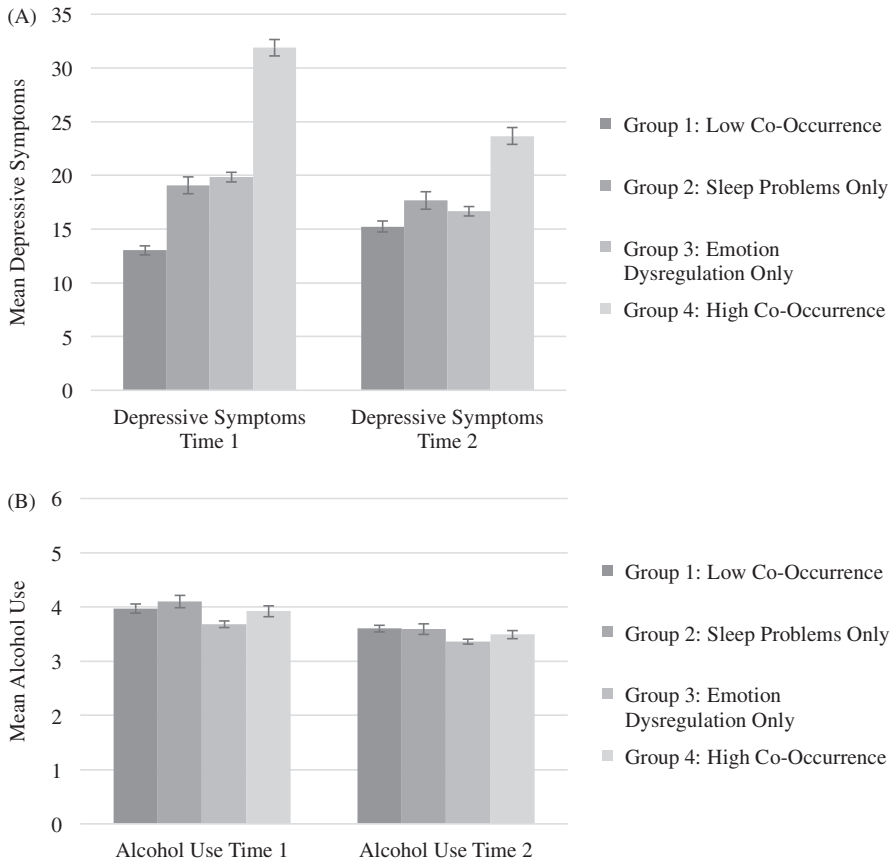

Figure 1. This figure displays the results of the 3-way interaction. For ease of presentation, Part A outlines the group results for depressive symptoms at Times 1 and 2, and Part B outlines the group results for alcohol use at Times 1 and 2.

individuals drink for different reasons. For example, past researchers have indicated individuals engage in higher levels of alcohol use during celebrations, to reduce inhibition—like shyness, and to forget things about which they may worry.[51] It may be that the groups in this study differed in their motives for drinking. Individuals in the high co-occurring group (ie, high levels of sleep problems and emotion dysregulation)—who also display high levels of depressive symptoms—could be using alcohol as a coping mechanism (eg, using alcohol as self-medication). In contrast, perhaps those in the low co-occurring group (ie, low levels of sleep problems and emotion dysregulation) use alcohol in a less problematic manner (eg, when socializing with friends). As we did not assess motives for drinking in this study, future research should examine whether these groups do differ on aspects such as problematic coping behaviors and social behaviors.

A major strength of our study is that we explicitly examined individual differences using a person-centered approach, rather than a variable-centered approach. Previous researchers have investigated trajectories of wellbeing in young adulthood; for instance, Galambos et al[52] found that, on average, wellbeing (measured by depression, self-esteem, and anger) improved from 18 to 25 years of age and that enrolling in a university and leaving home did not predict greater change in wellbeing over time in comparison to youth who did not attend a university. These results, however, were based on variable-centered analyses, specifically examining average change across all university students versus average change across non-university students. While these findings provide important information about the association between university attendance and adjustment, using a variable-centered analysis masks the heterogeneity of participant responses and profiles, and mitigates the potential to identify at-risk students. Our person-centered analysis adds an important dimension to our knowledge of how distinct profiles of first-year university student problems are related in the short- and long-term to adjustment problems.

Although our results display findings that should be of interest to those in university settings, it must be noted that the results of this study are based on a sample of Canadian university students, which may differ from a sample of university students in the

United States. Similarities among university students in the two countries, however, are clear (see National College Health Assessment 2016 results, carried out with both Canadian and US students).[53] With regard to alcohol use, binge drinking occurs at high levels with both American university students[17] and Canadian university students.[18,19] The World Health Organization has indicated the highest level of alcohol use tends to be found in the Americas—including Canada and the United States—and Europe (and this is the case for youth [age 15–19] alcohol consumption as well).[54] Depressive symptoms and sleep problems also are fairly prevalent in youth/young adults in both the United States[21] and Canada.[20] Emotion dysregulation also is unlikely to be different among students in the two countries.

The results of this study can be applied to the work carried out by both Canadian and American university health practitioners. For example, our results demonstrate that in the short term (ie, our concurrent results), depressive symptoms were moderately high for individuals who displayed either sleep problems or emotion dysregulation; however, these findings did not persist over the long term. Perhaps these individuals experienced a stressful transition in their first year of being in the university, thus they displayed moderate levels of depressive symptoms during that time; it also could be that these individuals used new coping mechanisms to deal with adjustments throughout this period of time. However, over the long term, these symptoms appeared to diminish and were at the same level of those in the low co-occurrence group. One way university health practitioners may be able to aid students would be to address methods of improving either sleep quality or difficulties with regulating emotions; alternatively, if it is simply adjustment to university in general, one potential strategy could be to help find or develop a variety of coping strategies to deal with adjustment difficulties. In contrast, individuals with high co-occurrence displayed elevated levels of depressive symptoms in both the short- and long-term Perhaps one way of identifying these individuals is to have health practitioners that are already in contact with students also assess—at a subjective level—whether the students are experiencing sleep difficulties and/or difficulties regulating emotions that they experience. These students in particular would benefit from some form of intervention or assistance—specifically targeting both sleep problems and emotion dysregulation—starting in the first year of student university attendance.

Limitations

This study has a number of limitations, which must be taken into consideration. First, as the sample consisted only of university students who tend to be frequent drinkers of alcohol, variability in drinking behaviors may be smaller than in other age groups, or there may be differences in reasons for consuming alcohol, leading to a reduced ability to find group differences. The findings also may differ in populations where alcohol use is not as high as it is in young adulthood (eg, for individuals over the age of 25).[50] Second, these findings may not apply to the general population as they are based on a single university sample. An advantage of using one university sample, however, is that we were able to develop a strong relationship with the participants, and thus, retention was high over time. In addition, the pattern of findings from this study is unlikely to be unique to university students. Future work should extend this study by assessing populations other than university students to examine whether the patterns of association between sleep problems and emotion dysregulation are consistent across other groups. Future research also could then address whether there are varying patterns of association between sleep problems and emotion dysregulation in these populations, and whether any co-occurrence is related to adjustment indicators such as depressive symptoms and alcohol use.

A third limitation was that these data are based on self-report. It would have been beneficial to assess sleep problems using an objective measure (eg, actigraphy). Self-report measures, however, represent an important way to investigate individuals' perceptions of their sleep quality, the variable of interest in this study. Second, a concern with using self-report data is that participants may provide responses that are socially desirable. However, given the variability in the responses among this sample, including high-risk scores, this may not be a concern. Future research could examine whether the same patterns of co-occurrence that were found throughout this study still result when using objective measures of sleep quality (eg, actigraphy). This would provide insight for how both subjective and objective measures of sleep quality are related to both emotion dysregulation and adjustment indicators at a person-centered level.

A fourth limitation is that although we did collect data over time, these results should not be interpreted as causal effects. Rather, they suggest that groups of individuals at one point in time may display differing characteristics over time. Future research should examine whether interventions for sleep and/or emotion dysregulation help those displaying elevated levels of mental health problems as this would provide some evidence of cause and effect.

Finally, this study was focused only on self-reported depressive symptoms and alcohol use as these are two areas of wellbeing that are pertinent for university students. However, psychosocial adjustment comprises multiple aspects of life, so another area for future research would be to examine other indicators of adjustment such as social interactions, friendship quality, self-esteem, and stress.

Conclusion

This study provides insight into specific co-occurrence patterns between sleep problems and emotion dysregulation. Future work should be conducted so researchers can examine whether these patterns of association remain stable over time, and whether changes in these patterns are associated with changes in health outcomes (eg, depressive symptoms). In other words, are these four groups of co-occurrence found throughout each year of university attendance, and do individuals remain in the same group over time? Knowledge of the stability of this co-occurrence would provide even more insight into how sleep problems and emotion dysregulation are associated with negative health outcomes over time.

Overall, the examination of the association between sleep problems and emotion dysregulation at a person-centered level in this study provides novel information about how these adjustment difficulties differ across individuals and enhances the ability to assess their long-term links with negative outcomes such as self-reported depressive symptoms and alcohol use. University is an important time of transition and our results indicate that adjustment difficulties in the first year of university attendance can have long-lasting effects, particularly for students with co-occurring adjustment difficulties.

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Conflict of interest disclosure

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ORCID

Thalia Semplonius http://orcid.org/0000-0002-2214-4051

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