

**BINGE EATING AND PURGING IN FIRST-YEAR COLLEGE STUDENTS:
PREVALENCE, PSYCHIATRIC COMORBIDITY, AND ACADEMIC PERFORMANCE**

Running title: binge eating and purging in college students

RICCARDO SERRA ^{a, b}
GLENN KIEKENS ^a
JOHAN VANDERLINDEN ^a
ELSKE VRIEZE ^a
RANDY P AUERBACH ^c
CORINA BENJET ^d
LAURENCE CLAES ^{e, f}
PIM CUIJPERS ^g
KOEN DEMYTTENAERE ^a
DAVID D EBERT ^h
LORENZO TARSITANI ^b
JENNIFER GREIF GREEN ⁱ
RONALD C KESSLER ^j
MATTHEW K NOCK ^k
PHILLIPPE MORTIER ^{a, l}
RONNY BRUFFAERTS ^{a, m}

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as doi: [10.1002/eat.23211](https://doi.org/10.1002/eat.23211)

^aDepartment of Neurosciences, Center for Public Health Psychiatry, Department of Neurosciences, KU Leuven University, Leuven, Belgium

^bDepartment of Human Neurosciences and Mental Health, Sapienza University of Rome, Rome, Italy

^cDepartment of Psychiatry, Vagelos College of Physicians and Surgeons, Columbia University, New York, NY, USA

^dNational Institute of Psychiatry Ramón de la Fuente Muñiz, Mexico City, Mexico

^e Faculty of Psychology and Educational Sciences, KU Leuven University, Leuven, Belgium

^fFaculty of Medicine and Health Sciences, University of Antwerp, Antwerp, Belgium

^g Department of Clinical, Neuro and Developmental Psychology, Amsterdam Public Health research institute, Vrije Universiteit Amsterdam, the Netherlands

^hDepartment of clinical Psychology and Psychotherapy, University of Erlangen-Nuremberg, Erlangen, Germany.

ⁱ Wheelock College of Education & Human Development, Boston University, Boston, MA, USA

^jHarvard Medical School, Department of Health Care Policy, Harvard University, Boston, MA, USA

^kDepartment of Psychology, Harvard University, Boston, MA, USA

^lHealth Services Research Group, IMIM-Institut Hospital del Mar d'Investigacions Mèdiques; CIBER Epidemiología y Salud Pública (CIBERESP), Madrid, Spain

^m Center for Public Health Psychiatry, Leuven, Belgium. Institute for Social Research, Population Studies Center, University of Michigan, Ann Arbor, MI, USA.

Corresponding author:

Ronny Bruffaerts, PhD

Universitair Psychiatrisch Centrum – KU Leuven,

Campus Gasthuisberg, Herestraat, 49, B-3000 Leuven, Belgium.

E-mail: ronny.bruffaerts@med.kuleuven.be

Abstract: 234 words

Article: 3733 words

ABSTRACT

BACKGROUND: Binge eating and purging behaviors (BPB) are common among college students, but evidence is scant on prevalence and associations of BPB with mental health problems and objective academic performance. This study aims to investigate: (1) 12-month prevalence of BPB among college first-year students, (2) comorbidity patterns of BPB with various mental health problems, and (3) the association of BPB with objective academic functioning.

METHODS: Using data from the Leuven College Surveys (Belgium), as part of the World Mental Health Surveys International College Student initiative, we cross-sectionally assessed 12-month BPB and mental health problems among college first-year students (N=4,889; response rate=73.2%) at the beginning of the academic year. Objective measures of academic functioning (final grades, expressed in academic year percentage

1 “AYP” [0-100%] and academic failure) were obtained from administrative records at the end of the academic
2 year.

3
4 **RESULTS:** Twelve-month prevalence of BPB was 7.6% (7.3% binge eating and 1.0% purging), with higher
5 rates among females than males. Bivariate models showed an association between BPB and numerous mental
6 health problems (ORs=3.4-18.4). Multivariate models showed associations with non-suicidal self-injury, post-
7 traumatic stress, internalizing/externalizing problems and suicidal ideation. After controlling for sociodemo-
8 graphic characteristics and comorbid mental health problems, BPB were still associated with lower AYP (-4.1
9 to -11.2% range) and elevated odds of academic year failure (ORs=1.4-4.2).

10
11 **CONCLUSIONS:** BPB (especially binge eating) are relatively common and associated with mental health
12 problems, comparatively low academic performance, and higher risk of academic failure among college first-
13 year students. Further study is needed to examine the causal dynamics underlying these associations.

14
15 **Keywords:** binge eating, purging, academic, college students, comorbidity, eating disorders
16
17

INTRODUCTION

Binge eating and purging behaviors (BPB) are common in western countries (McBride, McManus, Thompson, Palmer, & Brugha, 2013), with estimates for binge eating in the 4.2% - 11.2% range (more commonly reported by female than male respondents; Reichborn-Kjennerud et al., 2003) and 1.3% - 2.4% for purging (with 3 times higher odds for women; Mitchison & Mond, 2015). The incidence of BPB peaks in late adolescence (Lewinsohn, Striegel-Moore, & Seeley, 2000; Sim, Lebow & Billings, 2013), with the transition from high school to college being a sensitive period for the occurrence of BPB (Compas, Wagner, Slavin, & Vannatta, 1986; Levine, 1996; Slane, Klump, McGue, & Iacono, 2014; Yu et al., 2018).

BPB are associated with increased physical and mental health problems (Fairweather-Schmidt, Lee, & Wade, 2015; Kärkkäinen, Mustelin, Raevuori, Kaprio, & Keski-Rahkonen, 2018; Wade, Wilksch, & Lee, 2012). However, most researchers have investigated associations with mental health problems — such as mood and anxiety disorders (Berg et al., 2009; Keski-Rahkonen & Mustelin, 2016), substance use, post-traumatic stress, or personality disorders (Solmi, Hatch, Hotopf, Treasure, & Micali, 2014; Woodside et al., 2001), suicidal thoughts and behaviors or non-suicidal self-injury (Eisenberg et al., 2011; Micali et al., 2015) — either *in isolation*, or in consideration of only a limited set of comorbidities. Given that these mental health problems frequently co-occur (Auerbach et al., 2018), it is unclear whether BPB are uniquely associated with specific mental health problems. In order to address this limitation, it is necessary to examine a large variety of mental health problems *together* in relation to BPB. In addition, given that BPB are common among emerging adults and that the vast majority of high school graduates enroll in college (UNESCO Institute for Statistics), it is surprising that the association between BPB and academic performance has rarely been investigated. To our knowledge, the only studies that assessed this association (Hoerr, Bokram, Lugo, Bivins & Keast, 2002; Yanover & Thompson, 2008) found higher levels of subjectively perceived interference in academic functioning among students reporting eating disorder symptoms. However, these findings should be interpreted with caution because of the relatively low number of cases, the absence of assessments of comorbid disorders which could be causing the academic impairment, and the use of self-reported measures of academic interference – all related

1 to possible bias (Kuncel, Credé, & Thomas, 2005). Hence, further work on this topic is needed to clarify whether
2 BPB are associated with an *objectively* recorded lower academic performance and higher risk of failing the first-
3 year students year (Dalgard, Mykletun, Rognerud, Johansen, & Zahl, 2007; Hooven, Snedker, & Thompson,
4 2012; Jablonska et al., 2012). If this is the case, it is crucial to clarify whether this association remains significant
5 if we control for sociodemographic confounders and the presence of mental health problems.

6 In order to address these limitations, we use data from the Leuven College Surveys, carried out in annual
7 surveys of college during the academic years 2012-2013 and 2013-2014, as part of the WHO World Mental
8 Health International College Student Initiative (WMH-ICS; [http://www.hcp.med.harvard.edu/wmh/col-
9 lege_student_survey.php](http://www.hcp.med.harvard.edu/wmh/college_student_survey.php)). The WMH-ICS aims to collect cross-national epidemiological information about
10 mental health problems among college populations worldwide. Building upon these findings, the initiative will
11 investigate the efficacy of various interventions promoting students' well being, social integration, and aca-
12 demic functioning. The aim of this study is to investigate the prevalence of BPB in the past year, the associated
13 mental health problems, the extent to which BPB were associated with objectively-assessed measures of aca-
14 demic performance (obtained from official university records at the end of the first year of college), and to test
15 this association controlling for sociodemographic confounders and comorbidity. The setup is exploratory in
16 nature, and, hence, hypotheses-generating instead of hypotheses-testing. Against this backdrop, we anticipated
17 a prevalence rate of BPB in the 10-35% range (Berg et al., 2009; Dakanalis et al., 2016; Lipson & Sonnevile,
18 2017). As only few studies investigated the associations between mental health problems and BPB in a multi-
19 variate context, no specific hypotheses were formulated regarding unique associations between both. In addi-
20 tion, this is the first study that investigates the association between BPB and objective academic performance,
21 and so our approach is exploratory in nature. As previous studies found that certain sociodemographic charac-
22 teristics and mental health problems were related to reduced academic performance (Auerbach et al., 2016;
23 Bruffaerts et al., 2018; Kiekens et al., 2016; Mortier et al., 2015), we controlled for sociodemographic con-
24 founders and the presence of other mental health problems.

25 **METHODS**

1 **2.1. Procedures**

2 As a part of the WMH-ICS, data were extracted from the Leuven College Surveys (Belgium), an ongo-
3 ing web-based survey of KU Leuven college students. With over 40,000 students enrolled, KU Leuven repre-
4 sents Belgium's largest university. In 2012–2013 and 2013–2014, a total of 7,493 Dutch-speaking incoming
5 students were eligible for inclusion at the start of the academic year (i.e., census sampling). Recruitment was
6 structured in three phases and involved different strategies to achieve a higher response rate. In phase one,
7 enrolled students received a letter inviting them to a free psycho-medical examination organized by the local
8 student health center. During the checkup, the survey was administered. In phase two, non-respondents were
9 sent customized e-mails containing secured internet links to the survey. Phase three was identical to phase two,
10 but included an additional incentive (i.e., a 20-euro store credit coupon). Each phase included reminders, which
11 were sent to a maximum amount of eight contacts. The final sample consisted of 4,889 students, for an overall
12 weighted response rate of 73.2%. (adjusted for dropout rate during the academic year). The study's protocol
13 was approved by the University Hospital Leuven Biomedical Ethical Board (B322201215611) and by the Bel-
14 gian Commission for the Protection of Privacy (VT005053139).

15 **2.2. Measures**

16 *Socio-demographic and college-related variables*

17 Socio-demographic characteristics were assessed at the beginning of the academic year and included
18 gender (female vs. male), age (i.e., 18 years or younger vs. 19 years and older), nationality (i.e., Belgian vs.
19 non-Belgian), family financial situation (i.e., easy vs difficult: students were asked to evaluate their family
20 financial situation as *very easy*, *easy*, *fairly easy* or *fairly difficult*, *difficult*, *very difficult*; responses were then
21 dichotomized), parental level of education (i.e., high: both parents completed at least a bachelor's degree;
22 mixed: only one completed a bachelor's degree; and low: neither completed a bachelor's degree), and family
23 composition (i.e., separated/divorced vs. married parents). College-related variables included: secondary school
24 type (i.e., general vs. non-general track), student status (i.e. full time vs. non-full time), and higher-level field
25 of study (i.e., Biomedical sciences, Science and Technology, and Human Sciences).

Twelve-month binge eating and purging behaviors

BPB were assessed at the beginning of the academic year using selective items, taken from the Mini International Neuropsychiatric Interview Screen (Lecrubier et al., 1997), evaluating pathological binge eating and pathological purging. The full measure investigates the presence of 17 different disorders and has a good inter-rater reliability (kappa coefficients ranging from 0.88 to 1.0) and test-retest reliability (kappa coefficients between 0.76 and 0.93). The items used for assessing the presence of BPB have shown high specificity (0.96) and reasonable sensitivity (0.63) with eating disorders. Students were asked: “*Have you ever experienced times lasting 3 months or longer when you had eating binges at least twice a week; that is, your eating was out of control and you ate a very large amount of food over a short period of time (2 hours or less)?*” and “*Have you ever experienced times lasting 3 months or longer when you made yourself vomit or took laxatives or did other things to avoid gaining weight after binge eating?*” Twelve-month prevalence was scored positively if students indicated having experienced such a period in the 12 months prior to college entry.

Twelve-month mental health problems

Mental health problems were assessed at the beginning of the academic year utilizing the Global Appraisal of Individual Needs Short Screener (GAIN-SS), a well-validated instrument for the screening of 12-month mental health problems in adolescent and adult populations (Dennis, Chan, & Funk, 2006). This instrument, consisting of 20-items, is designed to identify groups of adolescents and young adults with a possible need for referral or treatment and to help with treatment planning and evaluation of progress (Dennis et al., 2006). The GAIN-SS is also accurate and useful in addressing mental health and substance abuse problems and has been validated among several different populations (e.g. Mortier et al., 2015; Sacks, Melnick, & Grella, 2008; Shinn et al., 2007; Truman, Sharar, & Pompe, 2011). It also has been used to screen for various mental health problems such as major depression, psychotic problems, substance abuse problems, and bipolar disorder (Rush, Castel, Brands, Toneatto, & Veldhuizen, 2012; SAMHSA, 2015). The GAIN-SS scoring presents four sub-scales, addressing one mental health problem’s subgroup: internalizing problems (depression, anxiety, in-

1 somnia, post-traumatic stress, and suicidality), externalizing problems (inattentiveness, hyperactivity, impul-
2 sivity, and conduct disorder), substance use and abuse (problematic use, substance abuse, and dependence), and
3 crime/violence-related problems (interpersonal, property, and drug-related crimes). The instrument's subscales
4 showed reasonable to good internal consistency (Cronbach $\alpha = 0.65 - 0.81$), and a high correlation with the
5 original corresponding subscales of the 60–120 min DSM-IV-TR based GAIN structured interview (Pearson r
6 = 0.84 – 0.93). Recommended cut-off scores for each problem are three or more positive symptoms. Although
7 the GAIN-SS accurately detects mental health problems, it does not assess categorical mental health disorders.

8 We also assessed risk for other mental health problems. Screening for mania/hypomania and intermit-
9 tent explosive disorder included two items from the screener section of the Composite International Diagnostic
10 Interview, third version (CIDI-3.0; Kessler & Üstün, 2004). Past year psychotic symptoms (i.e., hallucinations
11 and delusions) included two items taken from the CIDI-3.0 Psychosis Screener (Haro et al., 2006). Non-suicidal
12 self-injury was assessed with the corresponding item from the Self-Injurious Thoughts and Behaviors Interview
13 (SITBI; Nock, Holmberg, Photos, & Michel, 2007) that asked students “*Did you ever do something to hurt*
14 *yourself on purpose, without wanting to die (e.g., cutting yourself, hitting yourself, or burning yourself)?*” The
15 SITBI construct validity for Non-Suicidal Self Injury (NSSI) is good ($\kappa=0.74$), with excellent inter-rater relia-
16 bility and test-retest reliability after 6-month follow-up STB items were taken from the SITBI (Nock et al.,
17 2007). For the purpose of this research, we included data regarding suicidal ideation (“*Did you ever in your life*
18 *have thoughts of killing yourself?*”), with the latter being clearly differentiated from a passive death wish (“*Did*
19 *you ever wish you were dead or would go to sleep and never wake up?*”). The construct validity of the SITBI is
20 good to excellent in comparison to other instruments including the Kiddie Schedule for Affective Disorders and
21 Schizophrenia (K-SADS- PL; $\kappa = .48-0.65$) and the Beck Scale for Suicide Ideation ($\kappa = 0.59$). Also, inter-
22 rater reliability and test-retest reliability are excellent ($\kappa = 0.7-1.0$; Nock et al., 2007).

23 ***Academic performance***

24 Academic performance was obtained at the end of the academic year using two specific outcomes. First,
25 academic year percentage (AYP) is the final grade percentage (range 0.0–100.0%), as objectively calculated by

1 the KU Leuven administration office. The AYP, mean result of all final course grades (in terms of percentages)
2 obtained after the examination periods in June and September, is an expression of the academic achievement of
3 the individual student in a given academic year. The AYP for each year is calculated after the completion of
4 any retakes the following September. If students do not participate in an examination, the grade obtained for
5 that particular course is zero. Second, we also use cumulative study efficiency (CSE) as a measure of academic
6 performance. CSE is a percentage that reflects the relation between the number of credits a student has passed
7 throughout the year within a program and the number of credits that student has taken within that program.
8 Thus, CSE provides an indication of course progress; first-year students with $CSE < 30\%$ are not allowed to
9 continue with their academic program, and therefore fail their first year of college. Based on the CSE scores we
10 received by the KU Leuven administration office, students were grouped into two groups, those with $CSE \geq 30\%$
11 and those with $CSE < 30\%$.

12 **2.3. Statistical Analyses**

13 Appropriate missing data strategies were used to ensure that findings were representative of the entire
14 student population. Non-response propensity weighting was performed to account for potential differences be-
15 tween survey respondents and non-respondents on the sociodemographic and college-related variables included
16 in the study, and multivariate imputation by chained equations was used to adjust for within-survey item non-
17 response (van Buuren, 2007). Using the package mice in R (Buuren & Groothuis-Oudshoorn, 2011), the final
18 data consisted of 100 imputed datasets obtained after 100 iterations. Descriptive statistics and prevalence esti-
19 mates were reported as weighted numbers (n), and weighted proportions (%) with associated standard errors.
20 Cross-sectional associations between 12-month BPB and mental health problems were evaluated using bivariate
21 and multivariate logistic regression models and reported as odds ratios and associated 95% confidence intervals.
22 Based on multivariate equations, including relevant sociodemographic (as derived in preliminary analyses; see
23 supplementary table 1) and presence of 12-month comorbidity, we evaluated the prospective association be-
24 tween BPB and academic performance in two ways. First, we used linear regression analyses to examine

1 whether 12-month BPB were associated with significantly lower AYP (0-100%). Second, we used logistic re-
2 gression analyses to examine whether students with 12-month BPB had significantly elevated odds of having
3 to end their study program due to insufficient study progress (i.e., CSE < 30%). Finally, we also determined the
4 Population Attributable Risk Proportion (PARP) of 12-month BPB by calculating what proportion of students
5 failing the academic year may have been prevented, if it were possible to prevent or treat each case of 12-month
6 BPB, assuming a causal association. All analyses were performed with SAS (version 9.4) and R (version 3.5.1).

7 RESULTS

8 3.1. Sample description

9 Sample characteristics are presented in Table 1. The sample consisted of 4,889 first-year students,
10 (55.4% females) with an average age of 18.4 (SE=1.1). Mean AYP was 50.0 (SD =18.1; SE =0.3) with 24.1%
11 (SE =0.6) of the students under the 30.0% CSE cut-off for passing the academic year. These estimates are
12 comparable to the entire population of students at KU Leuven (mean AYP = 48.5%; SD=18.5; CSE < 30%
13 =26.8%).

14 [INSERT TABLE 1 ABOUT HERE]

15 3.2. Twelve-month binge eating and purging behaviors

16 BPB in the past year were reported by 7.6% (SE=0.4) of first-year students, with higher estimates for
17 binge eating (7.3% [SE=0.4]) than purging (1.0% [SE=0.2]). Binge eating infrequently co-occurred with purg-
18 ing: only 10.1% (SE=1.8) of those who reported binge eating in the past year also reported purging. Conversely,
19 12-month purging was strongly associated with binge eating, with 70.6% (SE=7.1) of students with purging
20 behaviors also reporting binge eating. Purging only was rare and present in only 0.3% (SE=0.1) of students;
21 making comparisons using this specific group not possible in further analyses. In comparison to men, being a
22 woman was significantly associated with BPB, with elevated odds ratios of 1.7 (95%CI= 1.3-2.21) for binge
23 eating (i.e., 8.9% vs. 5.4%) and 3.8 (95%CI=1.6-8.9) for purging (i.e., 1.6% vs. 0.4%).

24 3.3. Comorbidity patterns between binge eating and purging behaviors and mental health problems

1 Table 2 shows bivariate associations between 12-month BPB and mental health problems. Three find-
2 ings stand out. First, the binge eating only group showed a high rate of comorbid mental health problems com-
3 pared to the group without BPB (ORs in the 3.4-6.6 range; median OR=4.4). Second, compared to the group
4 without BPB, the comorbid binge eating and purging group showed the highest prevalence of mental health
5 problems, with elevated odds varying from 6.8 for intermittent explosive disorder and 18.4 for NSSI. Third, we
6 found a significant linear association between BPB (for both the binge eating only and the both binge eating
7 and purging groups) and the total number of comorbid mental health problems.

8 [INSERT TABLE 2 ABOUT HERE]

9 Table 3 presents the multivariate analyses of BPB comorbidity patterns. Binge eating only was signifi-
10 cantly associated with 5 out of 8 mental health problems (ORs in the 1.7-2.4 range; median OR=1.8), with
11 elevated odds for both internalizing and externalizing emotional problems. Students reporting comorbid binge
12 eating and purging also were significantly more likely to engage in 12-month NSSI when compared to students
13 reporting no BPB (OR=3.9) and students reporting only binge eating or purging (i.e., the single BPB group;
14 OR=3.2).

15 [INSERT TABLE 3 ABOUT HERE]

16 3.4. Associations between 12-month BPB and academic functioning

17 The association between BPB and both AYP and CSE was investigated in bivariate and multivariate
18 models (Table 4). Even after controlling for relevant sociodemographic confounders (see supplementary Table
19 1) and presence of comorbid mental health problems, we observed a significant negative association between
20 BPB and academic functioning. Both binge eating ($\beta = -4.1\%$) and purging ($\beta = -11.2\%$), were associated with
21 lower AYP, as well as higher odds of 1.4 and 4.3 for failing the first year of college. The PARP calculations
22 indicate that up to 3.9% of all first-year students failing the academic year may be preventable, if it were possible
23 to prevent or treat each case of 12-month BPB, assuming a causal association between BPB and academic
24 performance.

25 [INSERT TABLE 4 ABOUT HERE]

DISCUSSION

This is the first study in a representative sample of college first year students that investigated the prevalence of BPB and associated psychiatric comorbidities with objectively recorded indicators of academic functioning. These elements contribute substantially to prior research in the fields of disordered eating and college mental health. The major findings are that BPB (especially binge eating) are relatively common behaviors in first-year college students and are associated with a variety of mental health problems, as well as comparatively low academic functioning.

The 12-month prevalence of BPB (i.e., 7.6%) fall in the lower range of previous findings in college population, for both bingeing (Dakanalis et al., 2016; Eisenberg et al., 2011) and purging (Mitchison, Hay, Slewa-Younan, & Mond, 2014; Tomori & Rus-Makovec, 2000). Possible explanations are the high specificity of the items used - previous studies used a much broader definition of BPB (Lipson & Sonnevile, 2017) - and cultural differences in eating habits across countries and continents (Mitchison, Touyz, Gonzalez-Chica, Stocks, & Hay, 2017). Consistent with previous research, female students reported binge eating and purging at two- and five-times higher rates than males. Interestingly, male students reported a similarly higher risk for binge drinking (Wilsnack, Wilsnack, Gmel, & Kantor, 2017), which might be an indication of underlying gender liabilities with different clinical manifestations of an underlying psychological factor.

The current findings provide further evidence for a robust link between BPB and a range of mental health problems, including both internalizing and externalizing emotional problems. These associations may reflect a shared underlying vulnerability. BPB may also represent a coping mechanism for anxiety, depression, or PTSD-related traumatic memories (Palmisano et al., 2018). Alternatively, BPB may also increase risk for onsets of other mental health problems (e.g., Riley, Davis, Combs, Jordan, & Smith, 2016). Also, the comorbidity with NSSI/suicidal behaviors has been reported in eating disorder patients, as these behaviors may be functionally equivalent within the self-harming spectrum (Claes & Muehlenkamp, 2014; Fox et al., 2019). Taken together, our data are consistent with the thought that BPB represent a behavioral marker of psychopathological distress among incoming college students. In addition, our results are in line with previous research

1 showing that binge eating is as strongly associated with adverse outcomes as the combination of both binge
2 eating and purging (Kessler et al., 2013), therefore further validating the decision of DSM-5 to designate a
3 specific Binge-Eating disorder as distinct from bulimia nervosa.

4 Students who engaged in BPB in the past year had, on average, a decrease of 4.1–11.2% in their AYP
5 compared to those without BPB. That means that, on average, a student who functions on an academic level in
6 the 50th percentile will drop to the 25th-35th percentile in the presence of BPB (Bruffaerts et al., 2018). We also
7 found that a student with binge eating had 1.4 higher odds of failing the first year than did other students with
8 comparable scores on all other measured predictors. Those with purging are more than 4 times more likely to
9 fail their academic year. On balance, BPB are associated with lower academic functioning compared to other
10 mental health problems. Previous studies have shown prospectively lower academic functioning in association
11 with anxiety, depression, and other types of internalizing emotional problems of 1.2-2.9% of the academic per-
12 centage (Eisenberg et al., 2011; Hysenbegasi, Hass, & Rowland, 2005). Other reported a lower AYP of 4.7%
13 in students with externalizing mental health problems (Bruffaerts et al., 2018), 3.6-7.9% in those with suicidal
14 thoughts and behaviors (Mortier et al., 2015) and 5.9% in those engaging in NSSI (Kiekens et al., 2016). In
15 contrast to broader constructs like anxiety and depression, BPB are specific behavioral manifestations. It is
16 therefore striking that, even after controlling for comorbidities (together with other important confounders like
17 gender), BPB were still associated with academic impairment. The high prevalence of BPB, as well as its sig-
18 nificant impact on academic functioning, call to the need for a better understanding of these common behaviors
19 among college students, as they may add to long-term consequences for both individuals, as well as society.
20 Our findings suggest that timely, effective interventions for BPB may prevent up to 3.9% of first-year academic
21 failures (i.e., 78 students in this study).

22 **Limitations and future directions**

23 Several limitations deserve attention in interpreting the results of this study. First, although a response rate of 73% is
24 strong, residual non-response bias might have affected our findings. To address this, we applied state-of-the-art missing
25 data handling techniques. Yet, when considering the local nature of our data, further research is needed to evaluate the

1 generalizability of our findings. Indeed, food and eating habits may vary significantly across countries, potentially im-
2 pacting the prevalence of BPB and the associated psychological burden (Mitchison et al., 2017). Second, our study was
3 based on well-validated items rather than clinical interviews. For instance, the wording of the item assessing purging not
4 only mentions whether students vomited or took laxatives, but also questions whether they did other things to avoid gain-
5 ing weight. Some students may have interpreted the latter as also including behaviors, such as fasting or exercising, that
6 are not considered purging. As a consequence, the true prevalence of purging might be even lower than the one reported
7 here. Relatedly, it is unclear what proportion of students with 12-month BPB of our sample would also meet full thresh-
8 old disorder criteria. Emerging evidence shows that 10.5% of college students engaging in disordered eating behaviors
9 also fulfill the diagnostic criteria for an eating disorder (Sonneville & Lipson, 2018). An important next step will there-
10 fore be to clarify to what extent solely engaging in BPB is related to higher risk of comorbidity and academic failure.
11 Further, it is probably unlikely that the prospective association between BPB and academic performance is a direct one.
12 Future research is needed beyond this initial investigation to evaluate the generalizability of these findings and clarify the
13 causal dynamics underlying these associations. Indeed, BPB interact with multiple variables in complex models. Studies
14 with larger samples should build upon these findings and test more complex models - for example larger sets of specific
15 mental health problems, familial, or relational variables in the prediction of academic performance, or a potential moder-
16 ating role of gender and weight in the relation between BPB, mental health problems, and academic functioning. Finally,
17 longitudinal studies are needed to investigate the predictive role of BPB on long-term mental health and academic out-
18 comes.

19 These limitations notwithstanding, the current study makes significant advances in the field of mental health in
20 college students by demonstrating, for the first time, that the presence of 12-month BPB are objectively associated with
21 comparatively low academic performance, as well as higher risk of academic failure among college first year students.
22 Awaiting further research, we provide preliminary evidence that the presence of 12-month BPB may be a useful behavioral
23 markers to identify vulnerable students with increased mental health and academic difficulties in the first year of college.
24

References

- 1
2
3 Auerbach, R. P., Alonso, J. L., Axinn, W. G., Cuijpers, P., Ebert, D. D., Green, J. G., ... Bruffaerts, R. (2016).
4 Mental disorders among college students in the World Health Organization World Mental Health
5 Surveys. *Psychological Medicine*, *46*(14). doi:10.1017/S0033291716001665
- 6 Berg, K. C., Frazier, P., & Sherr, L. (2009). Change in eating disorder attitudes and behavior in college women:
7 Prevalence and predictors. *Eating Behaviors*, *10*(3), 137-142. doi:10.1016/j.eatbeh.2009.03.003
- 8 Bruffaerts, R., Mortier, P., Kiekens, G., Auerbach, R. P., Cuijpers, P., Demyttenaere, K., ... Kessler, R. C.
9 (2018). Mental health problems in college freshmen: Prevalence and academic functioning. *Journal of*
10 *Affective Disorders*, *225*, 97-103. doi:10.1016/j.jad.2017.07.044
- 11 Buuren, S. v., & Groothuis-Oudshoorn, K. (2011). mice : Multivariate Imputation by Chained Equations in R.
12 *Journal of Statistical Software*, *45*(3). doi:10.18637/jss.v045.i03
- 13 Claes, L., & Muehlenkamp, J. J. (2014). *Non-suicidal Self-injury in Eating Disorders: Advancements in*
14 *Etiology and Treatment*: Heidelberg : Springer.
- 15 Compas, B. E., Wagner, B. M., Slavin, L. A., & Vannatta, K. (1986). A prospective study of life events, social
16 support, and psychological symptomatology during the transition from high school to college. *American*
17 *Journal of Community Psychology*, *14*(3), 241-257. doi:10.1007/BF00911173
- 18 Dakanalis, A., Timko, A., Serino, S., Riva, G., Clerici, M., & Carrà, G. (2016). Prospective Psychosocial
19 Predictors of Onset and Cessation of Eating Pathology amongst College Women. *European Eating*
20 *Disorders Review*, *24*(3), 251-256. doi:10.1002/erv.2433
- 21 Dalgard, O. S., Mykletun, A., Rognerud, M. A., Johansen, R., & Zahl, P. H. (2007). Education, sense of mastery
22 and mental health: results from a nation wide health monitoring study in Norway. *7*(1).
23 doi:10.1186/1471-244X-7-20
- 24 Dennis, M. L., Chan, Y. F., & Funk, R. R. (2006). Development and Validation of the GAIN Short Screener
25 (GSS) for Internalizing, Externalizing and Substance Use Disorders and Crime/Violence Problems

- 1 Among Adolescents and Adults. *American Journal on Addictions*, 15(s1), s80-s91.
2 doi:10.1080/10550490601006055
- 3 Eisenberg, D., Nicklett, E. J., Roeder, K., & Kirz, N. E. (2011). Eating Disorder Symptoms among College
4 Students: Prevalence, Persistence, Correlates, and Treatment-Seeking. *Journal of American College*
5 *Health*, 59(8), 700-707. doi:10.1080/07448481.2010.546461
- 6 Fairweather-Schmidt, A. K., Lee, C., & Wade, T. D. (2015). A Longitudinal Study of Midage Women with
7 Indicators of Disordered Eating. *Developmental Psychology*, 51(5), 722-729. doi:10.1037/dev0000011
- 8 Fox, K., Wang, S., Boccagno, C., Haynos, A., Kleiman, E., & Hooley, J. (2019). Comparing self-harming
9 intentions underlying eating disordered behaviors and NSSI: Evidence that distinctions are less clear
10 than assumed. *International Journal Of Eating Disorders*. doi: 10.1002/eat.23041
- 11 Haro, J. M., Arbabzadeh-Bouchez, S., Brugha, T. S., De Girolamo, G., Guyer, M. E., Jin, R., . . . Kessler, R. C.
12 (2006). Concordance of the Composite International Diagnostic Interview Version 3.0 (CIDI 3.0) with
13 standardized clinical assessments in the WHO World Mental Health Surveys. *International Journal of*
14 *Methods in Psychiatric Research*, 15(4), 167-180. doi:10.1002/mpr.196
- 15 Hawkins, R. C., & Clement, P. F. (1980). Development and construct validation of a self-report measure of
16 Binge eating tendencies. *Addictive Behaviors*, 5(3), 219-226. doi:10.1016/0306-4603(80)90042-8
- 17 Hilbert, A., Bishop, M. E., Stein, R. I., Tanofsky-Kraff, M., Swenson, A. K., Welch, R. R., & Wilfley, D. E.
18 (2012). Long-term efficacy of psychological treatments for binge eating disorder. *The British journal*
19 *of psychiatry : the journal of mental science*, 200(3), 232-237. doi:10.1192/bjp.bp.110.089664
- 20 Hoerr, S., Bokram, R., Lugo, B., Bivins, T., & Keast, D. (2002). Risk for Disordered Eating Relates to both
21 Gender and Ethnicity for College Students. *Journal Of The American College Of Nutrition*, 21(4), 307-
22 314. doi: 10.1080/07315724.2002.10719228
- 23 Hooven, C., Snedker, K. A., & Thompson, E. A. (2012). Suicide Risk at Young Adulthood: Continuities and
24 Discontinuities from Adolescence. *Youth & Society*, 44(4), 524-547. doi:10.1177/0044118X11407526

- 1 Hysenbegasi, A., Hass, S. L., & Rowland, C. R. (2005). The impact of depression on the academic productivity
2 of university students. *The journal of mental health policy and economics*, 8(3), 145-151.
- 3 Jablonska, B., Lindblad, F., Östberg, V., Lindberg, L., Rasmussen, F., & Hjern, A. (2012). A national cohort
4 study of parental socioeconomic status and non-fatal suicidal behaviour-the mediating role of school
5 performance. *BMC Public Health*, 12(1), 17. doi:10.1186/1471-2458-12-17
- 6 Kärkkäinen, U., Mustelin, L., Raevuori, A., Kaprio, J., & Keski-Rahkonen, A. (2018). Do Disordered Eating
7 Behaviours Have Long-term Health-related Consequences? *European Eating Disorders Review*, 26(1),
8 22-28. doi:10.1002/erv.2568
- 9 Keski-Rahkonen, A., & Mustelin, L. (2016). epidemiology of eating disorders in Europe: prevalence, incidence,
10 comorbidity, course, consequences, and risk factors. *current opinion in psychiatry*, 29(6), 340-345.
11 doi:10.1097/YCO.0000000000000278.
- 12 Kessler, R., & Üstün, T. B. (2004). The World Mental Health (WMH) Survey Initiative version of the World
13 Health Organization (WHO) Composite International Diagnostic Interview (CIDI. *International*
14 *Journal of Methods in Psychiatric Research*, 13(2), 93-121. doi:10.1002/mpr.168
- 15 Kessler, R., Berglund, P., Chiu, W., Deitz, A., Hudson, J., & Shahly, V. et al. (2013). The Prevalence and
16 Correlates of Binge Eating Disorder in the World Health Organization World Mental Health Surveys.
17 *Biological Psychiatry*, 73(9), 904-914. doi: 10.1016/j.biopsych.2012.11.020
- 18 Kiekens, G., Claes, L., Demyttenaere, K., Auerbach, R. P., Green, J. G., Kessler, R. C., . . . Bruffaerts, R. (2016).
19 Lifetime and 12-Month Nonsuicidal Self-Injury and Academic Performance in College Freshmen.
20 *Suicide and Life-Threatening Behavior*, 46(5), 563-576. doi:10.1111/sltb.12237
- 21 Kuncel, N. R., Credé, M., & Thomas, L. L. (2005). The Validity of Self-Reported Grade Point Averages, Class
22 Ranks, and Test Scores: A Meta-Analysis and Review of the Literature. *Review of Educational*
23 *Research*, 75(1), 63-82. doi:10.3102/00346543075001063
- 24 Lecrubier, Y., Sheehan, D. V., Weiller, E., Amorim, P., Bonora, I., Harnett Sheehan, K., . . . Dunbar, G. (1997).
25 The Mini International Neuropsychiatric Interview (MINI). A short diagnostic structured interview:

- 1 reliability and validity according to the CIDI. *European Psychiatry*, 12(5), 224-231.
2 doi:10.1016/S0924-9338(97)83296-8
- 3 Levine, M. P., & Smolak, L. (1996). Media as a context for the development of disordered eating. In *the*
4 *developmental psychopathology of eating disorders* (pp. 235-257). Hillsdale, NJ: Lawrence Erlbaum
5 associates.
- 6 Lewinsohn, P. M., Striegel-Moore, R. H., & Seeley, J. R. (2000). Epidemiology and Natural Course of Eating
7 Disorders in Young Women From Adolescence to Young Adulthood. *Journal of the American Academy*
8 *of Child & Adolescent Psychiatry*, 39(10), 1284-1292. doi:10.1097/00004583-200010000-00016
- 9 Lipson, S., & Sonnevile, K. (2017). Eating disorder symptoms among undergraduate and graduate students at
10 12 U.S. colleges and universities. *Eating Behaviors*, 24, 81-88. doi:10.1016/j.eatbeh.2016.12.003
- 11 McBride, O., McManus, S., Thompson, J., Palmer, R., & Brugha, T. (2013). Profiling disordered eating patterns
12 and body mass index (BMI) in the English general population. *Social Psychiatry and Psychiatric*
13 *Epidemiology*, 48(5), 783-793. doi:10.1007/s00127-012-0613-7
- 14 Micali, N., Solmi, F., Horton, N. J., Crosby, R. D., Eddy, K. T., Calzo, J. P., . . . Field, A. E. (2015). Adolescent
15 Eating Disorders Predict Psychiatric, High-Risk Behaviors and Weight Outcomes in Young Adulthood.
16 *Journal of the American Academy of Child & Adolescent Psychiatry*, 54(8), 652-659.e651.
17 doi:10.1016/j.jaac.2015.05.009
- 18 Mitchison, & Mond, J. (2015). Epidemiology of eating disorders, eating disordered behaviour, and body image
19 disturbance in males: a narrative review. *Journal of Eating Disorders*, 3(1). doi:10.1186/s40337-015-
20 0058-y
- 21 Mitchison, D., Hay, P., Slewa-Younan, S., & Mond, J. (2014). The changing demographic profile of eating
22 disorder behaviors in the community. *BMC Public Health*, 14(1). doi:10.1186/1471-2458-14-943
- 23 Mitchison, D., Touyz, S., Gonzalez-Chica, D. A., Stocks, N., & Hay, P. (2017). How abnormal is binge eating?
24 18-Year time trends in population prevalence and burden. *Acta Psychiatrica Scandinavica*, 136(2), 147-
25 155. doi:10.1111/acps.12735

- 1 Mortier, P., Demyttenaere, K., Auerbach, R. P., Green, J. G., Kessler, R. C., Kiekens, G., . . . Bruffaerts, R.
2 (2015). The impact of lifetime suicidality on academic performance in college freshmen. *Journal of*
3 *Affective Disorders, 186*, 254-260. doi:10.1016/j.jad.2015.07.030
- 4 Nock, M. K., Holmberg, E. B., Photos, V. I., & Michel, B. D. (2007). Self-Injurious Thoughts and Behaviors
5 Interview: Development, Reliability, and Validity in an Adolescent Sample. *Psychological Assessment,*
6 *19*(3), 309-317. doi:10.1037/1040-3590.19.3.309
- 7 Palmisano, G. L., Innamorati, M., Susca, G., Traetta, D., Sarracino, D., & Vanderlinden, J. (2018). Childhood
8 Traumatic Experiences and Dissociative Phenomena in Eating Disorders: Level and Association with
9 the Severity of Binge Eating Symptoms. *Journal of Trauma & Dissociation, 19*(1), 88-107.
10 doi:10.1080/15299732.2017.1304490
- 11 Reichborn-Kjennerud, T., Bulik, C., Kendler, K., Roysamb, E., Maes, H., Tambs, K., & Harris, J. (2003).
12 Gender differences in binge-eating: a population-based twin study. *Acta Psychiatrica Scandinavica,*
13 *108*(3), 196-202. doi: 10.1034/j.1600-0447.2003.00106.x
- 14 Riley, E. N., Davis, H. A., Combs, J. L., Jordan, C. E., & Smith, G. T. (2016). Nonsuicidal Self-injury as a Risk
15 Factor for Purging Onset: Negatively Reinforced Behaviours that Reduce Emotional Distress. *Eur Eat*
16 *Disord Rev, 24*(1), 78-82. doi:10.1002/erv.2407
- 17 Rush, B., Castel, S., Brands, B., Toneatto, T., & Veldhuizen, S. (2012). Validation and comparison of diagnostic
18 accuracy of four screening tools for mental disorders in people seeking treatment for substance use
19 disorders. *Journal of Substance Abuse Treatment, 44*(4). doi:10.1016/j.jsat.2012.08.221
- 20 Sacks, S., Melnick, G., & Grella, C. E. (2008). Introduction to this issue: Studies of co-occurring disorders in
21 the criminal justice system. *Behavioral Sciences & the Law, 26*(4), 347-349. doi:10.1002/bsl.833
- 22 Sonnevile, K., & Lipson, S. (2018). Disparities in eating disorder diagnosis and treatment according to weight
23 status, race/ethnicity, socioeconomic background, and sex among college students. *International*
24 *Journal Of Eating Disorders, 51*(6), 518-526. doi: 10.1002/eat.22846

- 1 Substance Abuse and Mental Health Services Administration. (2015). screening and assessment of co-occurring
2 disorders in the justice system. *HHS publication, (SMA)-15-4930*.
- 3 Shinn, M., Gottlieb, J., Wett, J. L., Bahl, A., Cohen, A., & Baron Ellis, D. (2007). Predictors of Homelessness
4 among Older Adults in New York City: Disability, Economic, Human and Social Capital and Stressful
5 Events. *Journal of Health Psychology, 12(5)*, 696-708. doi:10.1177/1359105307080581
- 6 Sim, L. A., Lebow, J., & Billings, M. (2013). Eating disorders in adolescents with a history of obesity.
7 *Pediatrics, 132(4)*, e1026-e1030. doi:10.1542/peds.2012-3940
- 8 Slane, J. D., Klump, K. L., McGue, M., & Iacono, W. G. (2014). Developmental trajectories of disordered
9 eating from early adolescence to young adulthood: A longitudinal study. *International Journal of*
10 *Eating Disorders, 47(7)*, 793-801. doi:10.1002/eat.22329
- 11 Solmi, F., Hatch, S., Hotopf, M., Treasure, J., & Micali, N. (2014). Prevalence and correlates of disordered
12 eating in a general population sample: the South East London Community Health (SELCoH) study.
13 *Social Psychiatry and Psychiatric Epidemiology, 49(8)*, 1335-1346. doi:10.1007/s00127-014-0822-3
- 14 Tomori, M., & Rus-Makovec, M. (2000). Eating behavior, depression, and self-esteem in high school students.
15 *Journal of Adolescent Health, 26(5)*, 361-367. doi:10.1016/S1054-139X(98)00042-1
- 16 Truman, S. D., Sharar, D. A., & Pompe, J. C. (2011). The Mental Health Status of Expatriate Versus U.S.
17 Domestic Workers: A Comparative Study. *International Journal of Mental Health, 40(4)*, 3-18.
18 doi:10.2753/IMH0020-7411400401
- 19 UNESCO Institute of statistics (2015). Total enrollment in tertiary education (ISCED 5 to 8), regardless of age,
20 expressed as a percentage of the total population of the five-year age group following on from secondary
21 school leaving. *World Bank EdStats*. Retrived from <https://data.worldbank.org/data-catalog/ed-stats>
- 22 van Buuren, S. (2007). Multiple imputation of discrete and continuous data by fully conditional specification.
23 *Statistical Methods in Medical Research, 16(3)*, 219-242. doi:10.1177/0962280206074463
- 24 Wade, T. D., Wilksch, S. M., & Lee, C. (2012). A Longitudinal Investigation of the Impact of Disordered Eating
25 on Young Women's Quality of Life. *Health Psychology, 31(3)*, 352-359. doi:10.1037/a0025956

- 1 Wilsnack, R., Wilsnack, S., Gmel, G., & Kantor, L. (2017). Gender Differences in Binge Drinking: Prevalence,
2 Predictors, and Consequences. *Alcohol Research*, 39(1), E1-E20.
- 3 Woodside, D. B., Garfinkel, P. E., Lin, E., Goering, P., Kaplan, A. S., Goldbloom, D. S., & Kennedy, S. H.
4 (2001). Comparisons of Men With Full or Partial Eating Disorders, Men Without Eating Disorders, and
5 Women With Eating Disorders in the Community. *American Journal of Psychiatry*, 158(4), 570-574.
6 doi:10.1176/appi.ajp.158.4.570
- 7 Yanover, T., & Thompson, J. K. (2008). Self-reported interference with academic functioning and eating
8 disordered symptoms: Associations with multiple dimensions of body image. *Body Image*, 5(3), 326-
9 328. doi:10.1016/j.bodyim.2008.03.008
- 10 Yu, Z., Indelicato, N. A., Fuglestad, P., Tan, M., Bane, L., & Stice, C. (2018). Sex differences in disordered
11 eating and food addiction among college students. *Appetite*, 129, 12-18.
12 doi:10.1016/j.appet.2018.06.028
- 13
14
15
16
17
18
19
20
21
22
23
24

Table 1

Sociodemographic variables	w(n)	w(%)	SE
Sex (female)	2,709	55.4	0.7
Age > 18 years	1,261	25.8	0.7
Belgian nationality	4,531	92.7	0.4
Parents' financial situation difficult	862	17.6	0.6
<i>Parental educational level^a</i>			
Both parents high education	2,854	58.4	0.8
One parent high education	1,205	24.6	0.7
Neither parents high education	830	17.0	0.6
Non-married parents ^b	1,070	21.9	0.7
College-related variables			
Fulltime student	4,611	94.3	0.3

<i>Area of enrolment</i>				Sociodemographic and College-Related Characteristics of the Total
Human sciences	2,353	48.1	0.7	Sample (n = 4,889)
Science and technology	1,387	28.4	0.6	
Biomedical sciences	1,149	23.5	0.6	
General secondary school track	4,557	93.2	0.4	
<i>Academic performance</i>				
Cumulative Study Efficiency (CSE) < 30 %	1,179	24.1	0.6	
	Mean	SD	SE	
Academic Year Percentage (AYP)	50.0	18.1	0.3	

Note: a high education level was defined as holding at least a bachelor's degree, b defined as parents divorced or separated. w(n) = weighted number of cases, w(%) = weighted percentage of sample, SE = Standard Error, SD = Standard Deviation.

	Prevalence ^a			Binge eating only vs. no BPB (ref- erent group)	Comorbid BPB vs. no BPB (referent group)	Comorbid BPB vs. single BPB (referent group)
	w(n)	w(%)	SE	OR (95% CI)	OR (95% CI)	OR (95% CI)
12-month mental health problems						
Internalizing problems	977	21.6	0.7	5.0 (3.9; 6.4)	9.3 (4.2; 20.2)	1.9 (0.9; 4.3)
Externalizing problems	738	16.3	0.6	4.1 (3.2; 5.3)	8.2 (4.0; 16.8)	2.0 (1.0; 4.3)
Substance use problems	204	4.5	0.4	3.4 (2.4; 5.0)	7.7 (3.5; 16.7)	2.2 (1.0; 5.1)
Positive screen IED	190	4.2	0.4	4.3 (3.0; 6.3)	6.8 (2.9; 15.8)	1.7 (0.7; 4.0)
Positive screen broad mania	245	5.4	0.4	6.6 (4.9; 9.0)	11.9 (5.9; 24.3)	1.8 (0.9; 3.9)
Positive screen PTSD	610	13.5	0.6	5.4 (4.1; 7.0)	11.6 (5.6; 24.0)	2.2 (1.0; 4.8)
Psychotic life experience	135	3.0	0.3	3.4 (2.1; 5.3)	11.1 (4.9; 25.0)	3.2 (1.3; 8.0)
Non-suicidal self-injury	109	2.4	0.3	4.4 (2.7; 7.0)	18.4 (8.2; 41.2)	4.3 (1.8; 10.2)

Suicide ideation	213	4.7	0.4	5.7 (4.1; 8.0)	11.2 (5.2; 24.2)	2.0 (0.9; 4.5)
Any comorbid mental health problem	1,815	40.2	0.8	6.6 (4.8; 9.1)	11.8 (3.9; 35.8)	1.9 (0.6; 5.9)
No. comorbid mental health problems						
None	2,701	59.8	0.8	Ref	Ref	Ref
1	908	20.1	0.7	2.8 (1.8; 4.2)	2.6 (0.5; 12.2)	0.9 (0.2; 4.6)
2	507	11.2	0.5	5.1 (3.4; 7.7)	5.2 (1.2; 23.3)	1.1 (0.2; 5.0)
3	213	4.7	0.4	12.7 (8.3; 19.4)	14.9 (3.6; 62.8)	1.2 (0.3; 5.5)
4 or more	187	4.1	0.3	22.8 (15.2; 34.0)	74.9 (23.8; 235.9)	3.5 (1.1; 11.5)
χ^2 (p-value) ^b	-	-	-	345.9 (<.001)	59.9 (<.001)	4.6 (.031)

Note: a Prevalence estimates among those without 12-month binge eating and purging behaviors. b Pooled estimate of 100 Cochran-Armitage linear trend tests. Bivariate associations are based on separate models for each row, with the variable in the row as predictor. Binge eating only refers to students who report binge eating in the past 12-months without purging (n = 322). Comorbid BPB refers to students who report both 12-month binge eating and purging (n = 36). Single BPB refers to students with either 12-month binge eating or purging, but not both (n = 337). No BPB refers to

Table 2

Bivariate Associations
Eating and Purging and
Problems.

students without 12-month binge eating and purging (n = 4516). w(n) = weighted number of cases, w(%) = weighted percentage; SE = Standard Error, BPB = Binge eating and purging behaviors, OR = Odds Ratio, 95% CI = 95% Confidence Interval, IED = Intermittent Explosive Disorder, PTSD = Post Traumatic Stress Disorder, Ref = Reference group. Significant associations are shown in bold.

Between 12-month Binge
Comorbid Mental Health

Table 3

	Binge eating only vs. no BPB (referent group)	Comorbid BPB vs. no BPB (referent group)	Comorbid BPB vs. single BPB (referent group)
12-month mental health problems	OR (95% CI)	OR (95% CI)	OR (95% CI)
Internalizing problems	1.8 (1.1; 2.7)	1.6 (0.5; 5.1)	1.1 (0.3; 3.7)
Externalizing problems	1.8 (1.3; 2.7)	2.2 (0.9; 5.4)	1.4 (0.5; 3.5)
Substance use problems	1.5 (0.9; 2.4)	2.3 (0.9; 6.3)	1.7 (0.6; 4.9)
Positive screen IED	1.3 (0.8; 2.1)	0.9 (0.4; 2.5)	0.9 (0.3; 2.5)
Positive screen broad mania	2.4 (1.6; 3.7)	1.8 (0.8; 4.5)	1.1 (0.4; 2.7)
Positive screen PTSD	1.7 (1.1; 2.6)	1.8 (0.6; 4.9)	1.7 (0.6; 4.6)
Psychotic life experiences	1.0 (0.6; 1.8)	1.8 (0.7; 4.9)	1.9 (0.7; 5.3)
Non-suicidal self-injury	1.2 (0.6; 2.1)	3.9 (1.4; 11.3)	3.2 (1.0; 9.6)

Suicide ideation		1.7 (1.0; 2.8)	1.4 (0.5; 4.1)	0.8 (0.2; 2.6)	Multivariate Associations Between 12-month Binge Eating and Purging Behaviors and Comorbid Mental Health Problems
No. comorbid mental health problems					
	None or one	Ref	Ref	Ref	
	2	1.4 (0.8; 2.6)	1.5 (0.3; 7.2)	0.8 (0.2; 4.0)	
	3	2.1(0.9; 4.6)	2.4 (0.4; 14.9)	0.7 (0.1; 4.9)	
	4 or more	1.7 (0.5; 5.3)	3.7 (0.4; 37.0)	1.1 (0.1; 11.8)	
	χ^2 (<i>p</i> -value) ^a	1.5 (.220)	1.2 (.283)	0.2 (.649)	

Note: ^a Pooled estimate of 100 Cochran-Armitage linear trend tests. Multivariate associations are based on all factors shown in the table. Binge eating only refers to students who report binge eating in the past 12-months without purging (n = 322). Comorbid BPB refers to students who report both 12-month binge eating and purging (n = 36). Single BPB refers to students with either 12-month binge eating or purging, but not both (n = 337). No BPB refers to students without 12-month binge eating and purging (n = 4516). BPB = Binge eating and pruging behaviors, OR = Odds Ratio, 95% CI = 95% Confidence Interval, IED = Intermittent Explosive Disorder, PTSD = Post Traumatic Stress Disorder, Ref = Reference group. Significant associations are shown in bold.

Table 4

Prediction of 12-Month Binge Eating and Purging Behaviors on Academic Year Percentage and Cumulative Study Efficiency

	Academic Year Percentage		Cumulative Study Efficiency < 30 %	
	BPB only in model	Full multivariate model ^a	BPB only in model	Full multivariate model ^a
	β (95% CI)	β (95% CI)	OR (95% CI)	OR (95% CI)
Intercept	-	36.7 (33.6; 39.8)	-	-
12-month Binge Eating and Purging Behaviors				
Binge eating (yes vs no)	-6.5 (-8.7; -4.2)	-4.1 (-6.2; -1.9)	1.7 (1.3; 2.3)	1.4 (1.1; 1.9)
Purging (yes vs no)	-12.1 (-22.5; -1.8)	-11.2 (-21.0; -1.5)	3.9 (1.3; 12.3)	4.3 (1.3; 14.5)
Comorbid BPB	-13.5 (-20.3; -6.7)	7.1 (-4.5; 18.8)	2.8 (1.3; 5.7)	0.3 (0.1; 1.2)

Covariates

Sex (female)	-	2.1 (1.1; 3.1)	-	0.8 (0.7; 0.9)
Age > 18 years	-	-6.2 (-7.4; -5.1)	-	2.0 (1.7; 2.3)
Belgian nationality	-	3.4 (1.3; 5.6)	-	0.7 (0.5; 0.9)
Parents' financial situation difficult	-	-2.8 (-4.3; -1.4)	-	1.3 (1.1; 1.6)
<i>Parental educational level^b</i>				
Both parents high education	-	Ref	-	Ref
One parent high education	-	-3.3 (-4.5; -2.1)	-	1.4 (1.2; 1.7)
Neither parents high education	-	-5.0 (-6.4; -3.5)	-	1.7 (1.4; 2.1)

Non-intact family composition ^c	-	-2.1 (-3.4; -0.8)	-	-
<i>Area of enrolment</i>				
Human sciences	-	Ref	-	Ref
Science and technology	-	3.4 (2.2; 4.6)	-	0.7 (0.6; 0.8)
Biomedical sciences	-	1.0 (-0.2; 2.2)	-	0.9 (0.8; 1.1)
General secondary school track	-	14.7 (12.7; 16.7)	-	0.2 (0.2; 0.3)
12-month comorbid mental health problems	-	-3.3 (-4.3; -2.2)	-	1.5 (1.3; 1.8)

Note: ^a adjusted for covariates in table, ^b high education level was defined as holding at least a bachelor's degree, ^c defined as parents divorced or separated. Academic year percentage ranges between 0 and 100%. B = unstandardized beta coefficient, OR = Odds Ratio, 95% CI = 95% Confidence Interval, Ref = Reference group. Significant associations are shown in bold. The combined effect of comorbid BPB in the joint multivariate models needs to be interpreted by summing/multiplying the effects of the indicator variables binge eating, purging, and comorbid BPB in the prediction of academic year percentage (linear model)/cumulative study efficiency below 30% (logistic model). For example, the combined effect of comorbid BPB (= -4.1 - 11.2 + 7.1) in the prediction of academic year percentage equals a reduction of 8.2%, holding all other predictors equal. This

is an example of a subadditive effect in which the joint effect of two conditions is less than the sum of their individual effects.

Table 1

Sociodemographic and College-Related Characteristics of the Total Sample (n = 4,889)

Sociodemographic variables	w(n)	w(%)	SE
Sex (female)	2,709	55.4	0.7
Age > 18 years	1,261	25.8	0.7
Belgian nationality	4,531	92.7	0.4
Parents' financial situation difficult	862	17.6	0.6
<i>Parental educational level^a</i>			
Both parents high education	2,854	58.4	0.8
One parent high education	1,205	24.6	0.7
Neither parents high education	830	17.0	0.6
Non-married parents ^b	1,070	21.9	0.7
College-related variables			
Fulltime student	4,611	94.3	0.3
<i>Area of enrolment</i>			
Human sciences	2,353	48.1	0.7
Science and technology	1,387	28.4	0.6
Biomedical sciences	1,149	23.5	0.6
General secondary school track	4,557	93.2	0.4
<i>Academic performance</i>			
Cumulative Study Efficiency (CSE) < 30 %	1,179	24.1	0.6
	Mean	SD	SE
Academic Year Percentage (AYP)	50.0	18.1	0.3

Note: a high education level was defined as holding at least a bachelor's degree, b defined as parents divorced or separated. w(n) = weighted number of cases, w(%) = weighted percentage of sample, SE = Standard Error, SD = Standard Deviation.

Table 2

Bivariate Associations Between 12-month Binge Eating and Purging and Comorbid Mental Health Problems.

12-month mental health problems	Prevalence ^a			Binge eating only vs. no BPB (referent group)	Comorbid BPB vs. no BPB (referent group)	Comorbid BPB vs. single BPB (referent group)
	w(n)	w(%)	SE	OR (95% CI)	OR (95% CI)	OR (95% CI)
Internalizing problems	977	21.6	0.7	5.0 (3.9; 6.4)	9.3 (4.2; 20.2)	1.9 (0.9; 4.3)
Externalizing problems	738	16.3	0.6	4.1 (3.2; 5.3)	8.2 (4.0; 16.8)	2.0 (1.0; 4.3)
Substance use problems	204	4.5	0.4	3.4 (2.4; 5.0)	7.7 (3.5; 16.7)	2.2 (1.0; 5.1)
Positive screen IED	190	4.2	0.4	4.3 (3.0; 6.3)	6.8 (2.9; 15.8)	1.7 (0.7; 4.0)
Positive screen broad mania	245	5.4	0.4	6.6 (4.9; 9.0)	11.9 (5.9; 24.3)	1.8 (0.9; 3.9)
Positive screen PTSD	610	13.5	0.6	5.4 (4.1; 7.0)	11.6 (5.6; 24.0)	2.2 (1.0; 4.8)
Psychotic life experience	135	3.0	0.3	3.4 (2.1; 5.3)	11.1 (4.9; 25.0)	3.2 (1.3; 8.0)
Non-suicidal self-injury	109	2.4	0.3	4.4 (2.7; 7.0)	18.4 (8.2; 41.2)	4.3 (1.8; 10.2)
Suicide ideation	213	4.7	0.4	5.7 (4.1; 8.0)	11.2 (5.2; 24.2)	2.0 (0.9; 4.5)
Any comorbid mental health problem	1,815	40.2	0.8	6.6 (4.8; 9.1)	11.8 (3.9; 35.8)	1.9 (0.6; 5.9)
No. comorbid mental health problems						
None	2,701	59.8	0.8	Ref	Ref	Ref
1	908	20.1	0.7	2.8 (1.8; 4.2)	2.6 (0.5; 12.2)	0.9 (0.2; 4.6)
2	507	11.2	0.5	5.1 (3.4; 7.7)	5.2 (1.2; 23.3)	1.1 (0.2; 5.0)
3	213	4.7	0.4	12.7 (8.3; 19.4)	14.9 (3.6; 62.8)	1.2 (0.3; 5.5)
4 or more	187	4.1	0.3	22.8 (15.2; 34.0)	74.9 (23.8; 235.9)	3.5 (1.1; 11.5)
χ^2 (<i>p</i> -value) ^b	-	-	-	345.9 (<.001)	59.9 (<.001)	4.6 (.031)

Note: a Prevalence estimates among those without 12-month binge eating and purging behaviors. b Pooled estimate of 100 Cochran-Armitage linear trend tests. Bivariate associations are based on separate models for each row, with the variable in the row as predictor. Binge eating only refers to students who report binge eating in the past 12-months without purging (n = 322). Comorbid BPB refers to students who report both 12-month binge eating and purging (n = 36). Single BPB refers to students with either 12-month binge eating or purging, but not both (n = 337). No BPB refers to students without 12-month binge eating and purging (n = 4516). w(n) = weighted number of cases, w(%) = weighted percentage; SE = Standard Error, BPB = Binge eating and purging behaviors, OR = Odds Ratio, 95% CI = 95% Confidence Interval, IED = Intermittent Explosive Disorder, PTSD = Post Traumatic Stress Disorder, Ref = Reference group. Significant associations are shown in bold.

Table 3

Multivariate Associations Between 12-month Binge Eating and Purging Behaviors and Comorbid Mental Health Problems

	Binge eating only vs. no BPB (referent group)	Comorbid BPB vs. no BPB (referent group)	Comorbid BPB vs. single BPB (referent group)
12-month mental health problems	OR (95% CI)	OR (95% CI)	OR (95% CI)
Internalizing problems	1.8 (1.1; 2.7)	1.6 (0.5; 5.1)	1.1 (0.3; 3.7)
Externalizing problems	1.8 (1.3; 2.7)	2.2 (0.9; 5.4)	1.4 (0.5; 3.5)
Substance use problems	1.5 (0.9; 2.4)	2.3 (0.9; 6.3)	1.7 (0.6; 4.9)
Positive screen IED	1.3 (0.8; 2.1)	0.9 (0.4; 2.5)	0.9 (0.3; 2.5)
Positive screen broad mania	2.4 (1.6; 3.7)	1.8 (0.8; 4.5)	1.1 (0.4; 2.7)
Positive screen PTSD	1.7 (1.1; 2.6)	1.8 (0.6; 4.9)	1.7 (0.6; 4.6)
Psychotic life experiences	1.0 (0.6; 1.8)	1.8 (0.7; 4.9)	1.9 (0.7; 5.3)
Non-suicidal self-injury	1.2 (0.6; 2.1)	3.9 (1.4; 11.3)	3.2 (1.0; 9.6)
Suicide ideation	1.7 (1.0; 2.8)	1.4 (0.5; 4.1)	0.8 (0.2; 2.6)
No. comorbid mental health problems			
None or one	Ref	Ref	Ref
2	1.4 (0.8; 2.6)	1.5 (0.3; 7.2)	0.8 (0.2; 4.0)
3	2.1 (0.9; 4.6)	2.4 (0.4; 14.9)	0.7 (0.1; 4.9)
4 or more	1.7 (0.5; 5.3)	3.7 (0.4; 37.0)	1.1 (0.1; 11.8)
χ^2 (<i>p</i> -value) ^a	1.5 (.220)	1.2 (.283)	0.2 (.649)

Note: ^aPooled estimate of 100 Cochran-Armitage linear trend tests. Multivariate associations are based on all factors shown in the table. Binge eating only refers to students who report binge eating in the past 12-months without purging (n = 322). Comorbid BPB refers to students who report both 12-month binge eating and purging (n = 36). Single BPB refers to students with either 12-month binge eating or purging, but not both (n = 337). No BPB refers to students without 12-month binge eating and purging (n = 4516). BPB = Binge eating and purging behaviors, OR = Odds Ratio, 95% CI = 95% Confidence Interval, IED = Intermittent Explosive Disorder, PTSD = Post Traumatic Stress Disorder, Ref = Reference group. Significant associations are shown in bold.

Table 4

Prediction of 12-Month Binge Eating and Purging Behaviors on Academic Year Percentage and Cumulative Study Efficiency

	Academic Year Percentage		Cumulative Study Efficiency < 30 %	
	BPB only in model β (95% CI)	Full multivariate model ^a β (95% CI)	BPB only in model OR (95% CI)	Full multivariate model ^a OR (95% CI)
Intercept	-	36.7 (33.6; 39.8)	-	-
12-month Binge Eating and Purging Behaviors				
Binge eating (yes vs no)	-6.5 (-8.7; -4.2)	-4.1 (-6.2; -1.9)	1.7 (1.3; 2.3)	1.4 (1.1; 1.9)
Purging (yes vs no)	-12.1 (-22.5; -1.8)	-11.2 (-21.0; -1.5)	3.9 (1.3; 12.3)	4.3 (1.3; 14.5)
Comorbid BPB	-13.5 (-20.3; -6.7)	7.1 (-4.5; 18.8)	2.8 (1.3; 5.7)	0.3 (0.1; 1.2)
Covariates				
Sex (female)	-	2.1 (1.1; 3.1)	-	0.8 (0.7; 0.9)
Age > 18 years	-	-6.2 (-7.4; -5.1)	-	2.0 (1.7; 2.3)
Belgian nationality	-	3.4 (1.3; 5.6)	-	0.7 (0.5; 0.9)
Parents' financial situation difficult	-	-2.8 (-4.3; -1.4)	-	1.3 (1.1; 1.6)
<i>Parental educational level^b</i>				
Both parents high education	-	Ref	-	Ref
One parent high education	-	-3.3 (-4.5; -2.1)	-	1.4 (1.2; 1.7)
Neither parents high education	-	-5.0 (-6.4; -3.5)	-	1.7 (1.4; 2.1)
Non-intact family composition ^c	-	-2.1 (-3.4; -0.8)	-	-
<i>Area of enrolment</i>				
Human sciences	-	Ref	-	Ref
Science and technology	-	3.4 (2.2; 4.6)	-	0.7 (0.6; 0.8)
Biomedical sciences	-	1.0 (-0.2; 2.2)	-	0.9 (0.8; 1.1)
General secondary school track	-	14.7 (12.7; 16.7)	-	0.2 (0.2; 0.3)
12-month comorbid mental health problems	-	-3.3 (-4.3; -2.2)	-	1.5 (1.3; 1.8)

Note: ^a adjusted for covariates in table, ^b high education level was defined as holding at least a bachelor's degree, ^c defined as parents divorced or separated. Academic year percentage ranges between 0 and 100%. B = unstandardized beta coefficient, OR = Odds Ratio, 95% CI = 95% Confidence Interval, Ref = Reference group. Significant associations are shown in bold. The combined effect of comorbid BPB in the joint multivariate models needs to be interpreted by summing/multiplying the effects of the indicator variables binge eating, purging, and comorbid BPB in the prediction of academic year percentage (linear model)/cumulative study efficiency below 30% (logistic model). For example, the combined effect of comorbid BPB (= -4.1 - 11.2 + 7.1) in the prediction of academic year percentage equals a reduction of 8.2%, holding all other predictors equal. This is an example of a subadditive effect in which the joint effect of two conditions is less than the sum of their individual effects.