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MENTAL HEALTH PROBLEMS IN COLLEGE FRESHMEN: PREVALENCE AND ACADEMIC FUNCTIONING

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1. INTRODUCTION

The college years are a developmentally crucial period when students make the transition from late adolescence to emerging adulthood (Arnett, 2000). Epidemiological studies suggest that 12–50% of college students meet criteria for one or more common mental disorders (Blanco et al., 2008; Hunt & Eisenberg, 2010; Verger et al. 2010). Differences between college students and their non-college peers are generally understudied but the available evidence shows that college students are somewhat at lower risk of mental

disorders (Auerbach et al., 2016; Blanco et al., 2008). In any case, mental disorders in early adulthood are associated with long-term adverse outcomes in later adulthood, including persistent emotional and physical health problems (Scott et al., 2016), relationship dysfunction (Kerr & Capaldi, 2011), and labor market marginalization (Niederkröthenthaler et al., 2014; Goldman-Mellor et al., 2014). These long-term adverse outcomes may be mediated by mental health problems that exist during the college years, as these years constitute a peak period for the first onset of a broad range of mental disorders (Ibrahim et al., 2013).

In Belgium, around roughly 70% of high school graduates attains higher education after graduating from high school (Dehon & Ortiz, 2008), but only 37–39% will succeed and even 28% will never obtain any diploma (Declercq & Verboven, 2014). Reasons for dropout are comparable to international literature, and include: lower socio-economic status (Walpole, 2003), male gender (Dehon & Ortiz, 2008), or the overall lack of social resources (Tinto, 1998). Also mental disorders may contribute to college dropout. Most of the research so far discussed the role of pre-matriculation mental disorders on subsequent academic functioning (Kosidou et al., 2014; Eisenberg et al., 2009; Gunnell et al., 2009). Previous studies show that college students with mental disorders are twice as likely to drop out without obtaining a degree (Kessler et al., 1995; Hartley, 2010). Consistent with this finding, between 15% and 23% of college students with mental disorders suggest that they confer a negative academic impact (Kernan et al., 2008). Studies that investigate the association between mental health distress and academic performance in college are much scarcer. Most evidence exists for the finding that depression and suicidal thoughts and behaviours are related to a lower grade point average (De Luca et al., 2016; Mortier et al., 2015; Hysenbergasi et al., 2009; Andrews & Wilding, 2009). In addition, most studies focus on the impact of just one disorder (e.g. Meda et al., 2017; Arria et al., 2015), leading to uncertainties as to the overall associations of a broad range of mental health problems with academic outcomes. Prior studies also mostly relied on self-reported academic performance or were based on reports from students presenting to the student (mental) health center.

We address these shortcomings in the current report by using data obtained in the Leuven College Surveys. These surveys were carried out as part of the International College Student project (WMH-ICS; http://www.hcp.med.harvard.edu/wmh/college_student_survey.php) of the WHO World Mental Health Surveys. The WMH-ICS aims to obtain accurate cross-national information on the prevalence, incidence, and correlates of mental, substance, and behavioral problems among college students worldwide, to describe patterns of service use and unmet need for treatment, to investigate the associations of these disorders with academic functioning, and to evaluate the effects of a wide range of preventive and clinical interventions on student mental health, social functioning, and academic performance. The current study builds on earlier work on academic functioning in college students (Mortier et al., 2015; Kiekens et al., 2016; Auerbach et al., 2016). The aim is to investigate the prevalence of mental health problems in the past year and the extent to which these problems in freshmen in the Leuven College Surveys were associated with objectively-assessed measures of academic performance obtained from official university records at the end of the freshman year. We also go beyond previous studies in investigating the possibility that these associations vary by academic departments (like bio-engineering, law school,...) using

analysis methods that take into account clustering of students within departments so as to avoid over-generalizing conclusions.

2. MATERIAL AND METHOD

2.1. Procedures

As part of the WMH-ICS project, the Leuven College Surveys consist of a series of ongoing web-based self-report surveys of KU Leuven students. As Belgium's largest university, KU Leuven has an enrollment of over 40,000 students, with 7,527 Dutch-speaking incoming freshmen aged 18 years or older in the 2012 and 2013 entering classes eligible for the baseline survey. The sample was recruited in three stages. In the first stage, the baseline survey was included in a routine medical check-up organized by the university student health center early in the academic year. All incoming freshmen from all university departments were sent a standard invitation letter for the check-up. Students who arrived at their check-up were invited to complete the study survey on a desktop computer in the waiting room of the student health center. In a second stage, non-respondents to the first stage were personally contacted using customized emails containing unique electronic links to the survey. The third stage was identical to the second stage, but additionally included an incentive to complete the survey (i.e., a raffle for 20 euro store credit coupons). Each stage used reminder emails, setting the maximum amount of contacts at eight. The study's protocol was approved by the University Hospital Leuven Biomedical Ethical Board (B322201215611) and by the Belgian Commission for the Protection of Privacy (VT005053139). We used the code for a pure epidemiological study (in contrast to an intervention study) and have permission to include baseline samples until September 2018. The ethical board adopts the International Conference on Harmonisation – Guidelines of Good Clinical Practice) principles. Students who reported any 12-month suicidality or non-suicidal self-injury were presented with links to local mental health resources.

We obtained freshman departmental status from the KU Leuven administration office. The KU Leuven is divided in 40 departments based on the academic content offered to the enrolled students within that department (e.g., bio-engineering, law, romance languages – for a full list, see https://www.kuleuven.be/english/faculties_schools). A department is a micro-unit within the larger campus environment, with shared structural (e.g., classrooms), interpersonal (e.g., sense of belongingness), and social (e.g., sports participation) elements. The clustering of students in academic departments enabled us to estimate multilevel models that investigated the possibility of between-department variability in prevalence and associations of 12-month mental disorders with subsequent academic performance. Such an approach may be especially valuable given that students' wellbeing and performance are known to be is linked to peer-group characteristics, student–faculty interactions, and general institution characteristics (Astin, 1993; Fink, 2014).

2.2. Measures

The WMH-ICS survey instrument was developed by the World Mental Health Survey Consortium and includes multiple screening instruments for a wide range of mental health problems. For each respondent, survey data were linked to unique administrative unit-level

data obtained from the KU Leuven students' administration office, including academic year functioning, and sociodemographic variables.

Sociodemographic variables—Socio-demographics included gender, age, and parental educational level. Parental education was divided in three levels: both parents completed a high academic degree (i.e., college bachelor degree or more), only one parent obtained a high academic degree, and neither parent obtained a high academic degree. Parental education was included as covariate because it is a reliable proxy variable for socio-economic status (Hauser & Warren, 1997), as well as for young people's educational success and achievement-related behaviors (Eccles et al., 2004).

Mental health problems were assessed using the Global Appraisal of Individual Needs Short Screener (GAIN-SS), a well-validated screening instrument for 12-month mental health problems in adolescent and adult populations (Dennis et al., 2006). The 20-item instrument is developed to provide a quick and accurate screening of emotional and behavioural problems in order to identify groups of adolescents and young adults with a possible need for referral or treatment, and thus to aid in clinical referral, treatment planning, and program evaluation (Dennis et al., 2006). It is used by more than 1,700 agencies in both clinical services and research communities (Conrad et al., 2012). The GAIN-SS is one of the few screening instruments that effectively addresses mental health and substance abuse problems. The instrument has been used in a variety of populations (primary care, school, criminal justice system, homeless populations, college populations, and general population samples - e.g. Truman et al., 2012; Shinn et al., 2007; Sacks et al., 2008; Mortier et al., 2015). It has also been used to screen for various mental health problems such as major depression, psychotic problems, substance abuse problems, or bipolar disorder (Peters et al., 2008; Rush et al., 2013). The GAIN-SS consists of four sub-screeners, each indicative for one type of mental health problems, including: internalizing mental health problems (depression, anxiety, sleep problems, post-traumatic stress, and suicidal ideation), externalizing mental health problems (inattentiveness, hyperactivity, impulsivity, and conduct disorder), problems with substance use (problematic use, substance abuse, and dependence), and crime/violence-related problems (interpersonal, property, and drug related crimes). Sub-screeners show good internal consistency (Cronbach $\alpha=0.65-0.81$), and they are highly correlated with the original corresponding subscales of the 60–120 min DSM-IV-TR based GAIN structured interview (Pearson $r=0.84-0.93$; Dennis et al., 2006). For each type of mental health problems the recommended cut-off score of three or more positive symptoms in the past 12 months. The GAIN-SS does not allow us to assign diagnoses or identify disorders in se; the instrument is developed and used in order to identify 4 types of mental health problems.

Academic year percentage (AYP)—The AYP is the final grade percentage (range 0.0–100.0%), as objectively calculated by the KU Leuven administration office. The AYP is the mean result of all final course grades (in terms of percentages) obtained from the examination periods in June and September, and is an expression of the academic achievement of the individual student in a given academic year. The AYP is calculated after the September retakes. If students do not participate in an examination, the obtained grade

for this particular course is zero. For reasons of comparability with other studies, we also provide grade point average (GPA) apart from the AYP.

2.3. Statistical analyses

All analyses were performed with SAS (version 9.3) and MLwiN software (version 2.24; Rasbash et al., 2009). First, non-response propensity weighting techniques were applied on the data to adjust for socio-demographic differences between survey respondents and non-respondents using de-identified socio-demographic data for the population obtained from university administrative records. These techniques were applied to account for non-response bias and missingness of data. This approach enables us to obtain estimates representative for the full student population of incoming freshmen with respect to the post-stratification variables. Since response rates can be poor indicators of data representativity (Groves, 2006), we also calculated representativity indicators (R-indicators; Schouten et al., 2009) for each additional inclusion stage. These are calculated as $1 - (2 \times \text{the standard deviation of the response propensities})$. Response propensities are the probability of response, as calculated here by a logistic regression model, with response as the outcome variable and all sociodemographic variables as predictors. The more variability there is in the response probabilities, the better the sociodemographic variables actually explain the response (or non-response). In other words, the higher the standard deviation of the response propensities, the more likely there is nonresponse based on sociodemographic variables. Hence, subtracting 1 by 2 times the standard deviation of the response propensities results in a multivariate determined indicator of representativity. Values of R-indicators vary between 0 and 1, the latter indicating data are fully representative of the population under study with respect to the population parameters investigated.

Generalized linear modeling (GLM; using SAS GENMOD procedure) was used initially to estimate the associations of 12-month mental health problems with AYP adjusting for gender, age, and parental education. Two-level linear regression models were subsequently fitted, with students (level one) nested within academic departments (level two). We estimated between- and within-department random slopes for the associations of 12-month mental health problems with AYP, again adjusting for individual-level socio-demographics in the fixed part of the model. Significance testing from zero of fixed effects and (co)variances was performed using the univariate Wald test. Finally, we estimated Spearman's ranking correlation coefficients (using SAS PROC CORR procedure) between the predicted slopes of AYP on mental health problems from the multilevel models and departmental proportions in gender, age, parental educational level, 12-month mental health problems, and departmental mean values in AYP, and number of students enrolled.

Prevalence estimates are reported as weighted numbers (n), weighted proportions (%), and standard errors (SE), corrected for finite population sampling without replacement (SAS PROC SURVEYFREQ procedure). To describe between-department variance in variables, median values and interquartile range (IQR) were calculated. Model parameters are reported as weighted unstandardized regression coefficients (β), associated standard errors (SE), and 95% confidence intervals (95%CI).

3. RESULTS

3.1. Sample description

Sample and department characteristics are presented in Table 1. The final sample consisted of 4,921 freshmen (with a response rate of 73.2% after correction for college dropout). R-indicators increased from 0.803 after inclusion stage 1 to 0.815 after inclusion stage 3, suggesting a good socio-demographic representativeness of the weighted sample. Freshmen survey respondents were distributed over 38 different departments (two departments were left out of the analysis due to $n < 10$). The median number of students per department was 64 (IQR=36–164). The median departmental response rate was 67.4% (IQR=59.7–73.2) and the mean AYP across departments was 50.1% (corresponding to a GPA of 1.7).

3.2. Twelve month mental health problems

Mental health problems in the past year were estimated at 34.9% (SE=0.45) of college freshmen, with higher estimates for internalizing (23.7%) and externalizing (18.3%) problems than for either substance use (5.4%) or antisocial (0.1%) problems. Mental health problems were frequently co-occurring as 36.1% of those who had one type of problems also had another type of mental health problems. That means that mutual exclusive types of mental health problems were much lower, with estimates of 14.2% (SE=0.56) for internalizing problems, 8.6% (SE=0.46) for externalizing, 1.7% (SE=0.21) for substance use, and 0% for antisocial problems.

3.3. Associations between 12-month mental health problems and academic functioning

Table 2 shows the generalized linear model parameters estimating the association between mental health problem and academic functioning in two statistical models, i.e. a model for each of the mental health problem separately (left pane) and a full-factorial model (right pane) (bivariate analyses upon request). Two out of the four types of mental health problems (internalizing and externalizing problems) were associated with significant decreases in academic functioning (after adjusting for socio-demographics) of 2.9% and 4.7% in AYP, corresponding to a decrease of 0.2–0.3 in GPA, respectively. Substance abuse and antisocial problems were not significantly associated with academic functioning, although power to detect an association involving antisocial problems was low due to the small number of students with that disorder ($n=5$). Being older than 18 years old and having parents without academic degrees were also significantly associated with decreased academic functioning (with AYP reductions of 4.0–7.4%, corresponding to GPA reductions of 0.5–0.7).

In addition, we have also tested whether gender, age, or SES moderates the interaction between mental health problems and academic functioning. None of these interactions reached significance (tables upon request). We have also tested whether multicollinearity in the multivariate model may be an issue by calculating tolerance and variance inflation factors (VIF – Kutner et al., 2004). These statistics were very reassuring, with tolerance values in the range 0.880–0.992, and VIF values in the range 1.008–1.137. In fact, the Pearson correlations between the four types of mental health problems were rather low, i.e. all in the range 0.080–0.240 (4 out of 6 correlations significant).

3.4. Between-department variance in impact of 12-month mental health problems academic functioning

Table 3 shows summary results of the multilevel linear models that estimated between-department variance in the associations of mental health problems with academic functioning. The main finding is that the associations of internalizing and externalizing mental health problems remain significant when taking into account the between-departmental variability in the multilevel analyses, with externalizing mental health problems associated with a 4.3% (95% CI= -5.8 to -2.7) decrease and internalizing problems a 2.3% (95% CI= -4.1 to -0.6) decrease in AYP. We also found a significant interaction ($p=0.005$) between mean departmental academic functioning and the individual-level association between mental health problems and academic functioning: the negative individual-level association between mental health problems and academic functioning was stronger among freshmen in departments with a lower departmental AYP or GPA average. Indeed, these departments showed a higher decrease in AYP/GPA associated with externalizing mental health problems compared to those in higher performing departments, with within-department reductions of on average 4.1% in AYP (corresponding to 0.3 drop in GPA). Department membership explained 6.5% of the variance in the AYP/GPA among students with 12-month externalizing mental health problems compared to 3.7% among students without externalizing problems.

Spearman's ranking correlation coefficients between the estimated departmental decrease in AYP associated with externalizing problems (38 departments) and other departmental characteristics are presented in Table 4. Spearman's ρ between decrease in AYP associated with externalizing disorders and departmental AYP was 0.784 ($p<.001$). Decreases in AYP associated with externalizing problems were positively correlated with the proportion of males (Spearman's $\rho=0.324$, $p<0.05$) and the proportion of students with highly educated parents (Spearman's $\rho=0.484$, $p<0.01$) but negatively correlated with 12-month internalizing problems (Spearman's $\rho=-0.384$, $p<0.05$). After calculating partial Spearman ranking correlation coefficients (adjusting for all other departmental mean values and proportions in Table 4), the departmental decrease in AYP associated with 12-month externalizing problems remained significantly correlated with departmental AYP ($\rho=-0.747$; $p<0.001$).

4. DISCUSSION

This is the first study that investigated the extent to which a broad range of 12-month mental health problems are associated with objectively-measured academic performance among college freshman. We addressed several shortcomings of previous studies in the field, by including a large sample, using propensity weights that enable to draw population-based conclusions, and by using multivariate multilevel equations to investigate effects of the departments in the research questions. These elements make the innovation or impact of this paper above and beyond what has been done in the field of college mental health before. Two main findings stand out. First, freshmen with internalizing and externalizing mental health problems have significant lower academic functioning than other students. Second, the association of internalizing problems with academic functioning is consistent across departments, whereas the association of externalizing problems with academic functioning

varies significantly across departments as an inverse function of mean department-level AYP or GPA.

Approximately one in three indicated having mental health problems in the past year, a finding that is consistent with prior studies, although the estimate of alcohol problems is somewhat to the lower end (Auerbach et al., 2016; Aertgeerts et al., 2002). More importantly, externalizing mental health problems (other than Attention Deficit Hyperactivity Disorder; ADHD) in college students have been rarely examined, largely because of the assumption that persons with childhood onset externalizing problems are at high risk for dropping out in high school and thus never make it to college (Alexander et al., 1997). Still, we estimate the proportion of freshmen students with externalizing problems is one in five, higher than full (Lee et al., 2008) or subthreshold ADHD (around 7–8%) (Weyandt & DuPaul, 2006). The exact reason for such high numbers is unclear, and may be the result of the fact that we use a low-threshold screening instrument for mental health problems. It may also be explained by an increasing number of adolescents with mental health problems entering tertiary education (Gallagher, 2007).

Students who have mental health problems in the past year have, on average, a decrease of 2.9–4.7% of their AYP (or 0.2–0.3 decrease in GPA) at the end of the academic year compared to those without these problems. That means that a student who functions on an academic level in the 50th percentile will make a drop to the 38th and 35th percentile in the presence of internalizing or externalizing mental health problems, respectively, comparable to the Eisenberg et al. (2009) data, although the average GPA in US universities is higher than the one in our study (2.6 vs. 1.7, respectively – Zwick, 2004; Cabrera et al., 2013). A new finding is that a wide range of emotional problems – not just depression – have a significant association with lower academic functioning, even after adjusting for a broad set of confounders. Specifically freshmen with externalizing problems had a marked decrease in academic functioning. The role of externalizing problems in college is far from settled, mostly confined to studies of ADHD (Green & Rabiner, 2012) and high-risk health behaviors (Adams & Moore, 2007), and our data point to the need of studying these problems among college students in the future.

That externalizing problems play an important role in freshmen college life is further reflected by the fact that we found that context-specific features may moderate the associations of externalizing problems with academic functioning. Similar to what was found for suicide attempts (see Mortier et al., 2015), the association of 12-month externalizing problems with academic functioning was stronger in departments with lower academic functioning. The most plausible interpretation here is that academic programs that are more rigorous may increase student distress and may lead to higher mental health problems, and eventually to lower academic functioning. An alternative interpretation may be that academically poor educational environments have lower sense of connectedness or social support, and that this, in turn, may temper the academic impact of externalizing mental health problems (Tinto et al., 1993).

The results of this study should be interpreted in light of several limitations. First, the relatively low number of cases precluded simultaneous tests of level 2 effects for all

covariates, as such analyses require very large sample sizes (e.g., $N > 4,000,000$ - Jablonska et al., 2009). However, a low amount of level 2 units comes mainly at the cost of underestimating level 2 variances (Hox, 2010), leaving other estimates unbiased. Second, we did not have exact information on pre-college functioning of the freshmen in our sample. This may have led to the possibility that the associations we found could be partially driven by so-far unmeasured factors (such as social or intellectual functioning). However, the fact that we adjusted for the fixed effects of both age and parental educational level (i.e. proxies for fall-behinds in high school – Spera et al., 2009) in the multilevel models limits the possibility of a selection effect that explains away the observed interaction effect between departmental academic functioning and the individual-level association of externalizing problems with AYP. Third, because of limited statistical power we were unable to add additional covariates (such as family environment or peer relationships) in the regression models. Further research with larger cohorts or pooled data from the WMH-ICS surveys carried out in other universities may focus on adding these in statistical models because these variables may explain the association between mental health problems and academic performance. This is also the case for an extensive examination of comorbidity which is beyond the scope of the current study. Fourth, our data are based on the results of a screening instrument that assesses mental health problems. Despite the fact that this is a well-validated screener with good internal reliability and external validity, the use of a screening instrument implies that findings might have been different if we used full diagnostic interviews. Related to this, the GAIN-SS may not be the best instrument to identify antisocial personality in college freshmen. The information gathered on the proportion of students with antisocial problems is more likely to be informative than conclusive, because the lack of any statistical power for this type of mental health problems. Fifth, although nonresponse bias might limit the generalizability of our findings, we showed high socio-demographic representativeness of our final sample and non-response propensity weighting was used to adjust to the extent possible for sample bias. Finally, our findings are based on data from one university, and may therefore not be generalized to other universities or to college students in general.

The need to understand patterns of mental health problems among college students is important. Around 1/3 of college freshmen endorses problems with mental health in the previous 12 months, and our data also suggest that mental health problems are directly associated with lower academic performance. Low academic performance, in turn, is associated with dropout in the short-term and loss of human capital for societies in the longer term (Freudenberg & Ruglis, 2007). This means that emotional problems among college students are not just a theoretical, clinical, or educational problem but also a societal problem.

Our study suggests a potential role of the college environment as a target for treatment and prevention interventions. The best way to resolve that uncertainty definitively is to carry out experimental effectiveness trials that evaluate the effects of treating emotional problems on academic functioning. We plan to carry out such trials in subsequent phases of the WMH-ICS. Prior to implementing such interventions, though, it would be valuable to add longitudinal data and focus on potential level-2 explanatory variables (such as connectedness

to college) that might provide insights that could be used either to refine or target preventive and clinical interventions.

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TABLE 1
SAMPLE DESCRIPTION OF THE LEUVEN COLLEGE SURVEY (n=4,921)

	Sample		Departments		
	%(w)	SE	n(w)	median	IQR
Gender					
female	55.5	0.4	2725	53.7	33.4–71.0
male	44.6	0.4	2189	46.3	29.0–66.6
Age					
18y	73.9	0.4	3633	73.2	64.5–78.5
19y or more	26.1	0.4	1283	26.9	21.5–35.5
Parental education					
both high	60.0	0.4	2536	60.3	50.7–68.0
mixed	24.3	0.4	1027	23.6	19.4–30.0
both low	15.7	0.3	665	16.1	11.0–22.6
Mental disorder					
internalizing	23.7	0.4	957	23.3%	16.0–28.6
externalizing	18.3	0.4	734	18.7%	14.8–22.6
substance use	5.4	0.2	215	5.2%	1.7–8.7
antisocial	0.1	0.0	5	0.0%	0.0–0.0
	Mean	SE	SD	median	IQR
Academic year percentage (AYP)	50.1	0.2	18.3	49.9	46.3–54.0

Table 2

Impact of past year risk for mental disorders on academic year percentage

	Mental disorders separate in model*					Full multivariate model				
	β	SE	95% CI	χ^2	p	β	SE	95% CI	χ^2	p
(intercept)	-	-	-	-	-	56.524	0.518	55.508 57.539	11904.44	<0.001
Past year risk for mental disorder										
internalizing	-4.257	0.719	-5.665 -2.848	35.08	<0.001	-2.937	0.743	-4.393 -1.481	15.64	<0.001
externalizing	-5.869	0.780	-7.398 -4.341	56.66	<0.001	-4.663	0.822	-6.275 -3.051	32.15	<0.001
substance use	-4.991	1.343	-7.624 -2.359	13.81	<0.001	-2.648	1.364	-5.321 0.026	3.77	0.052
antisocial	-9.079	7.571	-23.918 5.759	1.44	0.230	-4.419	7.513	-19.144 10.307	0.35	0.556
Covariates										
being male (vs. female)	-	-	-	-	-	-0.714	0.616	-1.922 0.493	1.34	0.246
age 19 or more (vs. 18)	-	-	-	-	-	-7.387	0.726	-8.809 -5.964	103.58	<0.001
low parent education (vs. both high)	-	-	-	-	-	-7.098	0.858	-8.780 -5.416	68.42	<0.001
one parent with low education (vs. both high)	-	-	-	-	-	-4.020	0.704	-5.400 -2.639	32.57	<0.001

* adjusted for gender, age, and parental educational level.

MULTILEVEL ANALYSIS OF THE ASSOCIATION BETWEEN 12-MONTH MENTAL DISORDERS AND ACADEMIC YEAR PERCENTAGE

TABLE 3

Internalizing mental disorder	parameter ^d	SE	95%CI	p-value
Fixed effect on AYP	-2.323	0.905	-4.097 -0.549	<0.001
Random effect on AYP (departmental level)				
(mean departmental AYP) ²	10.857	3.870	3.272 18.442	0.005
(impact internalizing disorder) ²	5.892	5.291	-4.478 16.262	0.265
mean departmental AYP*impact internalizing disorder	3.270	3.288	-3.174 9.714	0.320
Externalizing mental disorder	parameter ^d	SE	95%CI	p-value
Fixed effect on AYP	-4.261	0.796	-5.821 -2.701	<0.001
Random effect on AYP (departmental level)				
(mean departmental AYP) ²	10.334	3.588	3.302 17.366	0.004
(impact externalizing disorder) ²	0.000 ^b	/	/ /	/
mean departmental AYP*impact externalizing disorder	6.215	2.188	1.927 10.503	0.005
Substance use disorder	parameter ^d	SE	95%CI	p-value
Fixed effect on AYP	-2.096	1.351	-4.744 0.552	0.121
Random effect on AYP (departmental level)				
(mean departmental AYP) ²	12.589	4.212	4.333 20.845	0.003
(impact substance use disorder) ²	0.000 ^b	/	/ /	/
mean departmental AYP*impact substance use disorder	-1.766	5.045	-11.654 8.122	0.726

^a beta-coefficient for fixed effect; variance/covariance for random effects

^b parameter set at zero due to negative variance

TABLE 4
SPEARMAN RANK CORRELATION BETWEEN DEPARTMENT CHARACTERISTICS

Departmental mean values and proportions	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. reduction in AYP associated with externalizing disorder	1.000									
2. mean AYP	0.784 ^{***}	1.000								
3. mean size (number of students)	-0.149	-0.055	1.000							
4. proportion of males	0.324 [*]	0.206	-0.205	1.000						
5. proportion of students aged 18	0.213	0.513 ^{***}	0.486 ^{**}	0.006	1.000					
6. proportion with parents with high educational level	0.484 ^{**}	0.652 ^{***}	-0.003	0.279	0.381 [*]	1.000				
7. internalizing disorder	-0.384 [*]	-0.474 ^{**}	0.141	-0.637 ^{***}	-0.283	-0.387 [*]	1.000			
8. externalizing disorder	-0.051	-0.185	-0.119	0.078	-0.340 [*]	0.101	0.213	1.000		
9. substance use disorder	-0.055	-0.174	0.041	0.148	-0.066	0.187	0.093	0.381 [*]	1.000	
10. antisocial personality disorder	-0.097	-0.099	0.384 [*]	-0.114	0.062	-0.082	0.185	0.070	0.041	1.000

* p<0.05

**

p<0.01

p<0.001