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Students perceived stress in academic programs: Consequences for its management

Stress perçu dans les filières universitaires : implications pour sa gestion

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Abstract

Background. – Academic stress contributes to the deterioration of the students' quality of life. Psychological determinants involved in the stress process, trait anxiety and coping, have been neglected when assessing the role of academic programs in stress. This study aimed at determining whether academic programs are associated with a high level of perceived stress above and beyond potential personal and environmental risk factors, as well as coping strategies.

Methods. – A cross-sectional survey was conducted in 2009 among third-year medical (total $n = 170$, participants 88%), dental ($n = 63$, 94%), psychology ($n = 331$, 61%) and sports sciences ($n = 312$, 55%) students in Montpellier (France). The stress level experienced during the last 2 months, trait anxiety and coping strategies were appraised. Substance use, psychological care, and stress triggers were also collected using a self-administered questionnaire.

Results. – Compared with medicine and after adjusting for gender and age, only the sports program was associated with a lower perceived stress risk: adjusted odds ratio: 0.54 [95% Confidence interval: 0.30; 0.99]. Substantial reductions in perceived stress risks were observed in science students after additional adjustments for non-academic stress triggers, substance use, psychological care (adjusted odds ratio: 0.20 [95% Confidence interval: 0.09; 0.41]), and also for trait anxiety and coping strategies (adjusted odds ratio: 0.23 [95% Confidence interval: 0.10; 0.54]). Compared with medicine and after these additional adjustments, psychology had a significantly lower perceived stress risk (0.34 [0.18; 0.64]; 0.40 [0.19; 0.86], respectively), dentistry had a similar risk (0.82 [0.35; 1.91]; 0.53 [0.20; 1.43], respectively).

Conclusion. – Sports and psychology programs had a lower perceived stress risk compared with medicine. Personal and environmental risk factors and coping strategies modified the association between academic program and perceived stress. Developing efficient coping strategies in students and improving academic environment could contribute to prevent the potential deleterious consequences of stress.

Keywords: Perceived stress; Undergraduate curriculum; Coping behaviour; Education

Résumé

Position du problème. – Le stress académique contribue à détériorer la qualité de vie des étudiants. La prédisposition à l'anxiété et les stratégies de coping, facteurs impliqués dans le stress, sont négligées dans l'étude du rôle du cursus universitaire sur le stress. Cette étude a analysé le rôle de la filière académique comme facteur de risque de stress perçu élevé après prise en compte des facteurs de risque personnels, environnementaux et des stratégies de coping.

Méthodes. – Enquête transversale menée chez des étudiants inscrits en troisième année à Montpellier en 2009–2010 : médecine, 170 (participants : 88 %) ; odontologie, 63 (94 %) ; psychologie, 331 (61 %) ; sports, 312 (55 %). Le niveau de stress perçu pendant les deux derniers

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mois, la prédisposition à l'anxiété et les stratégies de coping ont été évalués. Consommation de substances, suivi psychologique et sources de stress étaient aussi recueillis par auto-questionnaire.

Résultats. – Seule la filière sports avait un risque de stress perçu significativement moindre par rapport à la médecine après ajustement sur l'âge et le genre (Odds Ratio_{ajusté} : 0,54 [intervalle de confiance à 95 % : 0,30 ; 0,99]). Ce risque était réduit après ajustements complémentaires sur les facteurs environnementaux non académiques, les consommations de substances, un suivi psychologique (0,20 [0,09 ; 0,41]) ainsi que sur l'anxiété et les stratégies de coping (0,23 [0,10 ; 0,54]). Comparée à la médecine, la filière psychologie avait un risque moindre de stress perçu après ces mêmes ajustements (0,34 [0,18 ; 0,64] ; 0,40 [0,19 ; 0,86], respectivement), et la filière odontologie avait un risque semblable (0,82 [0,35 ; 1,91] ; 0,53 [0,20 ; 1,43], respectivement).

Conclusion. – Les filières sports et psychologie auraient un risque moindre de stress perçu par rapport à la filière médecine. L'association entre filière et stress perçu est influencée par les facteurs de risque personnels, environnementaux et les stratégies de coping. Développer des stratégies de coping efficaces et améliorer le cadre académique contribueraient à prévenir les conséquences délétères du stress.

Mots clés : Stress perçu ; Filière universitaire ; Gestion du stress ; Étudiants ; Éducation

Undergraduate students experience the transition from adolescence to adulthood, as well as massive socio-economic changes and increasing academic competition. Within this population, stress is a critical issue: most students (52 to 75%) report an intermediate or a high level of stress [1–4] which may impair health [2,5–8]. Academic stress contributes to the deterioration of the students' quality of life and causes drug abuse and academic failure [4,9–14].

Academic programs are viewed as not equally demanding and may be associated with different levels of stress. The medical program is viewed as a stressful environment [15]. However, few studies have compared academic programs and even some failed to confirm this statement [16,17]. The discrepancy in results has been explained by the instruments used to measure stress, some of which were not validated [16,17]. However, it also may come from neglected factors influencing stress. Academic stress must then be investigated in the context of other influences of stress in order to identify the academic program(s) at risk, stress risk factors and protective factors with the aim of acting upon them if possible and to decrease stress and its deleterious consequences.

Student psychological and behavioural characteristics play a key role in the stress process. Indeed, referring to the transactional stress and coping model developed by Lazarus and Folkman, perceived stress is the result of the cognitive evaluation of events in the context of the various resources people have [18,19]. Coping strategies, i.e., the individual cognitive and behavioural efforts to manage the internal and external demands encountered during a stressful situation, are personal psychological determinants of perceived stress. They are considered as mediators of the relationship between antecedent variables and health [19], explaining how antecedent variables (including the context) predict health-related outcomes. Some may counteract the effects of stress while others may worsen them. Problem-solving coping strategies (i.e. problem-focused categories of instrumental action, strategizing and problem-solving) have been associated with a better health and reduced negative affects; cognitive restructuring (i.e. active attempts to view the stressful event as harmless) and support-seeking (i.e. supports such as instrumental help, advice, comfort, or contact sought from parents, peers, or professionals) with a better well-being

[20–22]. These coping strategies are viewed as adaptive in contrast to avoidance coping strategies (i.e. efforts to disengage or stay away from the stressful situation) or to distraction strategies (i.e. focusing away from the stress) [23]. Anxiety trait is another key personal psychological determinant of perceived stress [18,19]. Trait anxiety interacts with the internal and external demands encountered during a stressful situation. The higher the anxiety trait level, the more a stressful situation promotes stress [24]. Environmental non-academic stress triggers that students face, i.e. daily hassles, finances, social relationships, personal life issues, also influence stress [11,16,25] and should be investigated.

Based on the transactional stress and coping model [19] and using a well-validated instrument to measure perceived stress [26], this study aimed at determining whether academic programs (medicine, dentistry, psychology and sports sciences) are associated with a high perceived stress level above and beyond potential personal and environmental risk factors, as well as coping strategies. The secondary objective was to investigate whether the academic programs are associated with different coping and vulnerability profiles. We focused on the factors associated with a high perceived stress level and explored the role of coping strategies as mediators of the relationship between academic programs and perceived stress.

1. Methods

1.1. Study design and population

A cross-sectional survey was conducted between mid-November and mid-December 2009 in Montpellier (France), among the third-year students who enrolled in one of the following programs: medicine ($n = 170$), dentistry ($n = 63$), psychology ($n = 331$) and sports sciences ($n = 312$). Students were given information about the survey and completed a consent form with an anonymous questionnaire during a compulsory class. The questionnaire was pilot tested with ten students. The protocol was also approved by an ethical committee, the Comité de Protection des Personnes SUD Méditerranée IV.

In order to determine whether participants were representative of their year regarding gender and age, data was

anonymously collected for all students at the enrolment office of each faculty.

1.2. Measures

1.2.1. Socio-economic data

Current sociodemographic data (age: < 20; 20; 21–22; 23–27; > 27 years), employment (yes/no; if employed; regular; occasional), involvement in associations (yes/no) were collected.

1.2.2. Trait anxiety

A validated French version of the State-Trait Anxiety Inventory trait form (STAI-Y) was used. This inventory has 20 items with answers ranked on a 4-point scale from ‘almost never’ to ‘almost always’ and assesses trait anxiety [27]. STAI-Y Trait score ranged from 20 to 80 with higher scores indicating greater trait anxiety. The inventory showed a good internal consistency: Cronbach’s alpha coefficient = 0.89. Trait anxiety was categorized according to T values based on STAI-Y-Trait scores and gender standardisation, with ‘high’ (T value > 55), ‘moderate’ (T value, 46 to 55), ‘slight’ (T value < 46) [28].

1.2.3. Perceived stress

A French version of the Perceived Stress Scale with 14 items (PSS-14) was used. This instrument has 14 questions with answers ranked on a 5-point scale from ‘never’ to ‘very often’ and assessed stressful experiences and responses to stress over the last 2 months [26,29]. PSS-14 scores from 0 to 56 with higher scores indicating higher perceived stress. The internal consistency was satisfactory: $\alpha = 0.86$.

Like perceived stress, we assessed stress triggers and substance use over the last 2 months and the coping strategies used to face these sources of stress.

1.2.4. Stress triggers

Life and education related stressor events known as stressors in students [1,30,31] were collected with the question: “Here are some sources of stress. Read each proposition, then, on the 6-point scale on the right-hand side, tick the cell which best describes your situation during the last 2 months.” The propositions were “family”, “interaction with peers”, “love life”, “moral isolation”, “personal financial difficulties”, “personal health problems”, “addiction”, “anxiety about the future”, “exams”, “continuous assessment”, “clerkship or placement”, “workload”. Each factor was ranked on a 6-point scale according to its intensity from 0 (not a stressor) to 5 (major stressor). Sources of stress were categorized as slight (scores from 0 to 2) or intense (from 3 to 5).

1.2.5. Coping strategies

The strategies used to cope with the sources of stress were assessed with a validated French version of the Brief Cope [32,33]. This instrument has 28 items with answers ranked on a 4-point scale from 1 ‘Not at all’ to 4 ‘Always’, and measures 14 scales of coping, of two items each. The internal consistency of each Brief Cope scale was satisfactory (planning: $\alpha = 0.71$;

active coping: 0.55; humour: 0.82; positive reframing: 0.70; acceptance: 0.75; instrumental support: 0.87; emotional support: 0.80; denial: 0.68; self-blame: 0.67; substance use: 0.91; behavioural disengagement: 0.60; religion: 0.89; venting: 0.76), except for the self-distraction scale ($\alpha = 0.18$). For these scales, a minimal α value of 0.50 is regarded acceptable [32].

Five higher dimensions of coping were extracted in agreement with the recently validated measurement model of the Brief Cope (Psychological Assessment, in revision). They included problem-solving (active coping, planning), cognitive restructuring (acceptance, humour, positive reframing), support-seeking (emotional support, instrumental support, religion), avoidance (behavioural disengagement, denial, self-blame, substance use) and distraction (self-distraction, venting). Each Brief Cope scale was scored by summing the scores of its two constitutive items [32,33], and each higher-order coping dimension was measured by the mean of its components scores. We further refer to them as coping strategies.

1.2.6. Health-related behaviours

Regular exercise (< 1 h/week; 1 to 3 h/week; > 3 h/week) was collected and substance use was assessed based on the frequency of:

- coffee consumption (> 3 cups a day, between 1 and 3 cups a day, No);
- alcohol consumption (every day, 3 to 4 times/week, 1 to 2 times/week, 2 to 3 times/month, less often, never);
- tobacco consumption (> 30 cigarettes per day, between 21 and 30 cigarettes per day, between 11 and 20 cigarettes per day, between 1 to 10 cigarettes per day, No);
- marijuana use (every day, regularly, from time to time, has tried, has stopped, never);
- mood regulating medicines, psychostimulant, over-the-counter stimulant, tranquillizer, antidepressant, and hypnotic (each was graded on a 4-point Likert scale: never, sometimes, often, every day).

The choice of these substances came from studies dedicated to substance use behaviors in students [34,35].

Students were also asked to report whether they had consulted a psychologist/psychiatrist since entering university. Psychological care was defined as tranquillizer, antidepressant or hypnotic use or consulting a psychologist/psychiatrist.

1.3. Statistical analyses

The four academic programs were compared with the Pearson χ^2 test for qualitative parameters and with the Kruskal-Wallis test for quantitative scores. Closed test procedures (Holm-Bonferroni and step-down bootstrap) were used for two by two comparisons between the four academic programs in order to control the family-wise error rate at 5% (SAS procedure multtest). The Fisher exact test or Pearson χ^2 test were used for qualitative parameters and the t -test or Wilcoxon tests for quantitative parameters. To determine the factors associated with perceived stress, PSS-14 scores

(PSS-14 scores ≥ 31 - upper quartile estimated in the whole sample) were dichotomized since their distribution was not gaussian. Although PSS-14 is not a diagnostic scale [26], PSS-14 ≥ 31 was reported as a perceived stress in the present article.

To estimate the perceived stress risk associated with the academic program, multivariate logistic regression models were built using a step-wise procedure. The medicine program was the reference level because of a large sample size and sex-ratio almost equal to 1. Multivariate logistic regression models included any factor associated with PSS-14 ≥ 31 after adjusting for gender and age: the significance level was $P < 0.3$ for entering variables and $P \leq 0.05$ for removing variables, except for age and gender which were included in all models. The age was dichotomized: less or equal to 20 years versus more than 20 years. The 20-year-old threshold accounted for a French standard education without repeating a year.

Several multivariate logistic models were built with the following covariates:

- model 1: gender, age (≤ 20 versus > 20 years), academic program, socio-economic and non-academic environmental factors, substance use and psychological care;
- model 2: the same covariates as in model 1, with the addition of coping strategies and trait anxiety;
- model 3: the same covariates as in model 1, with the addition of academic stress triggers;
- model 4: the same covariates as in model 3, with the addition of coping strategies and trait anxiety.

Their quality of adjustment was tested with the Hosmer and Lemeshow's statistic. Although not directly related to the objectives of the study, models 3 and 4 complement models 1 and 2 by giving an insight about aspects of the academic programs that would lead to stress.

To assess the impact of risk factors adjustment of model 1 on the gender-age-adjusted relative risk, roughly estimated by the gender-age-adjusted odds ratio (OR), the proportion of excess relative risk accounted for by covariates adjustment was calculated as:

$$OR_{\text{gender-age-adjusted}} - OR_{\text{adjusted for model 1 covariates}} = OR_{\text{gender-age-adjusted}} - 1$$

where positive values indicate reduction in ORs and negative values, increases in ORs, if $OR > 1$. Opposite interpretations are driven if $OR < 1$ [36].

In agreement with the transactional stress and coping model [19], we also tested whether academic programs had an indirect effect on a perceived stress mediated by coping strategies in simple mediation models. A mediator is defined as "a variable transmitting the effect of an independent variable on a dependent variable" [37]. Whether or not a mediation occurs can be determined by testing the independent variable's (IV) indirect effect through one or more mediators (Mi) on the dependent variable (DV). A mediating effect was evidenced by

showing a statistically significant increase in the beta estimate of the path between IV and DV when Mi was excluded (i.e., the total effect of IV on DV) in comparison with the beta estimate of the same path when Mi was included (i.e., the direct effect of IV on DV). Here, the academic program was the independent variable, a perceived stress, the dependent variable, a coping strategy, the mediator. Total effects of academic programs on a perceived stress were estimated with logistic regression models with the following form: $\text{Logit}(\text{perceived stress}) = b_0 + (b_1 \times \text{academic program}) + (b_{2i} \times \text{i adjustment factors})$. Direct effects were estimated with models with the following form: $\text{Logit}(\text{perceived stress}) = b'_0 + (b'_1 \times \text{academic program}) + (b'_{2i} \times \text{i adjustment factors}) + (b'_3 \times \text{coping strategy})$. Adjustment factors were gender, age, trait anxiety, sources of intense stress, family, personal difficulties, anxiety about the future, factors significantly associated with a perceived stress in model 2. Mediation of a coping strategy was tested through percentile-based bootstrap confidence interval of indirect effects (2.5 and 97.5 percentiles) estimated with 2000 bootstrap samples [38,39].

Interactions between academic program and gender, trait anxiety, or coping strategies significantly associated with perceived stress in model 2 were tested.

Statistical significance was set at 5%. Analyses were carried out with SAS¹ (version 9.1; SAS Institute Inc, Cary, NC, USA).

2. Results

Five hundred and eighty-two students (66.5% of the target population) took part in the study: medicine: 149 (88%), dentistry: 59 (94%), psychology: 201 (61%) and sports: 173 (55%). Their sociodemographic characteristics are reported in Table 1 as well as trait anxiety and PSS-14 scores. Participants were representative of their year with respect to gender (medicine: 58% female vs 58%, $P = 0.98$; dentistry: 52% female vs 54%, $P = 0.8$; psychology: 86% female vs 81%, $P = 0.098$; sports: 33% female vs 31%, $P = 0.8$) and age distribution (medicine, $P = 0.53$; dentistry, $P = 0.88$; psychology, $P = 0.11$; sports, $P = 0.17$).

Only the sports program had a significantly lower perceived stress risk in comparison with medicine after adjustment for gender and age ($OR_{\text{gender-age-adjusted}} = 0.54$, 95% confidence interval [0.30–0.99], Table 2). Female gender, a high or a moderate trait anxiety, tobacco use, psychological care, avoidance coping strategies, and the non-academic stressors, family, interaction with peers, love life, moral isolation, personal financial difficulties, personal health problems, addiction, anxiety about the future were perceived stress risk factors ($OR_{\text{gender-age-adjusted}} > 1$ with $P < 0.05$, Table 2). In contrast, problem-solving and cognitive restructuring coping strategies were protective factors ($OR_{\text{gender-age-adjusted}} < 1$ with $P < 0.05$, Table 2).

Model 1 and model 2 additional adjustments for socio-economic and non-academic environmental factors, substance use, psychological care, trait anxiety and coping strategies revealed that psychology had a significantly lower perceived

Table 1
Characteristics of third-year undergraduate students in their respective academic program.

	Total sample	Faculty Medicine	Faculty Dentistry	Faculty Psychology	Faculty Sports	<i>P</i> -value ^a
<i>Female gender, n (%)</i>	343 (60)	87 (58)	30 (52)	170 (86)	56 (33)	<0.001
<i>Age, n (%)</i>						<0.001
:: 20 years	161 (28)	45 (30)	15 (25)	47 (23)	54 (31)	
21–22 years	304 (52)	92 (62)	40 (68)	95 (47)	77 (45)	
∴ 23 years	116 (20)	12 (8)	4 (7)	59 (30)	41 (24)	
<i>Employment, n (%)</i>	159 (28)	37 (25)	11 (19)	52 (26)	59 (35)	0.050
<i>Regular employment, n (%)</i>	99 (60)	10 (27)	8 (73)	41 (79)	40 (68)	<0.001
<i>Involvement in associations, n (%)</i>	245 (42)	62 (42)	18 (31)	50 (25)	115 (67)	<0.001
<i>∴ 30 minutes commutation, n (%)</i>	224 (39)	55 (37)	22 (37)	88 (44)	59 (34)	0.26
<i>Regular exercise, n (%)</i>						<0.001
< 1 h per week	175 (30)	52 (35)	30 (51)	90 (45)	3 (2)	
1–3 h per week	187 (32)	76 (51)	20 (34)	77 (38)	14 (8)	
> 3 h per week	220 (38)	21 (14)	9 (15)	34 (17)	156 (90)	
<i>STAI-Y Trait score, median [Q1–Q3]</i>	43 [37–51]	44 [37–51]	45 [37–52]	47 [41–54]	39 [35–46]	<0.001
<i>Trait anxiety, n (%)</i>						<0.001
High (T > 55)	174 (31)	40 (30)	19 (33)	79 (40)	36 (22)	
Moderate (T: 46–55)	195 (35)	52 (38)	22 (39)	69 (35)	52 (31)	
Slight (T < 46)	186 (34)	43 (32)	16 (28)	50 (25)	77 (47)	
<i>PSS-14 score, median [Q1–Q3]</i>	25 [19–31]	26 [19–31]	25 [19–33]	27 [22–33]	21 [17–27]	<0.001
<i>PSS-14 score (∴ 31), n (%)</i>		39 (27)	17 (29)	66 (33.5)	23 (14)	<0.001

PSS: perceived stress scale. PSS-14 scores, from 0 to 56 increase with increased levels of perceived stress [26,29]; Q1: lower quartile; Q3: upper quartile.

^a *P*-values for comparisons between the four academic programs using the Pearson Chi² test for qualitative parameters, and Kruskal-Wallis test for quantitative scores.

stress risk in comparison with medicine ($OR_{\text{(adjusted for model 1 covariates)}} = 0.34$, 95% confidence interval [0.18–0.64]; $OR_{\text{(adjusted for model 2 covariates)}} = 0.40$, 95% confidence interval [0.19–0.86], Table 2). Model 1 adjustment reduced the gender-age-adjusted odds ratio in sports program by 74% (Table 2). Compared with medicine, dentistry had a similar risk. The stressors, family, personal financial difficulties, anxiety about the future, were perceived stress risk factors in both models 1 and 2 while psychological care, interaction with peer, and love life were risk factors only in model 1. A high or a moderate trait anxiety was a strong stress risk factor (model 2). Avoidance coping strategies were stress risk factors while problem-solving coping strategies were protective. There was no statistically significant indirect effect of academic programs on perceived stress mediated by a coping strategy (Table 3), and no significant interaction between the academic program, and gender, trait anxiety, problem-solving or avoidance coping strategies.

Additional adjustments for academic stress triggers in model 3 revealed that sports and psychology had a significantly lower perceived stress risks than medicine: sports, $OR_{\text{(adjusted for model 3 covariates)}} = 0.26$, 95% confidence interval [0.12; 0.55]; psychology, $OR_{\text{(adjusted for model 3 covariates)}} = 0.38$, 95% confidence interval [0.20; 0.73]. Dentistry had no significantly lower risk compared with medicine. In contrast, when coping strategies and trait anxiety were also adjusted for in model 4, no program was different from medicine. Family, anxiety about the future and workload were risk factors in both models 3 and 4 while psychological care, interaction with peers, moral isolation, personal financial difficulties, exams were risk factors only in model 3. A moderate or a severe trait anxiety and avoidance coping strategies were risk factors in model 4

while problem-solving coping strategies were a protective factor (data not shown, available on request).

As shown in Tables 1 and 4 and Figs. 1 and 2, academic programs were associated with different coping and vulnerability profiles. Medical and dental students were younger compared with psychology and sports students and most students were women in medicine, dentistry and psychology in contrast to the sports program. The factors significantly associated with perceived stress after gender-age adjustment which significantly varied between the academic programs were: trait anxiety, family, love life, moral isolation, personal financial difficulties, personal health problems, anxiety about the future, exams, continuous assessment, clerkship or placement, workload, psychological care, tobacco use and problem-solving coping strategies. Regarding these factors, we carried out two by two comparisons between the academic programs in order to identify which programs had more risk factors or protective factors. Significantly more psychology students reported the following stress risk factors: a high trait anxiety (vs sports, medicine or dentistry), family (vs sports), love life (vs sports or medicine), moral isolation (vs sports or medicine), personal financial difficulties (vs sports, medicine or dentistry), personal health problems (vs medicine), anxiety about the future (vs sports, medicine or dentistry), exams (vs sports), continuous assessment (vs sports, medicine or dentistry), clerkship or placement (vs dentistry), workload (vs sports), a psychological care (vs sports or medicine), and tobacco use (vs sports or medicine). However they developed the most problem-solving strategies. Significantly fewer medicine and/or dentistry students had the following stress risk factors: personal financial difficulties (medicine vs sports), anxiety about the future (medicine or dentistry vs sports),

Table 2
Factors associated with a perceived stress (PSS-14 score \geq 31) in third-year undergraduate students (582 students).

	Gender-age adjusted		Model 1		Model 2	
	Adjusted OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI
<i>Gender (female versus male)</i>	3.42***	2.17–5.37	1.83*	1.05–3.20	1.70	0.86–3.38
<i>Age (\leq 20 versus > 20 years)</i>	0.82	0.53–1.26	1.09	0.66–1.82	1.12	0.62–2.03
<i>Commutation (< 30 versus \geq 30 min/d)</i>	1.22	0.81–1.83				
<i>Employment (no versus yes)</i>	0.84	0.54–1.29				
<i>Involvement in association (no versus yes)</i>	0.85	0.56–1.30				
<i>Academic program</i>						
Dentistry versus medicine	1.10	0.55–2.22	0.82	0.35–1.91	0.53	0.20–1.43
Psychology versus medicine	1.04	0.63–1.70	0.34***	0.18–0.64	0.40*	0.19–0.86
Sports versus medicine	0.54*	0.30–0.99	0.20***	0.09–0.41	0.23***	0.10–0.54
<i>Non-academic stress triggers (intense versus slight)</i>						
Family	2.49***	1.66–3.73	1.84**	1.16–2.91	2.09**	1.22–3.56
Interaction with peers	3.02***	1.97–4.64	2.62***	1.62–4.24		
Love life	2.47***	1.65–3.69	1.67*	1.05–2.67		
Moral isolation	2.47***	1.65–3.71				
Personal financial difficulties	2.33***	1.56–3.47	1.99**	1.24–3.20	1.96*	1.13–3.38
Personal health problems	2.07**	1.33–3.21				
Addiction	2.37**	1.38–4.08				
Anxiety about the future	4.47***	2.72–7.33	4.23***	2.32–7.71	3.49***	1.69–7.22
<i>Regular exercise (\leq 3 versus > 3 h/week)</i>	1.47	0.92–2.34				
<i>Coffee use (no versus yes)</i>	0.88	0.58–1.33				
<i>Alcohol (< once/week versus \geq once/week)</i>	1.02	0.68–1.53				
<i>Tobacco (no versus yes)</i>	0.50***	0.34–0.75				
<i>Marijuana (never versus past or current use)</i>	0.70	0.47–1.04				
<i>Psychological care (yes versus no)</i>	2.63***	1.70–4.06	2.21**	1.36–3.59		
<i>Coping strategies (per additional unit)</i>						
Problem-solving	0.72***	0.61–0.84			0.68**	0.55–0.86
Cognitive restructuring	0.57***	0.47–0.69				
Support-seeking	1.12	0.95–1.33				
Avoidance	3.05***	2.31–4.02			1.60**	1.14–2.23
Distraction	1.03	0.86–1.24				
<i>Trait anxiety</i>						
High versus slight	56.5***	19.9–161			23.7***	7.86–71.7
Moderate versus slight	7.66***	2.64–22.3			4.75**	1.57–14.3

PSS: Perceived Stress Scale; OR: odds ratio; CI: confidence interval.

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

Model 1 step-wise logistic regression included socio-economic and environmental factors, academic program, substance use and psychological care with a gender-age adjusted odds ratio meeting $P < 0.30$. Model 2 included the same covariates as model 1 with the addition of coping strategies and trait anxiety with a gender-age adjusted odds ratio meeting $P < 0.30$.

Psychological care included tranquillizer, antidepressant or hypnotic use for the last 2 months or consulting a psychologist/psychiatrist since university entrance.

continuous assessment (medicine vs sports or vs dentistry), clerkship (dentistry vs sports or vs medicine). However more medical students had workload as a source of intense stress (medicine vs sports or vs dentistry). Protective problem-solving coping strategies were less developed by dental students (vs sports) and more of them had a high trait anxiety compared with sports students. They used more substances to face stress triggers compared with the other students (Brief Cope substance use scale, median score 4 vs 2, 2, 2, $P < 0.001$. This scale is part of avoidance coping strategies).

3. Discussion

The study first aimed at determining whether the academic programs (medicine, dentistry, psychology and sports sciences) are associated with a high level of perceived stress above and beyond other potential predictors, personal and environmental risk factors and coping processes. Only the

sports program had a significantly lower perceived stress risk in comparison with medicine after gender-age adjustment. Additional adjustment for socio-economic and non-academic environmental factors, substance use, and psychological care revealed a reduction in the gender-age-adjusted perceived stress risk in sports by 74% and a significantly lower perceived stress risk in psychology compared with medicine. These findings were maintained after additional adjustment for trait anxiety and coping strategies.

The study also aimed at investigating whether academic programs are associated with different coping and vulnerability profiles, focusing on all factors associated with a perceived stress. Compared with sports, medicine or dentistry students, more psychology students had the following stress risk factors: a high trait anxiety, family, personal financial difficulties, anxiety about the future; but they developed much more problem-solving strategies. Compared with sports or psychology, fewer medical and/or dentistry students had personal

Table 3
Test of indirect effects of academic programs on a perceived stress mediated by coping strategies.

Coping strategies	Academic program	Total effect	Direct effect	Indirect effect	Bootstrap 95% CI	Comparison between direct and total effects
Problem-solving	Dentistry	-0.3072	-0.4712	0.1640	-0.0210; 0.4643	NA
	Psychology	-0.9930	-0.8864	-0.1065	-0.2968; 0.0344	12%
	Sports	-1.2069	-1.2645	0.0576	-0.0932; 0.2601	NA
Avoidance	Dentistry	-0.3072	-0.3870	0.0798	-0.0990; 0.3167	NA
	Psychology	-0.9930	-0.9349	-0.0581	-0.2298; 0.0723	6.2%
	Sports	-1.2069	-1.2325	0.0256	-0.1192; 0.2104	NA
Support-seeking	Dentistry	-0.3072	-0.3063	-0.0009	-0.0927; 0.0936	0.3%
	Psychology	-0.9930	-0.9937	0.0007	-0.0713; 0.0754	NA
	Sports	-1.2069	-1.2061	-0.0008	-0.0693; 0.0915	<0.1%
Cognitive restructuring	Dentistry	-0.3072	-0.3047	-0.0025	-0.1185; 0.1011	0.8%
	Psychology	-0.9930	-0.9442	-0.0488	-0.1840; 0.0281	5.2%
	Sports	-1.2069	-1.1634	-0.0435	-0.1629; 0.0404	3.7%
Distraction	Dentistry	-0.3072	-0.3052	-0.0020	-0.1067; 0.1272	0.7%
	Psychology	-0.9930	-0.9933	0.0003	-0.0519; 0.0681	NA
	Sports	-1.2069	-1.2064	-0.0005	-0.0507; 0.0738	<0.1%

CI: confidence interval; NA: not applicable

Estimates of total effects (b_1) of academic programs on perceived stress from logistic regression models with the following form: $\text{Logit}(\text{perceived stress}) = b_0 + (b_1 \times \text{academic program}) + (b_2 \times i \text{ adjustment factors})$. Estimates of direct effects (b'_1) mediated by a coping strategy from models with the following form: $\text{Logit}(\text{perceived stress}) = b'_0 + (b'_1 \times \text{academic program}) + (b'_2 \times i \text{ adjustment factors}) + (b'_3 \times \text{coping strategy})$. Adjustment factors were gender, age, trait anxiety, sources of intense stress, family, personal difficulties, anxiety about the future, factors significantly associated with a perceived stress in model 2. The reference level of academic programs was medicine. Comparisons between total and direct effects were conducted with the ratio $(b_1 - b'_1 / b'_1)$ computed if the estimate of the direct effect was closer to 0 than the total effect's one [45].

financial difficulties and anxiety about the future but they did not much develop protective problem-solving coping strategies.

The strength of this cross-sectional survey rests on the quality of data. A majority of students participated (55 to 94%) and filled in the questionnaires with few missing data (< 5% for the main endpoint PSS-14). They were representative of their year with respect to gender and age. This contributed to the high quality of the data together with the validated instruments used to measure perceived stress, trait anxiety and coping strategies [26,28,29,32,33,40]. In addition, the validated instruments showed good psychometric properties. The survey occurred during mid-term, avoiding interferences with stress due to

starting the academic year or final exams. The academic programs provided a large range of stress triggers and coping profiles related to their own demands: entering the hospital wards in medicine, a high selection in dentistry, courses that determined a career in psychology and sports sciences, search for placements in psychology. In addition, medicine and dentistry students were likely to have different profiles compared to students attending other academic courses because of a high selection at the end of the first year. In addition to trait anxiety and coping strategies, collecting demographic data, socio-economic status, stress triggers, substance use and psychological care allowed adjustment for major confounding

Table 4
Distribution of students [n (%)] who experienced a source of stress as intense for the last 2 months.

Sources of stress	Total sample	Faculty Medicine	Faculty Dentistry	Faculty Psychology	Faculty Sports	P-value ^a
<i>Non-academic</i>						
Family	198 (34)	47 (32)	23 (39)	87 (43)	41 (24)	<0.001
Interactions with peers	141 (24)	37 (25)	14 (24)	54 (27)	36 (21)	0.61
Love life	255 (44)	58 (39)	22 (37)	108 (54)	67 (39)	0.007
Moral isolation	184 (32)	39 (27)	20 (34)	94 (47)	31 (18)	<0.001
Personal financial difficulties	227 (39)	32 (21)	18 (31)	108 (54)	69 (40)	<0.001
Personal health problems	128 (22)	18 (12)	11 (19)	61 (30)	38 (22)	<0.001
Addiction	72 (12)	14 (9)	8 (14)	32 (16)	18 (11)	0.24
Anxiety about the future	338 (58)	59 (40)	18 (31)	163 (81)	98 (57)	<0.001
<i>Academic</i>						
Exams	409 (70)	106 (71)	41 (69)	164 (82)	98 (57)	<0.001
Continuous assessment	293 (51)	36 (25)	32 (54)	150 (75)	75 (44)	<0.001
Clerkship or placement	191 (33)	61 (41)	1 (2)	73 (36)	56 (33)	<0.001
Workload	299 (52)	94 (63)	24 (41)	118 (59)	63 (37)	<0.001

^a P-values for comparisons between the four academic programs using Pearson Chi² test.

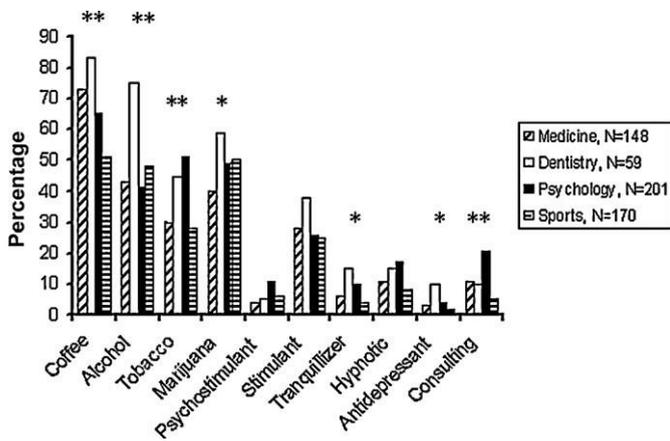


Fig. 1. Substance use during the last 2 months and mental health specialist consulting since university entrance, in third-year undergraduate students. Note. Alcohol: ∙: once per week; marijuana: past or current use; stimulant: over-the-counter stimulant; consulting: a psychologist or a psychiatrist since university entrance. Comparison between the four academic domains, ** $P < 0.001$; * $P < 0.05$.

factors [1], which was technically possible due to a large sample size. Age and gender were adjusted in all models. The 20-year-old threshold for age dichotomisation was chosen to account for a French standard education without repeating a year, avoiding a bias due to multiple previous curricula and heterogeneous maturity.

The present results support the hypothesis that the medicine program has a higher perceived stress risk even after adjusting for personal and non-academic environmental factors and coping strategies compared with psychology and sports programs. They are in line with a report which appraised the psychological distress in freshmen [41]. Possible arguments may be brought in: medicine program is demanding and the third-year French medical program is characterized by the transition to clinical training which is associated with high depression scores [42–44]. In the present study, workload, a strong stress risk factor, was reported by most medical students.

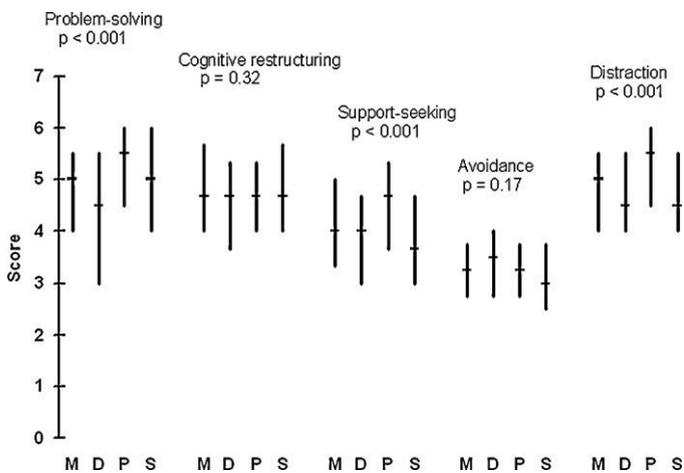


Fig. 2. Higher-order coping dimensions in third-year undergraduate students, median score (interquartile). P -value: comparison between the four academic programs, medicine (M), dentistry (D), psychology (P) and sports sciences (S).

We investigated the role of cofactors in the relationship between academic programs and perceived stress. Additional adjustments for socio-economic and non-academic environmental factors, substance use, and psychological care revealed a substantial reduction in the gender-age-adjusted perceived stress risk by 74% in sports and a significantly lower perceived stress risk in psychology compared with medicine. In the absence of interactions, these results suggest that these additional factors are confounding factors in the relationship between academic programs and perceived stress. This could be explained by the different students' profiles regarding risk factors. Compared with sports or psychology students, fewer medicine students had personal financial difficulties and anxiety about the future.

Although coping strategies are considered as mediators of the relationship between antecedent variables and health [19], no significant indirect effect of academic programs on perceived stress mediated by coping strategies was observed. We tested significance of indirect effects with percentile-based bootstrap confidence intervals as recommended by Preacher and Hayes [38,39]. However, the upper boundary of the 95% confidence interval of the indirect effect of psychology on perceived stress mediated by problem-solving strategies was close to 0 (0.0344, Table 3). In addition, the relative increase in estimates of the direct effect compared with the total effect (12%) was above the threshold set by Maldonado and Greenland to define an indirect effect, 10% [45]. These findings suggest that problem-solving strategies are likely to mediate the protective effect of the psychology program on perceived stress, compared with medicine. This is in line with the psychology program making students aware of adaptive coping strategies. In addition, in the present study psychology students much more developed protective problem-solving coping strategies compared with medical and dental students, although they were more presenting perceived stress risk factors.

The study shows that a high trait anxiety dominated the independent perceived stress risk factors by an order of magnitude, which supports findings about neuroticism-like traits. These latter traits (including trait anxiety) would reflect a greater sensitivity to negative information and are posited as post-traumatic stress disorder and mood disorders risk factors [46,47]. Personal financial difficulties were a perceived stress risk factor, which is in agreement with the evidence of low socio-economic status strongly associated with mental disorder [48]. The present study does not confirm a higher perceived stress risk in female students if trait anxiety was adjusted for [1,3,49,50]. This may be driven by a high trait anxiety preferentially present among females. Surprisingly, doing regular exercise was not an independent correlate although it is deemed to reduce stress [2]. These independent correlates of perceived stress emphasize the need for adjusting for personal and environmental factors in studies dealing with stress: first, trait personality, then coping strategies and stress triggers [16,17].

As the study was based on the transactional stress and coping model, the interaction between trait anxiety and the students'

context (i.e., academic programs) was tested. But it failed to be significant. Hence, in students with a high trait anxiety, the academic environment is not likely to act much upon the increase in perceived stress due to trait anxiety [51].

The study presents some limitations. Because the survey was cross-sectional, no causal inferences are implied between situational factors and a perceived stress. This limit specially applies to coping strategies which may evolve with stressful situations and affect perceived stress [19]. The direction of association is unknown. Certain personality and coping profiles may be a determinant in the choice of professions and therefore of academic programs. Different academic programs may in turn lead to varying levels of stress or promote different coping strategies. Secondly, physical activity, economic status, stress triggers, substance use and psychological care were self-reported without validated tools. In addition, regular exercise may have been misunderstood as sports. However the measurement errors likely affected equally all participants. The resulting bias may have not affected much the results. Finally, the survey enrolled undergraduate students in a single city. Since French universities are self-governing, academic setting may differ substantially in other cities, which will hamper direct generalisation of the results. But as a counterpart, recruitment in diverse settings, with or without professional program, i.e. clerkship for medicine, placement for psychology and practical work lab for dentistry, would mitigate this drawback. Participants globally had a similar trait anxiety as the French adult population [28].

The study suggests that academic sources of intense stress may result in students' engagement in dysfunctional coping processes rather than in problem-solving coping strategies. This emphasizes that identifying the major academic stressors is the first step in improving the academic environment to reduce stress. An effort should then be undertaken to offer students a training in order to develop adaptive coping strategies to prevent the harmful consequences of a high perceived stress level [8,13,14], especially in medicine and dentistry. Active coping, planning, effort expenditure, relaxation, and positive reappraisal constitute a set of efficient strategies to help improving health, academic involvement and short- and long-term performance [52]. Students who do not cope efficiently with stress could be especially trained to:

- identify their major academic stressors;
- realize which ineffective coping strategies (such as avoidance through substance use) they use to face these stressors;
- develop a repertoire of adaptive coping responses that might be used instead.

This kind of coping training has been successfully implemented in other contexts [53] and is promising. Mindfulness-Based Stress Reduction (MBSR) techniques, which have been shown to reduce significantly individual reports of perceived stress, worry, and anxiety [54], could also be offered. Education-based practitioners and applied psychologists in stress management are to be resorted to in order to

promote academic success and adaptive health-behaviour in students.

In conclusion, sports and psychology programs had a lower perceived stress risk compared with medicine. Personal and environmental risk factors as well as coping strategies modified the association between academic program and perceived stress. Developing adaptive coping strategies in students through empirically driven psycho-educational programs and improving the academic framework would contribute to prevent the deleterious consequences of high perceived stress levels.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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