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BMJ Open

Mental health and working constraints of first-year PhD students in health and science in a French university: a cross-sectional study in the context of occupational health monitoring

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ABSTRACT

Objectives To assess the mental health and working constraints perception of first-year PhD in France.

Design It is a cross-sectional study.

Setting The study was conducted by the team of the Lyon 1 University's Occupational Health and Medical Service for Staff, from October 2019 to February 2020. First-year PhD students employed by the university were seen during the routine occupational health medical check-up.

Participants A total of 161 PhD students in science from the 2019 intake were included in the study (participation rate 98%).

Outcome measures Data were collected using a self-questionnaire on psychosocial constraints at work (Job Content Questionnaire), the quality of the professional relationship with the supervisor (Advisory Working Alliance Inventory, Student perspective (AWAI-S)), medical conditions, anxiety (Generalized Anxiety Disorder-7) and depressive symptoms (Patient Health Questionnaire-9).

Results A total of 161 PhD students from the 2019 intake were included in the study (participation rate 98%). Most of the PhD students reported high psychological demands (58%), high decision latitude (53%), high social support (55%) and good professional relationships with their supervisor (mean of global score of AWAI-S=114.5). However, 34% showed signs of at least mild depression, 19% showed signs of anxiety and 20% were referred to a mental health professional after the survey. Bivariate analyses showed that history of psychiatric disorders, their relationship with their supervisor, having complementary teaching activities and stressful working conditions contributed to anxiety and depression.

Conclusions Even in the first year of their PhD, some students had mental health issues. It seems relevant to generalise the medical follow-up of all PhD students as soon as they enter the doctoral programme in order to detect and treat their health problems and psychological disorders at an early stage.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This is one of the first studies that assessed the health status of PhD student population in a health and science French university.
⇒ In the setting of a routine occupational health medical check-up we were able to include 98% of the 2019 PhD student intake.
⇒ Given this high participation rate any selection bias has been minimised.
⇒ Data were collected using a questionnaire containing standardised, validated questions and scales.
⇒ Job Content Questionnaire, Generalized Anxiety Disorder-7, Patient Health Questionnaire-9 and Advisory Working Alliance Inventory, Student perspective are relevant and validated questionnaires used in this research.

INTRODUCTION

Doctoral or PhD students are postgraduate researchers in training through research and the production of new knowledge, over 3 years. In France, many are employed members of staff in their research institute with a doctoral contract.[1] The training is difficult as it requires personal research work within a research team attached to a doctoral school, under the supervision and responsibility of one or more research directors. They prepare for an internationally recognised degree, a PhD, which confers the highest academic rank of doctor. To obtain the degree, they write a thesis which they defend in front of a jury.

This demanding training has been reported to be a source of concern for many PhD students around the world. Worldwide studies have reported students' concerns about their uncertain professional future, the difficult work-life balance, the fear of not having enough time to finish their research, the number of tenured research positions available and funding.[2 3] The perceived stress level of more than 2000 French PhD students was found to be high.[4 5] In addition, 36% of the

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6320 PhD students surveyed in Nature's bi-annual survey reported seeking help due to anxiety or depression.[2]

A review of 17 studies reporting PhD student well-being from 1998 to 2018 in Europe and North America reported that PhD students' health status and well-being affected their productivity in research, teaching, the quality of higher education delivered, their engagement in research and their risk of dropping out.[6 7] Academic burnout has also been reported in this population.[8 9]

Finally, a literature review with meta-analysis published in 2021 showed that among nearly 24 000 doctoral students included, 24% suffered from depression and 17% from anxiety. The authors conclude that it is necessary to systematically monitor the mental health of doctoral students.[10]

In France, the health of undergraduate students has been more widely studied than that of PhD students. In 2018, an assessment of psychosocial risks among 1031 staff of the Claude Bernard Lyon 1 University revealed that there were clearly severe psychological problems among the doctoral and postdoctoral students who participated.[11] The PhD students were three times more likely to develop a depressive disorder than the research professors and were also more likely to have suicidal thoughts than the rest of the staff (15.5% compared with 8.2%). However, the number of PhD students represented only 9.7% of total number of PhD students at the university. It was decided to evaluate in more detail the working constraints and mental health of PhD students at the university. A cross-sectional study was carried out to investigate the PhD students' mental health status and assess occupational and non-occupational factors.

METHOD

Design

This is a cross-sectional and an observational study which is part of the medical follow-up by the occupational health service of the university staff.

Participants

The study was conducted by the team of the University's Occupational Health and Medical Service for Staff, from October 2019 to February 2020 (before the start of the COVID-19 health crisis in France and the first lockdown). The target population was first-year PhD students at the university. The inclusion criteria were to be a student enrolled in the first year of their PhD at the university between 1 January 2019 and 31 December 2019 (2019 intake), employed by the university and to have given informed consent to participate in the study. PhD students doing research at the university but not employed by them were excluded.

Study measures

The PhD students were contacted by email, in alphabetical order, to make an appointment for their first occupational health visit, in accordance with the regulations for civil servants. The students completed a questionnaire in a paper format in the waiting room. This questionnaire, included 25 open-ended questions on their academic and professional background and their doctorate and 4 validated questionnaires.

The Job Content Questionnaire (JCQ) which assesses with 26 questions three dimensions of occupational psychosocial factors, that is, psychological demand (workload and time pressure, nine items), decision latitude (or job control including decision authority and skill discretion, nine items) and social support at work (by peers and supervisors, eight items). Responses were: strongly disagree/disagree/agree/strongly agree; they could thus be scored 1–4, and three scores corresponding to the three scales could be calculated and the median for each score was also calculated. Strong psychological demand thus corresponded to employees scoring above the median on the psychological demand scale, low decision latitude to those scoring below the median on the decision latitude scale and low social support to those scoring below the median on the social support scale. The combination of a high psychological demand and a low decision latitude assesses a job strain situation and the combination of a job strain and a low social support is an iso strain situation.[12] On this basis, job strain was also developed as a 4-point categorical variable:

- If psychological demand and decision latitude were both above median, the work context was considered 'active'.
- If psychological demand and decision latitude were both below median, the work context was considered 'passive'.
- If psychological demand was below median and decision latitude above median, the work context was considered 'relaxed'.
- If psychological demand was above median and decision latitude below median, the work context was considered 'tense' (job strain).

The Advisory Working Alliance Inventory, Student perspective (AWAI-S) which assesses the students perception of the quality of their professional relationship with their supervisor.[13] The value of the median was used to categorise the global score and each subscale score of the AWAI into four categorical variables.

The Generalized Anxiety Disorder (GAD-7) is a tool for identifying and assessing the severity of anxiety symptoms.[14] Two categorical variables were created according to the score of GAD-7.

Cut-offs for the five categories variables were: 0–5 for no anxiety, 6–10 for a mild anxiety, 11–15 for a moderate anxiety and 16–21 for a severe anxiety. A dichotomous variable which characterizes an anxiety syndrome was created with a cut-off at 10.

The Patient Health Questionnaire (PHQ-9) is a tool for identifying and assessing the severity of depression.[15 16] Two categorical variables were created according to the score of GAD-7.

Cut-offs for the five categories variables were: 0–4 for a minimal depression, 5–9 for a mild depression, 10–14

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for a moderate depression, 15–19 for a moderately severe depression and 20–27 for a severe depression. A dichotomous variable which characterizes a depressive syndrome was created with a cut-off at 5.

The questionnaire was in French. A French plus English version was also available for non-French speaking PhD students, using the English validated version of the questionnaires.

The occupational health doctors then carried out the medical visit using an interview guide developed specifically for the study. The students were, therefore, questioned and examined in a standardised manner about their medical, surgical, gynaecological, psychiatric and family history. The interview guide specified how the clinical examination should be done, for example, biometrics, examination by apparatus.

The occupational health doctors then provided feedback about the responses to the questionnaire to the PhD students. Any difficulties raised were discussed and at the end of this visit the PhD students were informed about the medical follow-up for the study. Participants were referred to a mental health professional if the GAD-7 and PHQ-9 scores indicated a depressive or anxiety syndrome or if suicidal thoughts were mentioned or reported in the questionnaire. Doctoral students referred were reassessed during a visit, to ensure that they had set up a psychological or psychiatric follow-up.

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

Statistical analysis

Because quantitative variables of this population data did not have a normal distribution, the non-parametric Kruskal-Wallis test was used for the comparison of quantitative data and the χ^2 test or Fisher's exact test were used for comparisons of categorical variables. Analyses were performed according to the gender (which was the medical gender).

The data were analysed using bivariate analyses to investigate the variables associated with anxiety (GAD-7 score ≥6), depression (PHQ-9 score ≥5) and job strain. Prevalence ratios assessing the association between the variables of interest and explanatory variables were estimated on log-binomial regression models using the GENMOD procedure in SAS.

The significance threshold for p was set at 5% for the comparative statistical analyses. All statistical analyses were carried out using SAS software, V.9.4. Data were analysed by gender as differences were expected.

RESULTS

Out of the 188 PhD students identified 23 were excluded because either they were not in the 2019 intake or were not employed by the university. Four of the 165 students remaining did not respond to our invitation, leaving 161 (98%) students in the 2019 intake and employed by the university who accepted to be involved in the study.

Socio-demographic and academic data

The PhD students included were mostly French (71%), men (58%) with a mean age of 25.8 years (SD: 2.7) (table 1). Most were single, with no children and their families lived outside the Auvergne-Rhône-Alpes region where the university is located. They were mainly graduates with a Master's degree and their professional experience consisted mainly of internships. The most represented fields of study were physics–astrophysics (20.5%), integrative molecular and cellular biology (19.9%) and computer science–mathematics (17.4%) (table 1). More than half of the students were funded by doctoral schools, 60% had a complementary teaching activity of up to 64 hours per year. A majority worked at only one geographical site and 65% had at least two supervisors (table 1).

Psychosocial factors in the workplace

According to the JCQ, 58.1% of the PhD students had a high psychological demand, that is, higher than the median value in this population (18.7), 53.5% had high decision latitude (median value=79.2) and 55.3% had high levels of social support at work (median value=27.8) (table 2). Women had lower decision latitude than men (57.4% vs 38.2%, p=0.02). The results show that 31.8% of the PhD students had stressful working conditions compared with 27.2% who reported in relaxed working conditions. A statistically significant higher proportion of men reported relaxed working conditions compared with women (36.9% vs 14.9%, p=0.02).

Quality of the professional relationship with the supervisor

The overall average AWAI-S score was high, 114.5 (SD=10.5), indicating good professional relationships (table 2). Just over 70% of the PhD students had a high identification score but the rapport and apprentice scores were lower (66.9% and 53.2% of PhD students respectively).

Mental health, GAD-7 and PHQ-9 scores

The study shows that 14.9% of PhD students reported a history of psychiatric disorders during the medical check-up, two-thirds of which were mood disorders (66.7%) (table 3). Only three students (1.9%) reported a history of suicide attempts. The GAD-7 score was low overall (mean=3.2; SD=3.3), corresponding to an absence of anxiety for 81% of the students. However, 15.5% of the PhD students had a GAD-7 score of between 6 and 10, indicating a mild anxiety disorder, requiring at least monitoring (table 3).

A third of the students reported depression, according to their PHQ-9 score, but for 28% this was mild. On the day of the visit, 3.1% of the students, all men (p=0.05), reported suicidal thoughts on the PHQ-9 questionnaire. In addition, 6.2% of the students said they had already consulted a mental health professional since starting their doctorate. Finally, 19.3% of the students were referred to

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Table 1 Socio-demographic and professional characteristics of participating PhD students

	All (n=161)		Women (n=68)		Men (n=93)		
Variables	**n**	**%**	**n**	**%**	**n**	**%**	**P value**
Age (years)							0.7
≤24	52	32.3	25	36.7	27	29.0	
25	40	24.8	15	22.1	25	26.9	
26	39	24.2	17	25.0	22	23.7	
≥27	30	18.6	11	16.2	19	20.4	
Birth place							0.4
France	114	70.8	48	70.6	66	71.0	
Europe (excluding France)	19	11.8	6	8.8	13	14.0	
Asia	14	8.7	7	10.3	7	7.5	
Africa	12	7.5	7	10.3	5	5.4	
America	2	1.2	0	0	2	2.2	
Marital status							0.1
Single	94	58.4	35	51.5	59	63.4	
Married/civil union/cohabitation	67	41.6	33	48.5	34	36.6	
Children							0.8
No	158	98.1	67	98.5	91	97.9	
Yes	3	1.9	1	1.5	2	2.2	
Parents' place of residence							0.5
Auvergne-Rhône-Alpes region	55	34.2	21	30.9	34	36.6	
Outside Auvergne-Rhône-Alpes region	106	65.8	47	69.1	59	63.4	
Level of study (≥1 answer possible)							
Master 2	146	90.7	63	92.7	83	89.3	0.5
Engineering degree	30	18.6	13	19.1	17	18.3	0.9
Associate professor/university degree/other	5	3.0	1	1.5	4	4.3	0.9
Professional experience, apart from the doctoral contract							
None	22	13.7	11	16.2	11	11.8	0.4
Student jobs	56	34.8	28	41.2	28	30.1	0.2
Internship	106	65.8	44	64.7	62	66.7	0.8
Temporary or permanent work contract	38	23.6	15	22.1	23	24.7	0.7
Other (volunteer, self-employed, civic service)	5	3.0					
Study area							**0.0002**
Physics and astrophysics	33	20.5	9	13.2	24	25.8	
Integrative molecular and cellular biology	32	19.9	20	29.4	12	12.9	
Computer science and mathematics	28	17.4	6	8.8	22	23.7	
Chemistry	25	15.5	9	13.2	16	17.2	
Evolution, ecosystems, microbiology, modelling	18	11.2	7	10.3	11	11.8	
Cognitive neuroscience/health sciences/ economic and management sciences	15	9.3	13	19.1	2	2.1	
Mechanical, energetic, civil engineering sciences and acoustic	10	6.2	4	5.9	6	6.5	
Funding source							0.9
Doctoral school	90	55.9	41	60.3	49	52.7	

Continued

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Table 1 Continued

Variables	All (n=161)		Women (n=68)		Men (n=93)		P value
	n	%	n	%	n	%	
Others: associations, region, Institute for Advanced Studies (ENS)	42	26.1	16	23.5	26	28.0	
National Research Agency	21	13.0	8	11.8	13	14.0	
Research organisation (eg, CNES, CEA, CNRS)	6	3.7	2	2.9	4	4.3	
European Union	2	1.2	1	1.5	1	1.1	
Number of supervisors (Director, co-director, co-supervisor)							0.3
1	57	35.4	24	35.3	33	35.5	
2	75	46.6	36	52.9	39	41.9	
3	23	14.3	6	8.8	17	18.3	
≥4	6	3.7	2	2.9	4	4.3	
Number of work sites (laboratories, teaching)							0.5
1	85	52.8	32	47.1	53	57.0	
2	54	33.5	27	39.7	27	29.0	
3	20	12.4	8	11.8	12	12.9	
≥4	2	1.2	1	1.5	1	1.1	
Additional activities (≥1 answer possible)							
Teaching	97	60.2	39	57.4	58	62.4	0.5
Scientific and technical information	3	1.9	2	2.9	1	1.1	0.6
Research valorisation	3	1.9	1	1.5	2	2.2	0.9
Consultant or expert	2	1.2	1	1.5	1	1.1	0.9
None	60	37.3	25	36.7	35	37.6	0.9

Bold values indicates study area are significantly different accodring to gender.

psychological or psychiatric care after the medical examination (table 3).

Bivariate analysis: identification of factors associated with GAD-7, PHQ-9 and job strain scores

Complementary teaching activity, job strain, a below-average doctoral-supervisor relationship, the coexistence of at least a mild depression and the existence of a psychiatric history were statistically significantly associated with a higher risk of anxiety for the PhD students, as early as the first year of the doctorate (table 4). The risk of anxiety was 4.9 times higher for PhD students who had a complementary teaching activity compared with those who did not teach (p≤0.0008).

Similarly, a below-average doctoral-supervisor relationship, the coexistence of anxiety and history psychiatric disorders increased the risk for PhD students to have depression symptoms, as early as the first year of the doctorate (table 4). The risk of depression symptoms was 2.1 times higher for PhD students whose total AWAI- S score was below the median, compared with those whose score was at least the median (p=0.002). Students with a history of psychiatric disorders were also 1.8 times more likely to have depression symptoms with a PHQ-9 score of 5 or higher (p=0.03). As early as the first year of the doctorate, a below-average quality doctoral-supervisor relationship was statistically associated with a greater risk of stressful working conditions, with a 2.3 times higher risk of job strain (p=0.001) for those with a total AWAI-S score was the median or less (table 4).

DISCUSSION

Academic supervision

The AWAI-S scores measured were in favour of good professional relationships between PhD students and their supervisors. However, the process of identification of the doctoral student with their supervisor was better than the support for professional development (apprentice) or the quality of the interpersonal relationship (rapport). For those respondents who reported difficulties since the start of their PhD, these were mainly lack of availability and reactivity (reasonable time for a response to the PhD request) of their supervisors. In theory, each doctoral school should specify, in a written code, the maximum number of PhD students that can be supervised by a single research director. However, in practice,

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Table 2 Psychosocial risk factors (Job Content Questionnaire) for PhD students and quality of their professional relationship with their supervisor (AWAI-S)

	All (n=161)		Women (n=68)		Men (n=93)		
Variables	**n**	**%**	**n**	**%**	**n**	**%**	**P value**
Psychological demands							0.2
Low psychological demands	65	42.9	24	35.8	41	46.6	
High psychological demands	90	58.1	43	64.2	47	53.4	
Decision latitude							**0.02**
Low decision latitude	73	46.5	39	57.4	34	38.2	
High decision latitude	84	53.5	29	42.6	55	61.8	
Social support at work							0.4
Low social support at work	71	44.7	27	40.3	44	47.8	
High social support at work	88	55.3	40	59.7	48	52.2	
Working conditions							**0.02**
Relaxed*	41	27.2	10	14.9	31	36.9	
Passive†	23	15.2	14	20.9	9	10.7	
Active‡	39	25.8	18	26.9	21	25.0	
Stressful§	48	31.8	25	37.3	23	27.4	
Iso strain¶							0.5
No	120	77.9	54	80.6	66	75.9	
Yes	34	22.1	13	19.4	21	24.1	
Total AWAI-S score /150							0.09
Score ≤median (115)	108	67.5	41	60.3	67	72.8	
Score >median (115)	52	32.5	27	39.7	25	27.2	
Rapport subscale /55							0.6
Score ≤median (44)	52	33.1	21	30.9	31	34.8	
Score >median (44)	105	66.9	47	69.1	58	65.2	
Apprentice subscale /70							0.5
Score ≤median (56)	72	46.8	28	43.8	44	48.9	
Score >median (56)	82	53.2	36	56.2	46	51.1	
Identification subscale /25							0.4
Score ≤median (16)	46	28.8	17	25.0	29	31.5	
Score >median (16)	114	71.2	51	75.0	63	68.5	

Bold values indicates decision latitude (dichotomic variable according to the median of the distribution) is significantly different according to gender
*Low psychological demands and high decision latitude.
†Low psychological demands and low decision latitude.
‡High psychological demands and high decision latitude.
§High psychological demands and low decision latitude.
¶Stressful working condition and low social support at work.
AWAI-S, Advisory Working Alliance Inventory, Student perspective.

not all doctoral schools have this in a written code and the number of PhD students supervised by a thesis director varies greatly. In a future study, it would be useful to ask how many other PhD students are supervised by the same PhD supervisor.

Psychosocial factors in the workplace

There was a statistically significant difference between men and women who reported their working conditions to be 'relaxed', 36.9% versus 14.9% (p=0.02), which is consistent with other published studies.[17 18] Decision latitude was also significantly low for more women than men (57.4% vs 38.2%, respectively p=0.02).

The distribution of PhD students' working conditions, according to the Job Content Questionnaire in our study was different from that of the psychosocial risk study that was performed in 2018 at the same university but was not

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Table 3 Mental health, GAD-7 and PHQ-9 scores for PhD students

Variables	All (n=161)		Women (n=68)		Men (n=93)		P value
	n	%	n	%	n	%	
History of psychiatric disorders							0.6
No	137	85.1	59	86.8	78	83.8	
Yes	24	14.9	9	13.2	15	16.1	
Type of psychiatric disorder							
Mood disorders	16	66.7	6	66.7	10	66.7	
Anxiety disorders	7	29.2	3	33.3	4	26.7	
Psychotic disorders	1	4.2	0	0	1	6.7	
Addictions	2	8.3	0	0	2	13.3	
History of suicide attempt							0.9
No	158	98.1	67	98.5	91	97.9	
Yes	3	1.9	1	1.5	2	2.1	
History of hospitalisation in a psychiatric ward							0.5
No	159	98.8	68	100	91	97.9	
Yes	2	1.2	0	0	2	2.2	
Consulted mental health professional since starting the doctorate							0.9
No	151	93.8	64	94.1	87	93,6	
Yes	10	6.2	4	5.9	6	6.5	
Suicidal thoughts recorded on the PHQ-9 on the day of the visit							0.05
No	156	96.9	68	100	88	94.6	
Yes	5	3.1	0	0	5	5.4	
Referral to a mental health professional after the visit							0.7
No	130	80.7	54	79.4	76	81.7	
Yes	31	19.3	14	20.6	17	18.3	
GAD-7 score							0.9
0–5: No anxiety	130	80.8	55	80.9	75	80.7	
6–10: Mild anxiety	25	15.5	10	14.7	15	16.1	
11–15: Moderate anxiety	5	3.1	2	2.9	3	3.2	
16–21: Severe anxiety	1	0.6	1	1.5	0	0	
PHQ-9 score							0.7
0–4: Minimal depression	106	65.8	44	64.7	62	66.7	
5–9: Mild depression	45	28.0	19	27.9	26	27.9	
10–14: Moderate depression	8	5.0	4	5.9	4	4.3	
15–19: Moderately severe depression	1	0.6	1	1.5	0	0	
20–27: Severe depression	1	0.6	0	0	1	1.1	

GAD-7, Generalized Anxiety Disorder-7; PHQ-9, Patient Health Questionnaire-9.

restricted to first-year PhD students.[11] Although more PhD students reported relaxed working conditions in the 2018 study, in the present study, more PhD students were in a job strain situation (31.8%) which is similar to the level reported in another national French survey, the SUMER 2017 survey (31.6%) that included 26 500 workers from diverse work settings.[19] The median scores for decision latitude (79.2 vs 69.0) and social support (27.8 vs 23.4) were globally higher in our population than in the SUMER 2017[19] survey, although the median score for psychological demands was lower (18.7 vs 21.1).

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Table 4 Determinants for the presence of anxiety (GAD-7 ≥6), depression (PHQ-9 ≥5) and job strain (high psychological demands and low decision latitude): bivariate analyses

Variables	Anxiety						
	Yes (GAD-7 score ≥6)		No (GAD-7 score <6)		Prevalence ratio	95% CI	P value
	n	%	n	%			
Teaching (complementary or part-time)							**0.0008**
No	3	12.0	59	45.4	1	–	
Yes	22	88.0	71	54.6	4.9	1.5 to 15.6	
History of psychiatric disorders							**0.03**
No	18	72.0	116	89.2	1	–	
Yes	7	28.0	14	10.8	2.5	1.2 to 5.2	
Job strain							**0.0008**
No	10	40.0	91	75.2	1	–	
Yes	15	60.0	30	24.8	3.4	1.6 to 6.9	
PHQ-9 score							**<0.0001**
0–4 (no depression, minimal depression)	7	28.0	98	75.4	1	–	
5–27 (mild, moderate, moderately severe and severe depression)	18	72.0	32	24.6	5.4	2.4 to 12.1	
Total AWAI-S score /150							
Score ≤median (115)	19	82.6	52	43.0	4.9	1.7 to 13.6	**0.003**
Score >median (115)	4	17.4	69	57.0	1	–	
Rapport subscale /55							
Score ≤median (44)	22	88.0	58	46.0	6.5	2.0 to 20.8	**<0.0001**
Score >median (44)	3	12.0	68	54.0	1	–	
Apprentice subscale /70							
Score ≤median (56)	17	73.9	60	48.0	2.6	1.1 to 6.3	**0.02**
Score >median (56)	6	26.1	65	52.0	1	–	
Identification subscale /25							
Score ≤median (16)	22	88.0	81	62.8	3.6	1.1 to 11.6	**0.008**
Score >median (16)	3	12.0	48	37.2	1	–	
Variables	**Depression**						
	Yes (PHQ-9 score ≥5)		No (PHQ-9 score <5)		Prevalence ratio	95% CI	P value
	n	%	n	%			
History of psychiatric disorders							**0.03**
No	42	76.4	95	89.6	1	–	
Yes	13	23.6	11	10.4	1.8	1.1 to 2.7	
GAD-7 Score							**<0.0001**
<6 (no anxiety)	32	64.0	98	93.3	1	–	
≥6 (mild, moderate and severe anxiety)	18	36.0	7	6.7	2.9	2.0 to 4.3	
Total AWAI-S score /150							
Score ≤median (115)	35	67.3	40	40.8	2.1	1.3 to 3.3	**0.002**
Score >median (115)	17	32.7	58	59.2	1	–	
Rapport subscale /55							
Score ≤median (44)	37	67.3	47	46.1	1.8	1.1 to 2.9	**0.01**

Continued

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Table 4 Continued

Variables	Depression: Yes (PHQ-9 score ≥5) n	%	No (PHQ-9 score <5) n	%	Prevalence ratio	95% CI	P value
Score >median (44)	18	32.7	55	53.9	1	–	
Apprentice subscale /70							
Score ≤median (56)	33	63.5	49	48.0	1.5	0.9 to 2.4	0.07
Score >median (56)	19	36.5	53	52.0	1	–	
Identification subscale /25							
Score ≤median (16)	45	81.8	63	60.0	2.2	1.2 to 3.9	**0.004**
Score >median (16)	10	18.2	42	40.0	1	–	

Variables	Job strain: Yes n	%	No n	%	Prevalence ratio	95% CI	P value
GAD-7 score							**0.0008**
<6 (no anxiety)	30	66.7	91	90.1	1	–	
≥6 (mild, moderate and severe anxiety)	15	33.3	10	9.9	2.4	1.5 to 3.8	
Total AWAI-S score /150							**0.001**
Score ≤median (115)	31	68.9	39	40.2	2.3	1.3 to 3.9	
Score >median (115)	14	31.1	58	59.8	1	–	
Rapport subscale /55							**0.02**
Score ≤median (44)	32	68.1	47	47.0	1.8	1.1 to 3.1	
Score >median (44)	15	31.9	53	53.0	1	–	
Apprentice subscale /70							**0.005**
Score ≤median (56)	32	69.6	45	45.0	2.0	1.2 to 3.5	
Score >median (56)	14	30.4	55	55.0	1	–	
Identification subscale /25							0.1
Score ≤median (16)	37	77.1	66	64.1	1.6	0.9 to 2.8	
Score >median (16)	11	22.9	37	35.9	1	–	

Bold values indicates having teaching (complementary or part time) is significantly associated with a presence of anxiety
AWAI-S, Advisory Working Alliance Inventory, Student perspective; GAD-7, Generalized Anxiety Disorder-7; PHQ-9, Patient Health Questionnaire-9.

Compared with a study published in 2015 on work-related suffering of 192 medical residents at a French Faculty of Medicine, the median psychological demands score was lower and the median decision latitude and social support scores were higher for the PhD students in our study (18.7 vs 24.0, 79.2 vs 72.0 and 27.8 vs 24.0, respectively).[20] The percentage of medical residents in a job strain situation were comparable to that in our study (32.8% vs 31.8%, respectively). In contrast, the iso strain, which was calculated from the decision latitude, psychological demand and social support scores, was higher among medical residents than among PhD students (29.7% vs 22.1%, respectively), suggesting that medical residents have less social support compared with the PhD students. These differences could also be explained by the fact that medical residents, who have a dual status, that is, student and junior doctor.

Mental health

In our study, only 3.7% PhD students had a GAD-7 score consistent with moderate/severe anxiety (score >10), compared with 39% British medical, dental and veterinary students reported in a study of 1000 British students.[21] In addition, 6.2% of the PhD students in our population had a PHQ-9 score ≥10 indicating moderate, moderately severe or severe depression syndrome compared with 27.3% of the British students. The low response rate in the British survey (53%) could be the reason for an overestimation of mental health disorders, and we cannot exclude a selection bias linked to a higher participation

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rate of students reporting poor mental health due to their studies. In contrast, the results from a recently published systematic review suggest that PhD students report greater levels of stress than the general population.[22]

In our study 3.1% of the PhD students reported suicidal thoughts at the time of the visit compared with 16.2% of the British students who reported suicidal thoughts in the previous 2 weeks. Five times more students reported suicidal thoughts in the 2018 survey at the same university and in Nature's PhD Survey five times more participants consulted mental health professionals (6.5% vs 36%).[2 11]

The results from the bivariate analyses showed that PhD students who had complementary teaching activities were almost five times more likely to have anxiety disorders compared with those who did not teach (p<0.001). In a study of 3000 French PhD students who taught it was reported that the design of courses and assessments, the choice of course materials, public speaking and the intellectual stimulation of students can contribute to anxiety symptoms among the teachers.[23]

Strengths of the study

In the setting of a routine occupational health medical check-up we were able to include 98% of the 2019 PhD student intake, and even PhD students who subsequently left were included. Given this high participation rate any selection bias has been minimised and we can, therefore, consider our sample as representative of first-year PhD students at our university. Data were collected using a questionnaire containing standardised, validated questions and scales. In addition, the students' responses were analysed and discussed with them during their visit. This enabled us to detect psychological distress and refer the students for treatment and also to ensure close individual follow-up for nearly 20% of the PhD students. The interviews were also conducted from November 2019 and February 2020, during a period of stable activity and before the health crisis linked to SARS-CoV-2. Finally, this is one of the first studies that assessed the health status of French PhD student population.

Study limitations

PhD students who are not employed by the university were excluded because their occupational health medical check-up is not done by the university's employee health service. Therefore, these results cannot be extrapolated to all PhD students doing research in our university research laboratories. It is possible that an employer other than the university would not have the conditions for working and therefore the psychosocial risks of PhD students would be different. Finally, these latter PhD students do not have access to the same medical and social support services at the university.

As the data were collected as written and oral responses given by PhD students in the questionnaire and during their medical check-up, we cannot exclude reporting bias, particularly under-reporting of mental health problems and difficulties encountered during the doctorate.

The supervisors' opinion about the quality of their relationship with their PhD students and their perception of the doctoral experience were not assessed in this study. However, given the importance of the quality of the professional relationship between research students and their supervisor, this assessment could have provided useful insights in this descriptive study.[24]

It was not possible to demonstrate causal links between certain variables and the health status of the PhD students because of the cross-sectional study design.

Statistical analyses performed were bivariate. For a better knowledge of the variables associated with an anxiety, a depression or a job strain among student PhD, multivariable analyses should be performed in the future.

Perspectives and suggestions

A follow-up study is planned for this population of PhD students using the same standardised questionnaires and medical examination in their third year to assess the evolution of their health and working constraints perception. An additional study could be conducted to consider the supervisors' point of view, including information on the number of other doctoral students they supervise and their availability. Finally, it seems appropriate to set up a medical follow-up as early as possible, in order to detect and treat their health problems and psychological disorders.

Contributors SA contributed to the conception or design of the work, the acquisition, the analysis, the interpretation of data and the drafting of the work. EF contributed to the acquisition, the analysis, the interpretation of data, the drafting of the work and acting as guarantor. YB contributed to the conception or design of the work, the acquisition and the drafting of the work. NB contributed to the conception or design of the work, the acquisition and the drafting of the work. BC contributed to the conception or design of the work, the interpretation of data and the drafting of the work.

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Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Consent obtained directly from patient(s).

Ethics approval The students were informed orally and in writing that their data would be entered anonymously into a computer and that they could have access to their data, request modifications to or destruction of their data, in accordance with the General Data Protection Regulation (GDPR). They were all informed about the study results, at the end of the study, by email. If the doctoral student did not consent to the use of the data, the medical visit was carried out according to the same procedures, but the data were not included in the study (one case). We recall that occupational health medical monitoring is mandatory. They also had the right to object to the processing of their data for these purposes by sending an email.The data were collected and entered into a computerised medical record on a secure web-based portal using MEDTRA software and then extracted into an anonymous database for statistical analysis. The data collection process was registered with the National Institute for Health Data (INDS) under reference no. I34092702202020 and with the university's register under reference no. 2020/002 by the university's data protection officer in compliance with the French data protection laws (CNIL). The protocol was approved by the ethics committee of the Lyon University College of General Medicine (notification number: 2020-10-29-02). Participants gave informed consent to participate in the study before taking part.

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Data availability statement Data are available upon reasonable request. The data sets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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