

1 **Title page**

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3 **When investigating depression and anxiety in undergraduate**  
4 **medical students timing of assessment is an important factor**  
5 **- a multicentre cross-sectional study**

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## Abstract

### Background

Symptoms of depression and anxiety experienced by undergraduate medical students have become a prominent concern. Evidence about students' depression and anxiety including prevalence, trajectory during medical education, gender differences and comparisons with age-matched peers is conflicting. However few studies of medical students' mental health specify the precise time of assessment. Proximity to examinations may be relevant. Precise identification of the time of data collection might help explain contradictory findings and facilitate provision of more timely support.

### Methods

This study addressed whether:

- 1] Proximity of final examinations affected students' depression and anxiety symptoms
- 2] Males and females differed in this respect.

We analysed data provided by 446 final year students from 6 UK medical schools. These students were a subset of data provided by 14 UK medical schools which participated in an online survey comparing first and final year students and in which final year response rates exceeded 30%. We used the Hospital Anxiety and Depression Scale to assess symptoms of depression and anxiety and the norms to indicate potentially clinically relevant cases. We grouped students into those for whom final exams were imminent i.e. within 2 months of completing the survey (n =164) and those for whom exams were more distant or had been taken (n=282). We used parametric and non-parametric tests to compare both groups and gender differences in respect of depression and anxiety sum scores and cases rates.

1 **Results**

2 For both depression and anxiety male and female students facing imminent final exams  
3 recorded greater prevalence and significantly higher mean scores. The effect size of  
4 differences for anxiety were large. No substantial gender differences were found for  
5 depression. Regardless of the timing of final exams female students recorded both  
6 significantly higher mean scores and clinically relevant rates for anxiety.

7 **Conclusions**

8 Proximity to final exams negatively affected the mental health of both male and female final  
9 year students. The study suggests that there may be times in the undergraduate medical  
10 curriculum when additional or targeted support is needed. It also highlights the need for  
11 research to provide a greater specificity of context when investigating medical students'  
12 mental health.

13

14 **Keywords:** depression, anxiety, undergraduate medical students, timing of assessment, final  
15 exams

16

## 1 **Background**

2 Although an issue of concern for many years, symptoms of depression and anxiety  
3 experienced by undergraduates, and in particular medical students, have become the focus of  
4 recent research. (1,2) Concern is not just for the possible impact on achievement during  
5 medical school but also, potentially, on professional commitment and future patient care.  
6 (3,4,5,6) A systematic review encompassing studies of medical students in Europe and the  
7 English-speaking world outside North America reported prevalence ranging from 6.0% to  
8 66.5% for depression and from 7.7% to 65.5% for anxiety. (7) The authors also noted the  
9 relatively poor quality of studies, the use of different validated instruments which may not be  
10 entirely comparable, failure to report the cut-off scores used to indicate severity or otherwise  
11 of depression or anxiety and the use of varying cut-off scores for validated instruments. They  
12 indicated that better quality studies tended to report lower prevalence. (7)

13 Other mental health issues have been found to affect medical students. Studies in several  
14 countries have found relatively high levels of substance abuse (both alcohol and drugs) and  
15 both eating and sleep disorders. (8,9,10) The focus of this paper is on the symptoms of  
16 depression and anxiety experienced by medical students. Studies of undergraduate medical  
17 students, undertaken in different countries, suggest that students experience increasing mental  
18 health issues including symptoms of depression and anxiety as their course progresses.  
19 (11,12) However other studies have found higher levels of depression and anxiety among  
20 medical students at the outset of their course. (13,14,15) Unfortunately most studies have  
21 been cross-sectional and where longitudinal studies have been undertaken, they are generally  
22 based in a single institution making generalisation difficult. (16,17)

23

24 Evidence that female medical students display higher levels of depression and anxiety than  
25 their male counterparts is similarly mixed. Studies in many countries have reported higher

1 levels of symptoms among female medical students compared to males. (13,18) For example  
2 female students in Serbia and Pakistan were found to record significantly higher levels of  
3 both depression and anxiety but gender differences for anxiety were more pronounced than  
4 those for depression. (18,19) By contrast, a study of Chinese medical students found a  
5 significantly higher proportion of male students had symptoms of depression compared to  
6 female students. (12)

7

8 Research has also suggested that the demands of medical education mean that medical  
9 students are more susceptible to depression and anxiety compared to non-medical students  
10 and non-student age matched peers. (20) However a review comparing the prevalence of  
11 depressive symptoms among medical and non-medical students concluded that medical  
12 students had similar or lower rates of depression compared to certain groups of non-medical  
13 students and there are few studies which have compared undergraduate medical students with  
14 age matched peers. (21)

15

16 It is notable that studies examining the trajectory of symptoms of depression and anxiety  
17 amongst medical students generally omit to describe the precise study points being compared.  
18 There is also evidence that students are more likely to experience symptoms of depression  
19 and anxiety at stressful times such as close to examinations. (22,23,24) Brand and  
20 Schoonheim-Klein (2009) examined the association between state anxiety displayed by  
21 dental students and different assessment methods, they found all types of assessment raised  
22 state anxiety but OSCEs were found to be particularly stressful. (25)

23

24 Evidence suggests that medical students are particularly reluctant to seek help for mental  
25 health issues. (26,27,28,29) Better identification of the precise times at which medical

1 students are more likely to be vulnerable can help to facilitate better support. Better  
2 identification of precise times may also facilitate clarification of conflicting research findings.

3

4 In a previous longitudinal study in one UK medical school, we followed the same  
5 undergraduate medical students through their course, examining the prevalence and trajectory  
6 of depression of four cohorts at 3 time points. (17) We used the Hospital Anxiety and  
7 Depression Scale (HADS-D). (30) Prevalence rates of raised levels of depression (HADS-D  
8 scores of  $\geq 8$ ) ranged from 2.7% - 10.6% and did not increase over time. We found a  
9 statistically significant increase overtime in mean scores for depression among male students  
10 only but this difference was small in terms of effect size as measured by Cohen's D. (17, 31)  
11 However very few students repeatedly recorded scores indicating raised symptoms of  
12 depression. We concluded that for many students, depression may be transitory, and for  
13 many, influenced by specific events and/or context. (17)

14

15 Our previous longitudinal study examined a wide range of medical students' attitudes,  
16 characteristics and experiences, including psychological variables, empathy, attitudes towards  
17 end of life care, and experience of bereavement as well as biographical details. Where  
18 possible all variables were measured using validated instruments. (See supplementary  
19 materials 1 for variables examined).

20 The previous study was conducted in only one medical school because of this limitation we  
21 undertook a cross-sectional comparison of students beginning and approaching the end of  
22 their undergraduate medical education in a multicentre study, using the same survey. In  
23 addition we collected details of the timing of final examinations.

24 We invited all UK medical schools to participate. One aim was to examine the following  
25 questions:

1 1] Whether proximity of final examinations affected students' anxiety and depression  
2 symptoms

3 2] Whether male and female students differed in this respect.  
4

## 5 **Methods**

6 Fourteen UK medical schools participated. Most participating schools provided both 5-6year  
7 standard courses and 4 year accelerated graduate entry courses (see supplementary materials  
8 2). It was not possible to classify schools on the basis of course style or educational delivery  
9 since accurate description of these was beyond the scope of the study. Depending on course  
10 structure, the survey was distributed to final year students either during the first or second  
11 academic term of their final year (2013/2014) and was available to them for a mean duration  
12 of 49 days. All schools sent students at least one reminder. The number and nature of  
13 reminders varied from school to school, depending on the terms of the ethical approval  
14 granted in each institution.  
15

16 Students had to give their consent online before being able to access the online questionnaire.  
17 They accessed the online questionnaire using a unique randomly generated PIN, provided to  
18 each participating school by the lead research team in Cambridge. Each school then randomly  
19 allocated tokens to their students. The lead research team automatically replaced PINs with  
20 study identifiers as only this team had access to completed questionnaires.  
21

22 The Cambridge team converted raw data into scales and analysed national data using IBM  
23 SPSS version 21. (32) Ethical approval was obtained from the University of Cambridge  
24 Psychology Research Ethics Committee (application number Pre.2012.44) and from the  
25 relevant committee in each participating medical school.

1 We used the Hospital Anxiety and Depression Scale (HADS), divided into HADS-D to  
2 measure depression and HADS-A to measure anxiety. (30) HADS is a self-report instrument  
3 initially developed to evaluate the presence and severity of anxiety and depression in general  
4 medical populations. It is generally regarded to have good psychometric properties for the  
5 general population. (33) In studies with populations suffering from specific illnesses  
6 specificity and sensitivity of both subscales have been reported to be acceptable. (34,35) The  
7 HADS has been widely used in the UK with members of the general population, (36) young  
8 adults, (37) undergraduates, (38) and medical students. (39,40)

9

10 For both scales we adopted the standard norms of scores of  $\geq 8$  indicated raised symptoms of  
11 depression or anxiety and scores of  $\geq 11$  indicating caseness of depression or anxiety. Because  
12 of considerations of normal distribution, we used Mann-Whitney U to compare scores for  
13 HADS-D, t tests to compare scores for HADS-A and chi square to compare prevalence rates  
14 of raised or caseness of both depression and anxiety. Depending on the variable distribution  
15 Pearson and Spearman correlation were used to measure associations. We measured effect  
16 size using Cohen's D. (31) Participants with missing data were excluded from the respective  
17 analysis.

18

19 For the purpose of the analysis we divided the final year students into two groups: those who  
20 had their final exams within 2 months after participating in the survey (imminent group) and  
21 those for whom all final exams were more than 2 months away or who had taken either all or  
22 most their final exams when completing the survey (not imminent group). There were no  
23 significant differences between the two groups forming the not imminent group (see  
24 supplementary material 3). We compared students for whom all final exams were imminent  
25 with those for whom exams were more distant or who had already taken their final exams.

1 We also examined the extent to which age was associated with symptoms of depression and  
2 anxiety and the relationship with type of student.

3

#### 4 **Results**

5 In total 780 (61.9% female) final year UK medical students participated. Response rates  
6 varied between schools ranging from 7% to 68%. Because of this variability we divided the  
7 participating schools on the basis of response rate. Taking a pragmatic approach, we selected  
8 6 schools in which response rates were greater than 30% for final year students and for which  
9 we also had details of the timing of final exams. The analyses reported here relate only to  
10 schools in this group, which comprised 446 (61.7% female) final year students with an  
11 overall response rate of 42.3%.

12

#### 13 **Insert Table 1 here**

14

15 Characteristics of the 446 participating final year students are presented in table 1. 164 final  
16 year students formed the imminent group. The remaining 282 students were divided between  
17 those for whom all final exams were more than 2 months away 196 and 86 who had taken  
18 either all or most their final exams when completing the survey (see table 2).

19

#### 20 **Insert Table 2 here**

#### 21 **Depression Scores (Table 3)**

22 Both male and female students for whom final exams were imminent recorded significantly  
23 higher mean scores for depression compared to their counterparts whose final exams were  
24 more distant or who had already taken their final exams. These differences were “modest” in  
25 terms of effect size.

1 **Insert Table 3 here**

2 **Depression Prevalence (Table 4)**

3 Among female students for whom final exams were imminent 30.3% recorded scores  
4 indicating raised levels of depression (HADS-D score  $\geq 8$ ) as compared to just over 11.4%  
5 among female students for whom final exams were more distant. Comparable figures for  
6 male students were 30.8% compared to 9.4%. For both female and male students these  
7 differences were significant.

8

9 **Insert Table 4 here**

10

11 **Gender Differences Depression**

12 Regardless of whether final exams were imminent or not, male and female students recorded  
13 very similar mean scores and prevalence rates indicating no substantial gender difference in  
14 respect of depression symptoms (Table 3, Table 4).

15

16 **Anxiety Scores (Table 5)**

17 Male and female students for whom final exams were imminent recorded significantly higher  
18 mean scores for anxiety compared to their counterparts whose final exams were more distant  
19 or who had already taken their final exams. These differences were large in terms of effect  
20 size, particularly among male students.

21

22

1 **Insert Table 5 here**

2

3 **Anxiety Prevalence (Table 6)**

4 Among female students for whom final exams were imminent, 75.8% recorded scores  
5 indicating raised levels of anxiety (HADS-A score  $\geq 8$ ) compared with 56.8% for whom final  
6 exams were more distant (Table 6). Comparable figures for male students were 72.3% and  
7 33.0%. For both female and male students these differences were significant.

8

9 **Insert Table 6 here**

10

11

12 **Gender Differences Anxiety**

13 Among students for whom exams were imminent females recorded significantly higher mean  
14 scores for anxiety than males ( $t=1.999$ ,  $p=0.047$ ) (Table 5). However the percentages of male  
15 and female students recording scores indicating raised levels of anxiety (HADS-A score  $\geq 8$ )  
16 were similar, although a far higher proportion of female students recorded scores of 11 or  
17 more (Table 6).

18 Among students for whom exams were not imminent female students recorded significantly  
19 higher mean scores for anxiety ( $t=4.484$ ,  $p<0.01$ ) and a significantly higher proportion of  
20 female students recorded scores indicating raised levels of anxiety (HADS-A score  $\geq 8$ ) Chi  
21 Square 13.841  $p<0.001$ .

22 Age was weakly associated with higher scores for both depression and anxiety. Graduate  
23 course students as a whole were found to record significantly higher scores for depression

1 than standard course students, but not for anxiety. However, among graduate entry students  
2 those whom exams were imminent recorded significantly higher depression and anxiety  
3 scores than their counterparts for whom exams were not imminent (see Supplementary  
4 materials 2).

5

## 6 **Discussion**

7 The timing of final exams was associated with differences in depression and anxiety  
8 symptoms experienced by final year students. Those facing exams within 2 months recorded  
9 significantly higher scores for both depression and anxiety and proportionately more  
10 displayed “raised” levels of both depression and anxiety than their counterparts for whom  
11 exams were more distant or had already been taken. Female and male students appeared  
12 equally affected by the proximity of final exams.

13 Both the mean score and prevalence of raised levels of depression indicated by the HADS-D  
14 score among final year students whose final exams were not imminent or had been taken  
15 were very similar to those recorded by students in their clinical years (years 4 to 6) in our  
16 previous study who participated at the beginning of their academic year. (17) They are also  
17 similar to a large-scale general population study using HADS-D in which almost a third of  
18 participants were in an age range comparable to medical students. (41)

19 Both the mean score and prevalence of depression indicated by the HADS-D score among  
20 final year students whose final exams were imminent were higher than those found in our  
21 previous study but markedly below those reported in some other studies of medical students.  
22 (17, 21) However as highlighted by Hope and Henderson there are problems of comparability  
23 of instruments. (7)

1 Unlike other studies we found no marked gender differences in respect of mean score or  
2 prevalence of raised levels of depression scores. (13,18,19) In respect of anxiety it is difficult  
3 to compare our findings with those of other studies of medical students since few studies  
4 have measured anxiety using HADS-A. Furthermore questions have been raised about the  
5 appropriateness of applying the same cut-off points as those used for depression to indicate  
6 raised levels of anxiety using HADS-A. (42, 43) Given that effect sizes of difference in mean  
7 scores recorded by students differing in respect of proximity of final exams were large, we  
8 conclude that anxiety levels in both female and male students increase. However the extent to  
9 which this is clinical relevant remains to be investigated.

10 The results of this study support the view found in our previous longitudinal study, that for  
11 many medical students heightened depression may be transitory. (17) To a lesser extent  
12 similar comments may be made in respect of anxiety. This is not to undermine the  
13 seriousness of depression or excessive anxiety experienced by medical students. Rather it is  
14 to suggest that by highlighting specific context or events when students' mental health may  
15 be deteriorating may enable better and more targeted support, particularly when resources are  
16 limited. Identification of such times when and contexts may encourage medical educators to  
17 engage in more open discussions. Specifically it is important to encourage both students and  
18 educators to acknowledge openly that there may be times and experiences which affect  
19 mental health, such as exams and/or first death of a patient. (44) This may particularly  
20 relevant since recent Australian research suggests that the medical school environment may  
21 contribute more to depressive symptoms in medical students than factors in their personal  
22 lives. (45) Establishment of special groups of medical educators involved in student support  
23 such as MEDISS may foster greater openness. Further given pressures on resources provision  
24 of support may be easier at defined times.

1 Equally important, by emphasising that any deterioration in mental health is common at  
2 specific times and may be transitory may also encourage a more open attitude among medical  
3 students themselves towards seeking help which evidence suggests they are reluctant to do.  
4 (26-29)

5 Currently there is considerable research focus on mental health of medical students as the  
6 pass through their training. However apart from indicating the stage in their course few  
7 studies mention the specific context in which the study is being undertaken. The study  
8 reported here suggests that this is a serious omission and needs to be addressed in future  
9 research.

#### 10 Limitations

11 Although our results cannot be generalised to all UK medical schools the strengths of the  
12 study reported here are firstly the number of final year medical students participants and  
13 secondly the fact that schools differed in terms of course structure and content. Although self-  
14 report via a questionnaire does not provide a clinical diagnosis the HADS scale does give an  
15 indication of the level symptoms of depression and anxiety. The cross-sectional nature of the  
16 study and the fact that timing of exams was linked to schools are also weaknesses. The  
17 overall response rate to the study was low, which we sought to address by limiting our  
18 analysis to schools achieving a response rate of more than 30%. This need to restrict analysis  
19 to a small number of schools introduces the possibility of bias.

20

#### 21 Conclusions

22 This study demonstrates the negative impact of proximity of final exams on the mental health  
23 of final year medical students; female and male students alike. For medical schools it  
24 suggests that there may be times in the undergraduate medical curriculum when additional or

1 targeted support is needed. By identifying particularly stressful times which may have  
2 negative impacts students may be encouraged to seek help without fear of embarrassment or  
3 stigmatisation. For medical education research, the study highlights the need for greater  
4 specificity of detailed context, particularly the timing of examinations, when investigating  
5 mental health.

6

### 7 **List of abbreviations**

8 HADS-A: Hospital Anxiety and Depression Scale – Anxiety

9 HADS-D: Hospital Anxiety and Depression Scale – Depression

10 N: Sample size

11 MEDISS: Medical Educators Involved in Student Support

12 OSCE: Objective Structured Clinical Examination

13 PIN: Personal Identification Number

14 SD: Standard deviation

15 UK: United Kingdom

16

17

### 18 **Declarations**

#### 19 **Ethics and consent to participate.**

20 Details of the ethical approval for all of the UK schools participating in the study (N=15)

21 University of Cambridge: Psychology Research Ethics Committee application number:

22 2012.44. This approval was accepted under reciprocal arrangements by the following:

23 University of Birmingham, University of Bristol, University of Glasgow, \*Hull Yorks

24 Medical School, University of Plymouth

25 Details of the ethical approval granted in other participating institutions:

1 \*Brighton and Sussex Medical School, University of Sussex: BSMS Research Governance  
2 and Ethics Committee (RGEG) application number: 13/163/MCD.  
3 Cardiff University School of Medicine Research Ethics Committee application number:  
4 12/57.  
5 University of Exeter Medical School Ethics Committee application number: 13/009/033.  
6 King's College, University of London, Biomedical Sciences, Dentistry, Medicine and Natural  
7 & Mathematical Sciences Research Ethics Subcommittee application number: BDM 13/14-  
8 14.  
9 University of Leicester Medicine and Biological Sciences College Ethics Committee  
10 application number: jmh9-678b.  
11 University of Liverpool School of Medicine Education Research Ethics Committee  
12 application number: 20130 6139.  
13 University of Manchester Research Ethics Committees application number:14127.  
14 University of Nottingham Faculty of Medicine and Health Sciences, Research Ethics  
15 Committee application number: G10102013 SoM PC.  
16 University of Swansea College of Human and Health Sciences and College of Medicine  
17 Research Ethics Committee application number:11113.

18  
19 At the outset of the online survey students were required to confirm that they had read the  
20 information materials relating to the study and to give their written consent to take part.  
21 Participation was voluntary.

22  
23 **Consent for publication.**

24 Not applicable.

25 **Availability of data and materials.**

1 The datasets used and or analysed in this study are available from the corresponding author  
2 on reasonable request. Please contact PT (pt350@medschl.cam.ac.uk).

3

#### 4 **Competing interests.**

5 The authors declare that they have no competing interests.

6

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10

#### 11 **Authors' contributions.**

12 The study was conceived, designed and developed by TQ, JB1, PT, and JB2. JB1 was  
13 responsible for devising and implementing the procedures for collecting the data which  
14 ensured total anonymity. Data analysis was undertaken by PT and TQ and interpretation by  
15 TQ, PT and JB2. TQ and PT undertook the preliminary drafting of the paper, PT, JB2 and  
16 JB2 revised critically for intellectual context. All authors have read and approved the final  
17 version of the manuscript.

18

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6

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11

1 **Tables**

2 **Table 1 Biographical characteristics of participants**

Gender	
Female	275 (61.7%)
Males	171 (28.3%)
Type of student	
Standard course	364 (81.6%)
Graduate course	82 (18.4%)
Average age: 24.8 years (3.437) Range: 21 -52 years.	

3

4 **Table 2 Timing of final exams**

		Frequency	Percent
Imminent	All exams within 2 months	164	36.8
Not Imminent	All exams more than 2 months away	196	43.9
	After exams (all or some)	86	19.3
	Total	446	100.0

5

6 **Table 3 Depression scores amongst students differing in proximity of final exams**

HADS-D	All		Females		Males	
	Timing of Final Exams					
	Imminent (n=164)	Not Imminent (n=282)	Imminent (n=99)	Not Imminent (n=176)	Imminent (n=65)	Not Imminent (n=106)
Mean	5.80	3.37	5.86	3.40	5.71	3.32
(SD)	(3.732)	(3.103)	(3.788)	(3.150)	(3.673)	(3.038)
<i>Median</i>	<i>5.50</i>	<i>3.00</i>	<i>6.00</i>	<i>3.00</i>	<i>5.00</i>	<i>3.00</i>
Skew: 0.975 Kurtosis:0.741						
All students: Mann Whitney U: U=13,807, z= -7.136, p<0.001, r (effect size) 0.338						
Female students: Mann Whitney U: U=5213, z= -5.556, p<0.001, r (effect size) 0.335						
Male students: Mann Whitney U: U=2051.5, z= -4.459, p<0.001, r (effect size) 0.341						

7

8

1 **Table 4 Depression prevalence amongst students differing in proximity of final exams**

Levels of depression	All		Females		Males	
	Timing of Final Exams					
	Imminent (n=164)	Not Imminent (n=282)	Imminent (n=99)	Not Imminent (n=176)	Imminent (n=65)	Not Imminent (n=106)
Normal <8 (%)	114 (69.5%)	252 (89.4%)	69 (69.7%)	156 (88.6)	45 (69.2%)	96 (90.6%)
Raised ≥8<11 (%)	33 (20.1%)	18 (6.4%)	20 (20.2%)	13 (7.4%)	13 (20.0%)	5 (4.7%)
Caseness ≥11 (%)	17 (10.4%)	12 (4.3%)	10 (10.1%)	7 (4.0%)	7 (10.8%)	5 (4.7%)

Chi Square: All 28.050 p<0.001; Females 15.293 p,0.001; Males 13.268 p<0.001

2

3 **Table 5 Anxiety scores for students differing in proximity of final exams**

HADS-A	All		Females		Males	
	Timing of Final Exams					
	Imminent (n=164)	Not Imminent (n=282)	Imminent (n=99)	Not Imminent (n=176)	Imminent (n=65)	Not Imminent (n=106)
Mean (SD)	10.60 (4.419)	7.55 (4.240)	11.15 (4.260)	8.40 (4.255)	9.75 (4.555)	6.14 (3.836)
Median	10.00	7.00	11.0	8.00	9.00	5.00

Skew: 0.280 Kurtosis: 0.587  
 All students: t=7.198, p<0.001; 95% ci 2.213/3.876; r (effect size) =0.7043  
 Female students: t=5.139, p<0.001; 95% ci 1.695/3.801; r (effect size) =0.6459  
 Male students: t=5.561, p<0.001; 95% ci 2.330/4.895; r (effect size) = 0.8573

4

5

6 **Table 6 Anxiety prevalence amongst students differing in proximity of final exams**

Levels of anxiety	All		Females		Males	
	Timing of Final Exams					
	Imminent (n=164)	Not Imminent (n=282)	Imminent (n=99)	Not Imminent (n=176)	Imminent (n=65)	Not Imminent (n=106)
Normal <8 (%)	42 (26.6%)	146 (51.8%)	24 (24.2%)	76 (43.2%)	18 (27.7%)	70 (66.0%)
Raised ≥8<11 (%)	41 (25.0%)	69 (24.5%)	20 (20.2%)	46 (26.1%)	21 (32.3%)	23 (21.7%)
Caseness ≥11 (%)	81 (49.4%)	67 (23.8%)	55 (55.6%)	54 (30.7%)	26 (40.0%)	13 (12.3%)

Chi Square: All 37.380 p<0.001; Female students: 17.070 p<0.001; Male students: 26.866 p<0.001

7

1 **Supplementary materials 1**

2 **Survey description**

3 The survey consisted of the following existing questionnaires:

Measure	Reference
Hospital Anxiety and Depression Scale (HADS-D)	Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatrica Scandinavia. 1983;67(6):361-70.
Hospital Anxiety and Depression Scale (HADS- A)	Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatrica Scandinavia. 1983;67(6):361-70.
Jefferson Scale of Empathy- Student Version (JSE-S)	Hojat, M., Gonnella, J. S., Nasca, T. J., Mangione, S., Vergare, M., & Magee, M. Physician empathy: definition, components, measurement, and relationship to gender and specialty. Am J Psychiatry,2002;159(9):1563-1569.
Davis’s Interpersonal Reactivity Index (IRI)	Davis M. Measuring individual differences in empathy: evidence for a multidimensional approach. J Pers, 1983; 44(1):113-26.
Collett-Lester Fear of Death Scale (CLFODS-R)	Lester D, Abdel-Khalek A. The Collett-Lester Fear of Death Scale: a correction Death Stud, 2003;(27):81-85.
Series of questions developed by Sullivan et al.	Sullivan AM, Lakoma MD, Block SD. The status of medical education in end-of-life care: a national report. J Gen Intern Med. 2003;18:685-695.

4

5 The following biographical characteristics were assessed:

6 Age, Gender, Social Class, Qualified doctor relative, English as first language, Spiritual and  
7 religious orientation, Personal experience of bereavement, together with date and relationship  
8 to deceased.

9

10

1 **Supplementary materials 2**

2 **Graduate course students and Standard course students**

3 Most standard course medical students in the UK enter medical school after completing  
 4 secondary school and most courses are either 5 or 6 years. Typically, standard course students  
 5 are aged 18-20 years depending on whether or not they have taken a year out (gap year).

6 Graduate course medical students enter medical school after completing a first degree.

7 (Bachelor of Science or Arts) Typically they are aged 21 years or over. Depending on the  
 8 entry requirements of the medical school or university their first degree may or may not be in  
 9 a science subject. Graduate entry students may also have higher degrees (masters or  
 10 doctorates). Graduate entry courses are normally 4 years.

11

12 **Table S1 Characteristics of graduate course and standard course students**

	Graduate Course			Standard Course		
Age	mean=28.12 SD=4.42 range (23-52years)			mean=24.05 SD=2.65 range (21-46years)		
	Timing of Final Exams			Timing of Final Exams		
	All	Imminent (n=43)	Not Imminent (n=39)	All	Imminent (n=121)	Not Imminent (n=243)
HADS-D						
Mean	5.24	6.58	3.77	4.04	5.52	3.31
(SD)	(3.533)	(3.567)	(2.879)	(3.513)	(3.764)	(3.139)
Median	5.00	6.00	4.00	3.00	5.00	3.00
HADS-A						
Mean	9.17	11.05	7.10	8.56	10.44	7.63
(SD)	(4.671)	(4.293)	(4.216)	(4.516)	(4.470)	(4.248)
Median	9.00	12.00	6.00	8.00	10.00	7.00

13

14 **Comparison of HADS scores by timing of final exams (imminent vs. not imminent)**

15 Graduate course students:

16 Depression:  $t=3.944$ ,  $p \leq 0.001$ , Mann-Whitney  $U=458.5$ ,  $p \leq 0.001$ ; Anxiety:  $t=4.190$ ,  $p \leq 0.001$

17 Standard course students:

18 Depression:  $t=5.571$ ,  $p \leq 0.001$ , Mann-Whitney = 9171.5,  $p \leq 0.001$ ; Anxiety:  $t=5.847$ ,  $p \leq 0.001$

1 **Table S2 Association between depression and anxiety scores and age:**

	HADS-D Spearman correlation			HADS-A Pearson correlation		
	All (n=446)	Graduate course (n= 82)	Standard course (n=364)	All (n=446)	Graduate course (n= 82)	Standard course (n=364)
age	0.136**	0.327**	0.019	0.125**	0.210	0.082

2 \*\* p ≤ .01

3

1 **Supplementary materials 3**

2 **Grouping of students**

3 The reason behind grouping those for whom all final exams were more than 2 months away  
4 and those who had taken either all or most their final exams when completing the survey to  
5 the not imminent groups was that there was no significant difference between both groups.

6

7 **Table S3 HADS data for imminent and not imminent group subgroups**

Group		HADS-A Anxiety score	HADS-D Depression Score
Exams within 2 months (all or some)	Mean	10.60	5.80
	N	164	164
	Std. Deviation	4.419	3.732
	Range	19	20
	Kurtosis	-0.632	0.444
	Skewness	0.034	0.656
Exams more than 2 months away	Mean	7.75*	3.61**
	N	196	196
	Std. Deviation	4.137	3.200
	Range	20	16
	Kurtosis	-0.393	1.360
	Skewness	0.446	1.242
After exams (all or some)	Mean	7.10*	2.83**
	N	86	86
	Std. Deviation	4.459	2.813
	Range	18	11
	Kurtosis	-0.320	0.409
	Skewness	0.435	1.053
Total	Mean	8.67	4.26
	N	446	446
	Std. Deviation	4.546	3.543
	Range	20	20
	Kurtosis	-0.587	0.741
	Skewness	0.280	0.975

8 \* p = 0.74; \*\* p = 0.21

9