Prevalence and persistence of depression among undergraduate medical students: a longitudinal study in one UK medical school.

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TITLE PAGE

Prevalence and persistence of depression among undergraduate medical students: a longitudinal study at one UK medical school.

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ARTICLE SUMMARY

Article focus:

- What is the prevalence of depression amongst male and female medical students?
- Does prevalence of depression increase or decrease during the course?
- For those affected, is depression persistent?

Key messages:

- Although prevalence of depression amongst medical students was not higher than that found comparable groups a significant minority of students displayed depression but the majority of these did so only on one occasion.
- Prevalence was not found increase over time.
- Although the majority of students who demonstrated depression did so on only one occasion mechanisms are needed to identify and support depressed students

Strengths and limitations of this study:

Strengths

- Data obtained from students in all six years of medical undergraduate training.
- Use of validated survey instrument allowing comparisons with comparable groups.
- Results of missing value analysis together with response rates indicate generalisability of study results to institution in which study conducted.

Limitations

- Study undertaken in one UK medical school undertaking a traditional medical course limit generalisability.
- Course structure results only half of students in the Core Science component being able to transfer to Clinical component so limiting longitudinal nature of study.
- Attrition of response rate.
- Use of single simple self-report instrument.

ABSTRACT

Objectives: To determine amongst male and female medical students the prevalence of depression, whether prevalence changes over time, and for students affected by depression, whether it persists.

Design: Longitudinal study comprising annual questionnaire surveys which included the depression subscale (HADS-D) of the Hospital Anxiety and Depression Scale.

Participants: Between 2007 and 2010, 1112 students entering Year 1 and 542 students entering Year 4 (the first years of Core Science and Clinical components respectively).

Methods: We analysed separately for men and women, mean HADS-D scores, the proportions whose scores indicated depression at different time-points and for students maintaining participation, the number of occasions on which their HADS-D scores indicated depression.

Results: Data provided by 725 Core Science and 364 Clinical students indicated no significant gender differences in median HADS-D scores. The range of mean HADS-D scores amongst Core Science students was 3.34 -3.49 and 2.16-2.91 amongst Clinical students. A small increase was found amongst male Clinical students [time coefficient 0.33 (95% CI 0.11- 0.55)] but not amongst women. No increase in mean HADS-D scores was observed amongst Core Science students.

Prevalence of depression varied from 2.2% to 14.8%. Prevalence was not found to increase over time. 220 Core Science and 150 Clinical students maintained participation, of these 18.2% and 10.6% respectively recorded HADS-D scores indicating depression on at least one occasion. Of 56 students recording depression at some point, 37 did so only once.

Conclusions

Amongst the medical students studied prevalence of depression was not higher than that

found for comparable groups. However in some years a significant minority displayed depression and amongst men approaching the end of clinical studies depression scores increased. Gender differences in respect of depression scores and prevalence were minimal. Mechanisms are needed to identify and support students suffering from depression, particularly those with persistent low mood.

MAIN TEXT

INTRODUCTION

Psychological wellbeing is important for medical students, for the patients they meet and for their future medical practice.[1- 4] Medical students with depression more commonly consider dropping out of their course.[5] Among newly qualified physicians associations have been found between depressive symptoms and increasing cynicism, self-perceived medical errors and lower levels of self-rated health.[6-8] As their careers progress, physicians have elevated rates of suicide compared to the general population.[9-12] Patient care is affected by psychological distress amongst physicians: poor communication, diminished quality of care and medical errors have been found to be associated with physician stress.[13,14]

Physicians are more likely to experience depression compared to the general population. [9-12] However, the prevalence of depression among medical students varies, depending on age, stage of training, methods of measurement and location.[15] The use of different study instruments limits the extent to which medical students can be compared directly with similarly aged populations. Even where valid comparisons have been made evidence remains conflicting.[16-20]

Gender differences in depression have been found in both practicing and newly qualified physicians, which mirror epidemiological studies indicating that depression is more common amongst women than men.[21] A study of US residents found that 45% of women compared to 32% of men reported 4 or 5 depressive symptoms.[6] Most, but not all studies conducted amongst medical students, using various instruments, show a similar pattern.[15,20,22,23]

The prevailing view is that depression rises during undergraduate medical education and that this rise is more pronounced among women.[15,20,24] However, this pattern is not

universally reported: studies amongst some medical student populations, show levels of depression fall between years 1 and 2 and between preclinical and clinical stages of training.[22,23] Longitudinal studies in the UK and Sweden suggest that some students repeatedly experience psychological distress during medical training,[25,26] but few studies have examined whether depression for an individual student is persistent.

The School of Clinical Medicine at the University of Cambridge is engaged in a study of factors in undergraduate education which may influence the quality of patient care provided by students in their subsequent medical practice. We regard student depression as one such factor. In October 2007, we began a longitudinal study involving all students coming to Cambridge to study medicine. This paper reports the findings in respect of three questions concerning male and female medical students:

1] What is the prevalence of depression?

2] Does prevalence of depression increase or decrease during the course?

3] For those affected, is depression persistent?

METHODS

Participants

The medical course at Cambridge comprises a Core Science component (Years 1-3) during which students learn core medical science with a small element of clinical experience leading to a primary BA degree, and a Clinical component (Years 4-6). Around 280 students, typically aged 18 – 19 years, enter Year 1. At the end of Year 3, approximately half continue into the Clinical component in Cambridge. From September 2007 – September 2010, all students entering Years 1 and 4 (the first years of the Core Science and Clinical components respectively) were invited to participate in a longitudinal study comprising annual questionnaire surveys. Students entering the

Clinical component in 2010 comprised those students who had entered the Core Science component in 2007 and who remained in Cambridge.

Outcome Measure

We measured depression using the depression subscale (HADS-D) of the Hospital Anxiety and Depression Scale.[27] HADS is a self–report instrument initially developed to evaluate the presence and severity of anxiety and depression in general medical populations. It is regarded as a useful tool for identifying those with emotional distress and has good psychometric properties.[28,29] HADS-D has been widely used in the UK among members of the general population,[30] among young adults within the general population,[31] with undergraduates,[32,33] medical students,[16,34,35] and medical practitioners.[36,37]

HADS-D comprises seven items expressed both positively and negatively, giving a maximum score of 21. It has widely recognised norms relating to depression: scores of 0-7 are regarded as "normal", scores of 8-10 indicate "possible" depression and scores of 11 and over indicate "probable" depression. The HADS-D norm of greater than or equal to 8 has been shown to have a sensitivity of 0.82 (95% CI 0.73-0.89) and a specificity of 0.74 (95% CI 0.60-0.84).[29] A study of UK undergraduates comparing results for HADS-D with interview data concluded that the HADS-D scale was a reasonably accurate indicator of depressive conditions in university students at the recommended cut-offs.[38]

Procedures

Students in years 1-5 received questionnaires during the first week of each new academic year (September / October). Students in Year 6 received questionnaires in January of their final year, prior to final examinations in June. We used a paper-based questionnaire for all students in 2007 and 2008 and for Clinical students in 2009. We used an online questionnaire for Core Science students in 2009 and for all students in

2010 (table 1). Participation was voluntary. Questionnaires were labelled by study number only. A study data manager (who had no access to results) sent one reminder to students after 2 weeks. A small prize was awarded annually by lottery to a small number of participants. The study received approval from the University of Cambridge Psychology Ethics Committee.

Analysis

Overall Approach

We took a HADS-D of greater than or equal to 8 to indicate depression. We set statistical significance at the 5% level ($p<0.05$) for all analyses. Only about half of the Core Science students present in Years 1-3 remained in Cambridge for Years 4-6, yielding small numbers for analysis across all six years (Figure 1). For this reason, we analysed data separately for students from the Core Science and Clinical components. For study questions 1 and 2 (prevalence of depression) we included all students completing questionnaires between 2007 and 2011. For study question 3 (persistence of depression) we included students entering either the Core Science or the Clinical component in 2007, 2008 and 2009, who maintained their participation for all years of their respective course.

Response bias

For study questions 1 and 2, (prevalence of depression) we undertook missing value analyses for men and women separately, using logistic regression to determine whether HADS-D on entry predicted subsequent study participation. Outcome variables were missing values (yes or no) for HADS-D at Years 2 and 3 for students entering year 1 and Years 5 and 6 for students entering year 4. The explanatory variable was HADS-D at Year 1 for Core Science students and Year 4 for Clinical students. We included 'year of course entry' as an explanatory factor, to adjust for student cohort. Students entering in 2010 were considered to have missing subsequent participation if they did not

respond in Year 2 / Year 5. We calculated odds ratios corresponding to the increased risk of non-response for every 1 unit increase in HADS-D at course entry, with 95% confidence intervals for odds ratios and p-values.

For study question 3 (persistence of depression) within each component we undertook separate t tests to examine whether there was any difference in the mean scores of those who maintained their participation and those who did not.

Detailed Analyses

For study question 1 (prevalence of depression) we measured separately for men and women, at each point in the course, mean HADS-D and the proportion with HADS-D scores ≥8 indicating depression. We compared median HADS-D amongst men and women using non-parametric tests (Mann Whitney U tests) and the proportions of men and women whose HADS-D indicated depression (Chi-squared tests).

For study question 2 (prevalence of depression over time) we undertook regression analyses separately for men and women, using a 'Generalised Estimating Equations' (GEE) method. We chose the GEE method because many students had repeated data, the HADS-D scores were skewed, and we did not want to make any full distributional assumptions. The model assumed a general (unstructured) correlation structure. In order to adjust for effect of student year of entry, we included this as an explanatory factor variable. To test the robustness of our model we applied a sensitivity analysis to the outcome variables, removing outliers more than 3 standard deviations away from the mean.

For study question 3 (persistence of depression) we examined separately for men and women the number of occasions on which individual students' HADS-D score indicated depression. Within each component we examined whether the proportions of men and women whose score indicated depression differed (i) on any occasion, (ii) on only one occasion, or (iii) on more than one occasion. Given the small sample size we used

Newcombe's method (39) with R software (40) to calculate differences in independent (i.e. unpaired) proportions together with 95% confidence intervals.

RESULTS

Participants

In total 725 Core Science and 364 Clinical students participated in the study. Table 1 shows the number of entrants to the Core Science and Clinical components for each year of entry (2007-2010) and those participating each year and providing depression data.

Table 1: Number of participating students providing depression scores at each year for each component of the course.

	Core Science Component			
	Participating students in Each Year of Course (% of year group) *(% of female)*			
	Total number of entrants	Year of component		
		Year 1	Year 2	Year 3
Students entering 2007	266 *(52.2%)*	182 (68.4%) *(51.1%)*	142 (53.4%) *(52.8%)*	121 (45.5%) *(53.7%)*
Students entering 2008	283 *(45.8%)*	139 (49.1%) *(58.3%)*	87 (30.7%) *(60.9%)*	78 (27.6%) *(60.2%)*
Students entering 2009	281 *(48.9%)*	156 (55.5%) *(53.2%)*	94 (33.4%) *(53.2%)*	84 (29.9%) *(57.1%)*
Students entering 2010	282 *(46.3%)*	188 (67.0%) *(50.5%)*	107 (37.9%) *(50.5%)*	
Total	1112 *(48.0%)*	665 (59.8%) *(52.9%)*	430 (38.7%) *(53.9%)*	283 (25.4%) *(56.5%)*

	Clinical Component			
	Participating students in Each Year of Course (% of year group) *(% of female)*			
	Total number of entrants	Year of component		
		Year 4	Year 5	Year 6
Students entering 2007	135 *(61.1%)*	102 (75.6%) *(62.7%)*	82(60.7%) *(67.1%)*	76(56.3%) *(67.1%)*
Students entering 2008	135 *(44.3%)*	97(71.9%) *(54.6%)*	70(51.9%) *(58.6%)*	57(42.2%) *(63.2%)*
Students entering 2009	135 *(49.6%)*	70(51.9%) *(46.4%)*	47(34.8%) *(45.7%)*	49 (36.3%) *(45.8%)*
Students entering 2010	137 *(53.3%)*	68(49.6%) *(50.0%)*	63(46.0%) *(55.6%)*	
Total	542 *(52.0%)*	337 (62.2%) *(54.3%)*	262 (48.3%) *(58.0%)*	182 (33.6%) *(59.9%)*

Response Bias

Table 2: Missing value analysis: Logistic regression results presented as odds ratios, 95% confidence intervals and p-values for relationship between HADS-D on entry and subsequent study participation, adjusting for student cohort

Depression (HADS-D)	Men	Women
Core Science component students		
odds ratio (95% CI)	1.05 (0.95 to 1.16)	1.08 (0.99 to 1.18)
p values	p=0.35	p=0.08
Clinical component students		
odds ratio(95% CI)	1.07 (0.91 to 1.25)	0.95 (0.79 to 1.15)
p values	p=0.43	p=0.62

Table 2 shows the results of the missing value analysis for study questions 1 and 2. For students in both components of the course, there was no significant relationship between HADS-D on entry and subsequent study participation. For study question 3, no statistically significant difference in mean HADS-D was found between students who maintained their participation and those who did not (analyses not shown).

Prevalence of Depression amongst men and women (Study question 1)

Table 3 shows, at each point in the course, mean HADS-D and the proportion of students whose HADS-D indicated depression.

Core Science component

Mean HADS-D ranged between 3.34 and 3.49. The proportion of students whose HADS-D scores indicated depression ranged between 5.7% (5.8% among men and 5.7% among women) and 10.6% (14.8% among men and 7.5% among women).

Clinical component

Mean HADS-D ranged between 2.16 and 2.91. The proportion of students whose HADS-D scores indicated depression ranged between 2.7% (3.2% among men and 2.2% among women) and 8.2% (5.6% among men and 10.0% among women).

Table 3 shows comparisons, at each point in the medical course, between median HADS-D amongst men and women (Mann Whitney U tests). There were no significant gender differences in either course component.

Table 3: Mean HADS-D (Standard deviation) and percentages of participants whose HADS-D indicated depression by gender for each year of course within each component. Non-parametric gender comparison of means and Chi-squared gender comparisons of percentages.

	Mean scores			
Year	All Mean (SD)	Men Mean (SD)	Women Mean (SD)	Mann Whitney U
Core science component students				
Yr 1 (n=665/313/352)	3.34 (2.36)	3.22 (2.24)	3.44 (2.47)	p=0.339
Yr 2 (n=429/197/232)	3.49 (2.75)	3.29 (2.77)	3.66 (2.76)	p=0.120
Yr 3 (n=282/122/160)	3.35 (2.85)	3.77 (3.16)	3.04 (2.56)	p=0.062
Clinical component students				
Yr 4 (n=337/157/180)	2.16 (2.08)	2.23 (2.06)	2.10 (2.11)	p=0.474
Yr 5 (n=260/109/151)	2.65 (2.51)	2.82 (2.66)	2.52 (2.40)	p=0.398
Yr 6 (n=182/72/110)	2.91(2.92)	3.08 (2.88)	2.79 (2.96)	p=0.311
	Prevalence			
Year	All % Depression (≥ 8)	Men % Depression (≥ 8)	Women % Depression (≥ 8)	X^2
Core science component students				
Yr 1 (n=665/313/352)	5.7%	5.8%	5.7%	[a] p=0.969
Yr 2 (n=429/197/232)	8.4%	7.1%	9.5%	[a] p=0.376
Yr 3 (n=282/122/160)	10.6%	14.8%	7.5%	[a] p=0.050
Clinical component students				
Yr 4 (n=337/157/180)	2.7%	3.2%	2.2%	[a] p=0.585
Yr 5 (n=260/109/151	5.8%	6.4%	5.3%	[a] p=0.701
Yr 6 (n=182/72/110)	8.2%	5.6%	10.0%	[a] p=0.286

[a] Comparison of men and women in respect of normal HADS-D (score ≤ 7) and HADS-D indicating depression (score ≥ 8)

Table 3 also shows he proportions of men and women whose HADS-D indicated depression (Chi-squared tests). Amongst Core Science component students, significantly more men than women in year 3 recorded HADS-D scores indicating depression, but there were no differences in other years. There were no significant differences between men and women in the Clinical component.

Prevalence of depression amongst men and women over time (Study Question 2)

Table 4 shows the results of the GEE models used in this analysis. These are supported by the finding reported above that missing values were not significantly dependent on initial depression levels (table 2). The time coefficient resulting from a GEE model should be interpreted as representing a population-averaged effect rather than an individual student-level effect.

Table 4: Linear time coefficients resulting from GEE regression analyses on the outcome variable HADS-D, adjusting for student year of entry, presented with 95% confidence intervals.

	Men	Women
Core science component students		
Depression (HADS-D)		
Time coefficients	0.20	-0.11
(95% CI)	(-0.03 to 0.43)	(-0.31 to 0.08)
Clinical component students		
Depression (HADS-D)		
Time coefficients	0.33	0.17
(95% CI)	(0.11 to 0.55)	(-0.04 to 0.39)

All results were similar after removal of outliers more than 3 SD from the mean.

Core Science component

The results indicate no significant difference, amongst either men or women, in HADS-D scores over time. Sensitivity analysis (removal of outliers) produced similar results.

Clinical component

A very small but statistically significant increase in HADS-D over time was found amongst men. No significant difference over time was found amongst women. Sensitivity analysis (removal of outliers) produced similar results.

Persistence of Depression amongst men and women (Study Question 3)

Table 5 shows the prevalence of depression recorded by students who maintained their participation throughout the three years of each course component.

Table 5: Prevalence of depression recorded by repeat participants.

	All	Men	Women	Differences in proportion women-men (95% CI)
Core science component students	n=220 (% of participants)	n=96 (% of participants)	n=124 (% of participants)	
On any occasion	40 (18.2%)	17 (17.7%)	23 (18.5%)	0.008 (-0.10 to 0.11)
On only one occasion	29 (13.2%)	9 (9.4%)	20 (16.1%)	0.07 (-0.03 to 0.15)
On more than one occasion	11 (5.0%)	8 (8.3%)	3 (2.4%)	-0.06 (-0.13 to 0.001)
Clinical component students	n=150 (% of participants)	n=59 (% of participants	n=91 (% of participants	
On any occasion	16 (10.6%)	5 (8.5%)	11 (12.1%)	0.04 (-0.08 to 0.13)
On only one occasion	8 (5.3%)	3 (5.1%)	5 (5.5%)	0.004 (-0.09 to 0.08)
On more than one occasion	8 (5.3%)	2 (3.4%)	6 (6.6%)	0.03 (-0.06 to 0.11)

Core Science component

Amongst the 96 men and 124 women who maintained their participation, 40 students (17 men and 23 women) recorded at least one HADS-D score indicating depression. Of these, 29 (9 men and 20 women) did so on only one occasion; 9 (6 men and 3 women) did so on two occasions. Two men recorded scores indicating "possible" depression throughout the Core Science course component.

Clinical component

Amongst the 59 men and 91 women who maintained their participation, 16 students (5 men and 11 women) recorded at least one HADS-D score indicating depression. Of these, 8 (3 men and 5 women) did so on one occasion; 6 (all women) did so on two

occasions. Two men recorded scores indicating "possible" depression throughout the Clinical course component.

Table 5 also shows the results of comparisons between men and women in respect of transitory or persistent depression. There were no significant gender differences in either course component.

DISCUSSION

Amongst groups of male and female medical students in Cambridge, the prevalence of depression varied from 2.2% to 14.8%. No significant changes in mean depression scores were observed amongst Core Science component students or amongst women in the Clinical component. A statistically significant increase in mean depression scores was found for men during the Clinical component. However, this increase was extremely small when considered against the 21 points of the HADS-D scale. Most students who demonstrated depression during the Core Science component did so on only one occasion. In the Clinical component, although few students experienced depression, half did so on more than one occasion. We found no evidence that women were more likely than men to experience depression, either on one occasion or persistently.

Our study obtained data on depression from students in all 6 years of medical training. In the Core Science component, for each year of the course between 25.4% and 59.8% of those eligible participated. Comparable figures for the Clinical component were 33.6% to 62.2%. Almost 27% of Core Science students and 37% of Clinical students entering between 2007 and 2009 participated on all occasions during their respective course components, allowing longitudinal observations to be made. These participation rates, allied with missing data analyses indicating that initial scores did not predict later non-response, support the generalisability of our results to the population of medical

students at the University of Cambridge. Where possible these results are related to existing literature using HADS-D in order to allow direct comparison.

Mean HADS-D scores recorded by students in our study ranged from 2.16 (SD 2.08) for Clinical students in year 4 of the course, to 3.49 (SD 2.75) for Core Science students in year 2. These are roughly similar to mean scores reported for comparable groups: scores from 2.68 to 7.5 for medical students elsewhere,[17,19,34] and from 2.33 to 5.2 for non-medical undergraduate populations.[41- 43]

Mean scores may not reflect the prevalence of significant depression. Using the HADS-D score of ≥8, we found the prevalence of depression ranged from 2.7% for Clinical students in year 4 of the course, to 10.6% for Core Science students in year 3. Prevalence of depression using a similar cut-off score amongst comparable groups has been found to vary from 9.5% to 29% for medical students,[16,17,19] and from 3.8% to 18% for non-medical undergraduates.[38,41] Studies in the general population in Norway and the UK have reported a prevalence of 8% and 12% respectively,[30,44] whilst a study of people aged 18-25 reported a prevalence of 12% amongst men and 18% amongst women.[31] Our results suggest that Cambridge medical students do not have a higher prevalence of depression than students in general or comparable non-student members of the general population. Other work, investigating the suicide rate amongst students at the University of Cambridge over the period 1970-1996 also found that rates were similar to comparable age groups in the general population.[45]

Although studies involving similarly aged members of the general population have reported a higher prevalence of depression amongst women compared to men,[31,44] we found no significant gender differences in either mean HADS-D or prevalence of depression in any year of the course. This replicates previous findings using the HADS with other undergraduates including medical and dental students.[46,47]

Turning to the question of whether psychological well-being deteriorates during university medical education a UK study of non-medical undergraduates found a significant increase in the proportion recording depression between the period immediately prior to the start of the course and the middle of the second academic year.[33] Few studies have examined the persistence of depression within individual students over time. In our study, regression analyses indicated no significant change for either men or women throughout the equivalent Core Science component of the course. Analysis of students in the Clinical component indicated a very small increase in mean scores for depression for men but not for women. These minor increases in mean depression scores may be related to the approach of finals examinations, or they may presage the known increase in depression seen amongst practising doctors.

For many students, the experience of depression was transient. Among repeat participants, 40 Core Science and 16 Clinical students recorded HADS-D scores indicating depression at some point. Of these 56 students, 37 did so on only one occasion. Nevertheless, 19 students (11 Core Science and 8 Clinical) showed evidence of repeated depression, with four men (2 in each component of the course) doing so in all three years of their respective course component. We found no significant difference in transient or persistent raised levels of depression between men and women.

The authors are not aware of any other studies using HADS-D of medical students against which to set these particular findings. However, their key implication is that whilst overall persistence of depression is low, there exists a small, important minority of students for whom depression is an ongoing experience. It is vital for medical schools to recognise and support all students experiencing depression, but in particular to consider how best to encourage this especially vulnerable group to seek help, given the evidence that suggests that they are reluctant to do so.[1,26,48,49]

The HADS-D is a well validated and widely used self-report instrument. The procedures for administering the survey were created to ensure anonymity and confidentiality.[50] This study is limited by being based on one UK university, providing a "traditional" course with a collegiate pastoral support structure. There may have been a systematic difference between those participating and those not participating (i.e. a non response bias) which may have affected our results. However, the missing value analysis supports the view that those continuing to participate could be considered representative of all student entrants in their year group and that continued participation was not influenced by scores for HADS-D recorded at the beginning of participation. We cannot exclude the possibility of an association between an unobserved change in depression and the missing values.

We tested for a linear relationship between year of course and depression which rests on the assumption that depression increases or decreases gradually over time. In reality this may not have been the case: mean scores could rise during one year and then decline during the next year. Unfortunately our sample size was too small and number of time points too few to test for quadratic or other polynomial relationships between individual course years and depression, but future studies may like to consider this. Future work should investigate the generalisability of these results to other medical schools in the UK and, in order to extend the relevance of findings to future patient care, the relationship between depression during undergraduate medical education and "burnout" after qualification. Further work is needed on identifying both transient and repeated experiences of depression among medical students and understanding possible causes related to course design and students' experience of it. For example, studies of students have found depressive symptoms to be related to prior mental health problems,[49] personality aspects such as maladaptive perfectionism,[51]and strong feelings of altruism and empathy.[52]

CONCLUSIONS

Overall, only a small proportion of the student body experienced depression. These findings do not support the view that medical students exhibit a higher prevalence of depression than other comparable groups or that differences in mean depression score or prevalence exist between men and women. Nevertheless, depression may start to become more prevalent as medical qualification approaches and a small number of students who experience depression do not recover from one year to the next. It is important that mechanisms should be in place to identify and support all students suffering from depression, but particularly the very few with persistent low mood. As part of this process, it remains important to challenge the stigma of mood disorder amongst health professionals to encourage students experiencing difficulty to seek and receive appropriate help.

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COMPETING INTERESTS STATEMENT

All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years; no other relationships or activities that could appear to have influenced the submitted work.

CONTRIBUTORSHIP STATEMENT

TQ, JB and DW were responsible for the conception and design of the study. TQ coordinated the study and managed the data collection. TQ and RP did the analyses, JB and DW contributed to interpretation of the findings. TQ wrote the first draft of the

manuscript. All authors had full access to all data and all were involved in critical revision of the manuscript.

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ETHICAL APPROVAL

The study was approved by the University of Cambridge Psychology Ethics Committee.

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1✓	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
	✓	(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2 ✓	Explain the scientific background and rationale for the investigation being reported
Objectives	3✓	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4✓	Present key elements of study design early in the paper
Setting	5✓	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6✓	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7✓	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*✓	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9✓	Describe any efforts to address potential sources of bias
Study size	10✓	Explain how the study size was arrived at
Quantitative variables	11✓	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12✓	(*a*) Describe all statistical methods, including those used to control for confounding
	✓	(*b*) Describe any methods used to examine subgroups and interactions
	✓	(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
	✓	(*e*) Describe any sensitivity analyses

Continued on next page

Results		
Participants	13*✓	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*✓	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*✓	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results	16✓	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17✓	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18✓	Summarise key results with reference to study objectives
Limitations	19✓	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20✓	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21✓	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22✓	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Dear Dr. Quince

MED-2012-0224
Depression among undergraduate medical students at one UK medical school.

Thank you for submitting your paper to Medical Education. I read it with great interest but I am afraid I am not able to offer publication.

With such a substantial literature already outlining the prevalence of depression and other clinical issues amongst medical students as well as examining which variables relate to prevalence rates it is difficult to discern what substantive advance is offered by the findings included in this report.

As you will appreciate we receive many more papers than we can accept and have to make some careful decisions about what to publish. This means making some difficult decisions based on originality, importance and academic rigour. I am sorry we cannot find space for your paper.

Thank you for giving us the opportunity to consider your work. Despite this disappointing outcome, I wish you every success with your continued research and educational activities.

Yours sincerely,

Dr Kevin Eva
Editor in Chief
Medical Education

Prevalence and persistence of depression among undergraduate medical students: a longitudinal study in one UK medical school.

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Primary Subject Heading:	Medical education and training
Secondary Subject Heading:	Mental health
Keywords:	Undergraduate medical students, Depression, Longitudinal study, Medical education

TITLE PAGE

Prevalence and persistence of depression among undergraduate medical students: a longitudinal study at one UK medical school.

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KEY WORDS

Undergraduate medical students, Depression, Longitudinal study, Medical education

WORD COUNT: 3348

ARTICLE SUMMARY

Article focus:

- What is the prevalence of depression amongst male and female medical students?
- Does prevalence of depression increase or decrease during the course?
- For those affected, is depression persistent?

Key messages:

- Although prevalence of depression amongst medical students was not higher than that found comparable groups a significant minority of students displayed depression but the majority of these did so only on one occasion.
- Prevalence was not found increase over time.
- Although the majority of students who demonstrated depression did so on only one occasion mechanisms are needed to identify and support depressed students

Strengths and limitations of this study:

Strengths

- Data obtained from students in all six years of medical undergraduate training.
- Use of validated survey instrument allowing comparisons with comparable groups.
- Results of missing value analysis together with response rates indicate generalisability of study results to institution in which study conducted.

Limitations

- Study undertaken in one UK medical school undertaking a traditional medical course limit generalisability.
- Course structure results only half of students in the Core Science component being able to transfer to Clinical component so limiting longitudinal nature of study.
- Attrition of response rate.
- Use of single simple self-report instrument.

ABSTRACT

Objectives: To determine amongst male and female medical students the prevalence of depression, ~~whether prevalence~~its ~~change~~s over time and~~, and for students affected by depression,~~ whether depression~~it~~ persists for affected students~~.~~

Design: Longitudinal study comprising annual questionnaire surveys which included the depression subscale (HADS-D) of the Hospital Anxiety and Depression Scale.

Participants: Between 2007 and 2010 all ~~Between 2007 and 2010,~~ 1112 students entering the Core Science component (Year 1) and all 542 students entering the Clinical component (Year 4) of the Cambridge (UK) medical course were followed-up annually. ~~(the first years of Core Science and Clinical components respectively).~~

Methods: We analysed, separately for men and women, mean HADS-D scores, ~~the~~ proportions whose scores indicated depression at different time-points and for students maintaining participation, ~~the~~ number of occasions on which their HADS-D scores indicated depression.

Results: ~~Data provided by~~ 725 Core Science and 364 Clinical students participated. ~~indicated no significant gender differences in median HADS-D scores. The range of m~~Mean HADS-D scores ~~amongst Core Science students was~~ranged between 3.34 -3.49 amongst all Core Science students and ~~and~~ between 2.16-2.91 amongst all Clinical students. There was no difference between men and women in median HADS-D scores. Prevalence of depression ranged between 5.7% - 10.6% amongst all Core Science students and between 2.7% - 8.2% amongst all Clinical students.

Over time Core Science students displayed no increase in mean HADS-D score. Amongst Clinical students only men displayed a small increase ~~A small increase was found amongst male Clinical students~~ [time coefficient 0.33 (95% CI 0.11- 0.55)].

Prevalence did not increase over time. ~~but not amongst women. No increase in mean HADS-D scores was observed amongst Core Science students.~~

~~Prevalence of depression varied from 2.2% to 14.8%. Prevalence was not found to increase over time.~~

220 Core Science and 150 Clinical students ~~maintained participation~~participated throughout the study.~~,~~ O~~o~~f these 18.2% and 10.6% respectively recorded HADS-D scores indicating depression on at least one occasion.~~ on at least one occasion.~~ Of 56 students recording depression at some point, 37 did so only once.

Conclusions:

Prevalence of depression amongst participants was similar to that reported for comparable groups. ~~Amongst the medical students studied prevalence of depression was not higher than that found for comparable groups. However in some years a significant minority displayed depression and a~~Amongst men approaching the end of clinical studies depression scores increased. In all years a minority of students displayed depression; for some this persisted. ~~Gender differences in respect of depression scores and prevalence were minimal.~~ Mechanisms are needed to identify and support students suffering from depression, particularly ~~those with persistent low mood~~when persistent.

MAIN TEXT

INTRODUCTION

Psychological wellbeing is important for medical students, for the patients they meet and for their future medical practice.[1- 4] Medical students with depression more commonly consider dropping out of their course.[5] Among newly qualified physicians associations have been found between depressive symptoms and increasing cynicism, self-perceived medical errors and lower levels of self-rated health.[6-8] As their careers progress, physicians have elevated rates of suicide compared to the general population.[9-12] Patient care is affected by psychological distress amongst physicians: poor communication, diminished quality of care and medical errors have been found to be associated with physician stress.[13,14]

Physicians are more likely to experience depression compared to the general population. [9-12] However, the prevalence of depression among medical students varies, depending on age, stage of training, methods of measurement and location.[15] The use of different study instruments limits the extent to which medical students can be compared directly with similarly aged populations. Even where valid comparisons have been made evidence remains conflicting.[16-20]

Gender differences in depression have been found in both practicing and newly qualified physicians, which mirror epidemiological studies indicating that depression is more common amongst women than men.[21] A study of US residents found that 45% of women compared to 32% of men reported 4 or 5 depressive symptoms.[6] Most, but not all studies conducted amongst medical students, using various instruments, show a similar pattern.[15,20,22,23]

The prevailing view is that depression rises during undergraduate medical education and that this rise is more pronounced among women.[15,20,24] However, this pattern is not

universally reported: studies amongst some medical student populations, show levels of depression fall between years 1 and 2 and between preclinical and clinical stages of training.[22,23] Longitudinal studies in the UK and Sweden suggest that some students repeatedly experience psychological distress during medical training,[25,26] but few studies have examined whether depression for an individual student is persistent.

The School of Clinical Medicine at the University of Cambridge is engaged in a study of factors in undergraduate education which may influence the quality of patient care provided by students in their subsequent medical practice. We regard student depression as one such factor. In October 2007, we began a longitudinal study involving all students coming to Cambridge to study medicine. This paper reports the findings in respect of three questions concerning male and female medical students:

1] What is the prevalence of depression?

2] Does prevalence of depression increase or decrease during the course?

3] For those affected, is depression persistent?

METHODS

Participants

The medical course at Cambridge comprises a Core Science component (Years 1-3) during which students learn core medical science with a small element of clinical experience leading to a primary BA degree, and a Clinical component (Years 4-6). Around 280 students, typically aged 18 – 19 years, enter Year 1. At the end of Year 3, approximately half continue into the Clinical component in Cambridge. All 1112 students entering the Core Science component (Year 1) and all 542 students entering the Clinical component (Year 4) between 2007 and 2010 were followed-up annually. Students were invited to participate in a longitudinal study comprising annual

questionnaire surveys. Students entering the Clinical component in 2010 comprised those students who had entered the Core Science component in 2007 and who remained in Cambridge.

Outcome Measure

We measured depression using the depression subscale (HADS-D) of the Hospital Anxiety and Depression Scale.[27] HADS is a self–report instrument initially developed to evaluate the presence and severity of anxiety and depression in general medical populations. It is regarded as a useful tool for identifying those with emotional distress and has good psychometric properties.[28,29] HADS-D has been widely used in the UK among members of the general population,[30] among young adults within the general population,[31] with undergraduates,[32,33] medical students,[16,34,35] and medical practitioners.[36,37]

HADS-D comprises seven items expressed both positively and negatively, giving a maximum score of 21. It has widely recognised norms relating to depression: scores of 0-7 are regarded as "normal", scores of 8-10 indicate "possible" depression and scores of 11 and over indicate "probable" depression. The HADS-D norm of greater than or equal to 8 has been shown to have a sensitivity of 0.82 (95% CI 0.73-0.89) and a specificity of 0.74 (95% CI 0.60-0.84).[29] A study of UK undergraduates comparing results for HADS-D with interview data concluded that the HADS-D scale was a reasonably accurate indicator of depressive conditions in university students at the recommended cut-offs.[38]

Procedures

Students in years 1-5 received questionnaires during the first week of each new academic year (September / October). Students in Year 6 received questionnaires in January of their final year, prior to final examinations in June. We used a paper-based questionnaire for all students in 2007 and 2008 and for Clinical students in 2009. We

used an online questionnaire for Core Science students in 2009 and for all students in 2010 (table 1). Participation was voluntary. Questionnaires were labelled by study number only. A study data manager (who had no access to results) sent one reminder to students after 2 weeks. A small prize was awarded annually by lottery to a small number of participants. The study received approval from the University of Cambridge Psychology Ethics Committee.

Analysis

Overall Approach

We took a HADS-D of greater than or equal to 8 to indicate depression. We set statistical significance at the 5% level ($p<0.05$) for all analyses. Only about half of the Core Science students present in Years 1-3 remained in Cambridge for Years 4-6, yielding small numbers for analysis across all six years (Figure 1). For this reason, we analysed data separately for students from the Core Science and Clinical components. For study questions 1 and 2 (prevalence of depression) we included all students completing questionnaires between 2007 and 2011. For study question 3 (persistence of depression) we included students entering either the Core Science or the Clinical component in 2007, 2008 and 2009, who maintained their participation for all years of their respective course.

Response bias

For study questions 1 and 2, (prevalence of depression) we undertook missing value analyses for men and women separately, using logistic regression to determine whether HADS-D on entry predicted subsequent study participation. Outcome variables were missing values (yes or no) for HADS-D at Years 2 and 3 for students entering year 1 and Years 5 and 6 for students entering year 4. The explanatory variable was HADS-D at Year 1 for Core Science students and Year 4 for Clinical students. We included 'year of course entry' as an explanatory factor, to adjust for student cohort. Students entering

in 2010 were considered to have missing subsequent participation if they did not respond in Year 2 / Year 5. We calculated odds ratios corresponding to the increased risk of non-response for every 1 unit increase in HADS-D at course entry, with 95% confidence intervals for odds ratios and p-values.

For study question 3 (persistence of depression) within each component we undertook separate t tests to examine whether there was any difference in the mean scores of those who maintained their participation and those who did not.

Detailed Analyses

For study question 1 (prevalence of depression) we measured separately for men and women, at each point in the course, mean HADS-D and the proportion with HADS-D scores ≥8 indicating depression. We compared median HADS-D amongst men and women using non-parametric tests (Mann Whitney U tests) and the proportions of men and women whose HADS-D indicated depression (Chi-squared tests).

For study question 2 (prevalence of depression over time) we undertook regression analyses separately for men and women, using a 'Generalised Estimating Equations' (GEE) method. We chose the GEE method because many students had repeated data, the HADS-D scores were skewed, and we did not want to make any full distributional assumptions. The model assumed a general (unstructured) correlation structure. In order to adjust for effect of student year of entry, we included this as an explanatory factor variable. To test the robustness of our model we applied a sensitivity analysis to the outcome variables, removing outliers more than 3 standard deviations away from the mean.

For study question 3 (persistence of depression) we examined separately for men and women the number of occasions on which individual students' HADS-D score indicated depression. Within each component we examined whether the proportions of men and women whose score indicated depression differed (i) on any occasion, (ii) on only one

occasion, or (iii) on more than one occasion. Given the small sample size we used Newcombe's method (39) with R software (40) to calculate differences in independent (i.e. unpaired) proportions together with 95% confidence intervals.

RESULTS

Participants

In total 725 Core Science and 364 Clinical students participated in the study. Table 1 shows the number of entrants to the Core Science and Clinical components for each year of entry (2007-2010) and those participating each year and providing depression data.

Table 1: Number of participating students providing depression scores at each year for each component of the course.

	Core Science Component			
	Participating students in Each Year of Course (% of year group) *(% of female)*			
	Total number of entrants	Year of component		
		Year 1	Year 2	Year 3
Students entering 2007	266 *(52.2%)*	182 (68.4%) *(51.1%)*	142 (53.4%) *(52.8%)*	121 (45.5%) *(53.7%)*
Students entering 2008	283 *(45.8%)*	139 (49.1%) *(58.3%)*	87 (30.7%) *(60.9%)*	78 (27.6%) *(60.2%)*
Students entering 2009	281 *(48.9%)*	156 (55.5%) *(53.2%)*	94 (33.4%) *(53.2%)*	84 (29.9%) *(57.1%)*
Students entering 2010	282 *(46.3%)*	188 (67.0%) *(50.5%)*	107 (37.9%) *(50.5%)*	
Total	1112 *(48.0%)*	665 (59.8%) *(52.9%)*	430 (38.7%) *(53.9%)*	283 (25.4%) *(56.5%)*

	Clinical Component			
	Participating students in Each Year of Course (% of year group) *(% of female)*			
	Total number of entrants	Year of component		
		Year 4	Year 5	Year 6
Students entering 2007	135 *(61.1%)*	102 (75.6%) *(62.7%)*	82(60.7%) *(67.1%)*	76(56.3%) *(67.1%)*
Students entering 2008	135 *(44.3%)*	97(71.9%) *(54.6%)*	70(51.9%) *(58.6%)*	57(42.2%) *(63.2%)*
Students entering 2009	135 *(49.6%)*	70(51.9%) *(46.4%)*	47(34.8%) *(45.7%)*	49 (36.3%) *(45.8%)*
Students entering 2010	137 *(53.3%)*	68(49.6%) *(50.0%)*	63(46.0%) *(55.6%)*	
Total	542 *(52.0%)*	337 (62.2%) *(54.3%)*	262 (48.3%) *(58.0%)*	182 (33.6%) *(59.9%)*

Response Bias

Table 2: Missing value analysis: Logistic regression results presented as odds ratios, 95% confidence intervals and p-values for relationship between HADS-D on entry and subsequent study participation, adjusting for student cohort

Depression (HADS-D)	Men	Women
Core Science component students		
odds ratio (95% CI)	1.05 (0.95 to 1.16)	1.08 (0.99 to 1.18)
p values	p=0.35	p=0.08
Clinical component students		
odds ratio(95% CI)	1.07 (0.91 to 1.25)	0.95 (0.79 to 1.15)
p values	p=0.43	p=0.62

Table 2 shows the results of the missing value analysis for study questions 1 and 2. For students in both components of the course, there was no significant relationship between HADS-D on entry and subsequent study participation. For study question 3, no statistically significant difference in mean HADS-D was found between students who maintained their participation and those who did not (analyses not shown).

Prevalence of Depression amongst men and women (Study question 1)

Table 3 shows, at each point in the course, mean HADS-D and the proportion of students whose HADS-D indicated depression.

Core Science component

Mean HADS-D ranged between 3.34 and 3.49. The proportion of students whose HADS-D scores indicated depression ranged between 5.7% (5.8% among men and 5.7% among women) and 10.6% (14.8% among men and 7.5% among women).

Clinical component

Mean HADS-D ranged between 2.16 and 2.91. The proportion of students whose HADS-D scores indicated depression ranged between 2.7% (3.2% among men and 2.2% among women) and 8.2% (5.6% among men and 10.0% among women).

Table 3 shows comparisons, at each point in the medical course, between median HADS-D amongst men and women (Mann Whitney U tests). There were no significant gender differences in either course component.

Table 3: Mean HADS-D (Standard deviation) and percentages of participants whose HADS-D indicated depression by gender for each year of course within each component. Non-parametric gender comparison of means and Chi-squared gender comparisons of percentages.

	Mean scores			
Year	All Mean (SD)	Men Mean (SD)	Women Mean (SD)	Mann Whitney U
Core science component students				
Yr 1 (n=665/313/352)	3.34 (2.36)	3.22 (2.24)	3.44 (2.47)	p=0.339
Yr 2 (n=429/197/232)	3.49 (2.75)	3.29 (2.77)	3.66 (2.76)	p=0.120
Yr 3 (n=282/122/160)	3.35 (2.85)	3.77 (3.16)	3.04 (2.56)	p=0.062
Clinical component students				
Yr 4 (n=337/157/180)	2.16 (2.08)	2.23 (2.06)	2.10 (2.11)	p=0.474
Yr 5 (n=260/109/151)	2.65 (2.51)	2.82 (2.66)	2.52 (2.40)	p=0.398
Yr 6 (n=182/72/110)	2.91(2.92)	3.08 (2.88)	2.79 (2.96)	p=0.311
	Prevalence			
Year	All % Depression (≥ 8)	Men % Depression (≥ 8)	Women % Depression (≥ 8)	X^2
Core science component students				
Yr 1 (n=665/313/352)	5.7%	5.8%	5.7%	[a] p=0.969
Yr 2 (n=429/197/232)	8.4%	7.1%	9.5%	[a] p=0.376
Yr 3 (n=282/122/160)	10.6%	14.8%	7.5%	[a] p=0.050
Clinical component students				
Yr 4 (n=337/157/180)	2.7%	3.2%	2.2%	[a] p=0.585
Yr 5 (n=260/109/151	5.8%	6.4%	5.3%	[a] p=0.701
Yr 6 (n=182/72/110)	8.2%	5.6%	10.0%	[a] p=0.286

[a] Comparison of men and women in respect of normal HADS-D (score ≤ 7) and HADS-D indicating depression (score ≥ 8)

Table 3 also shows he proportions of men and women whose HADS-D indicated depression (Chi-squared tests). Amongst Core Science component students, significantly more men than women in year 3 recorded HADS-D scores indicating depression, but there were no differences in other years. There were no significant differences between men and women in the Clinical component.

Prevalence of depression amongst men and women over time (Study Question 2)

Table 4 shows the results of the GEE models used in this analysis. These are supported by the finding reported above that missing values were not significantly dependent on initial depression levels (table 2). The time coefficient resulting from a GEE model should be interpreted as representing a population-averaged effect rather than an individual student-level effect.

Table 4: Linear time coefficients resulting from GEE regression analyses on the outcome variable HADS-D, adjusting for student year of entry, presented with 95% confidence intervals.

	Men	Women
Core science component students		
Depression (HADS-D)		
Time coefficients	0.20	-0.11
(95% CI)	(-0.03 to 0.43)	(-0.31 to 0.08)
Clinical component students		
Depression (HADS-D)		
Time coefficients	0.33	0.17
(95% CI)	(0.11 to 0.55)	(-0.04 to 0.39)

All results were similar after removal of outliers more than 3 SD from the mean.

Core Science component

The results indicate no significant difference, amongst either men or women, in HADS-D scores over time. Sensitivity analysis (removal of outliers) produced similar results.

Clinical component

A very small but statistically significant increase in HADS-D over time was found amongst men. No significant difference over time was found amongst women. Sensitivity analysis (removal of outliers) produced similar results.

Persistence of Depression amongst men and women (Study Question 3)

Table 5 shows the prevalence of depression recorded by students who maintained their participation throughout the three years of each course component.

Table 5: Prevalence of depression recorded by repeat participants.

	All	Men	Women	Differences in proportion women-men (95% CI)
Core science component students	n=220 (% of participants)	n=96 (% of participants)	n=124 (% of participants)	
On any occasion	40 (18.2%)	17 (17.7%)	23 (18.5%)	0.008 (-0.10 to 0.11)
On only one occasion	29 (13.2%)	9 (9.4%)	20 (16.1%)	0.07 (-0.03 to 0.15)
On more than one occasion	11 (5.0%)	8 (8.3%)	3 (2.4%)	-0.06 (-0.13 to 0.001)
Clinical component students	n=150 (% of participants)	n=59 (% of participants	n=91 (% of participants	
On any occasion	16 (10.6%)	5 (8.5%)	11 (12.1%)	0.04 (-0.08 to 0.13)
On only one occasion	8 (5.3%)	3 (5.1%)	5 (5.5%)	0.004 (-0.09 to 0.08)
On more than one occasion	8 (5.3%)	2 (3.4%)	6 (6.6%)	0.03 (-0.06 to 0.11)

Core Science component

Amongst the 96 men and 124 women who maintained their participation, 40 students (17 men and 23 women) recorded at least one HADS-D score indicating depression. Of these, 29 (9 men and 20 women) did so on only one occasion; 9 (6 men and 3 women) did so on two occasions. Two men recorded scores indicating "possible" depression throughout the Core Science course component.

Clinical component

Amongst the 59 men and 91 women who maintained their participation, 16 students (5 men and 11 women) recorded at least one HADS-D score indicating depression. Of these, 8 (3 men and 5 women) did so on one occasion; 6 (all women) did so on two

occasions. Two men recorded scores indicating "possible" depression throughout the Clinical course component.

Table 5 also shows the results of comparisons between men and women in respect of transitory or persistent depression. There were no significant gender differences in either course component.

DISCUSSION

Amongst groups of male and female medical students in Cambridge, the prevalence of depression varied from 2.2% to 14.8%. No significant changes in mean depression scores were observed amongst Core Science component students or amongst women in the Clinical component. A statistically significant increase in mean depression scores was found for men during the Clinical component. However, this increase was extremely small when considered against the 21 points of the HADS-D scale. Most students who demonstrated depression during the Core Science component did so on only one occasion. In the Clinical component, although few students experienced depression, half did so on more than one occasion. We found no evidence that women were more likely than men to experience depression, either on one occasion or persistently.

Our study obtained data on depression from students in all 6 years of medical training. In the Core Science component, for each year of the course between 25.4% and 59.8% of those eligible participated. Comparable figures for the Clinical component were 33.6% to 62.2%. Almost 27% of Core Science students and 37% of Clinical students entering between 2007 and 2009 participated on all occasions during their respective course components, allowing longitudinal observations to be made. These participation rates, allied with missing data analyses indicating that initial scores did not predict later non-response, support the generalisability of our results to the population of medical

students at the University of Cambridge. Where possible these results are related to existing literature using HADS-D in order to allow direct comparison.

Mean HADS-D scores recorded by students in our study ranged from 2.16 (SD 2.08) for Clinical students in year 4 of the course, to 3.49 (SD 2.75) for Core Science students in year 2. These are roughly similar to mean scores reported for comparable groups: scores from 2.68 to 7.5 for medical students elsewhere,[17,19,34] and from 2.33 to 5.2 for non-medical undergraduate populations.[41- 43]

Mean scores may not reflect the prevalence of significant depression. Using the HADS-D score of ≥8, we found the prevalence of depression ranged from 2.7% for Clinical students in year 4 of the course, to 10.6% for Core Science students in year 3. Prevalence of depression using a similar cut-off score amongst comparable groups has been found to vary from 9.5% to 29% for medical students,[16,17,19] and from 3.8% to 18% for non-medical undergraduates.[38,41] Studies in the general population in Norway and the UK have reported a prevalence of 8% and 12% respectively,[30,44] whilst a study of people aged 18-25 reported a prevalence of 12% amongst men and 18% amongst women.[31] Our results suggest that Cambridge medical students do not have a higher prevalence of depression than students in general or comparable non-student members of the general population. Other work, investigating the suicide rate amongst students at the University of Cambridge over the period 1970-1996 also found that rates were similar to comparable age groups in the general population.[45]

Although studies involving similarly aged members of the general population have reported a higher prevalence of depression amongst women compared to men,[31,44] we found no significant gender differences in either mean HADS-D or prevalence of depression in any year of the course. This replicates previous findings using the HADS with other undergraduates including medical and dental students.[46,47]

Turning to the question of whether psychological well-being deteriorates during university medical education a UK study of non-medical undergraduates found a significant increase in the proportion recording depression between the period immediately prior to the start of the course and the middle of the second academic year.[33] Few studies have examined the persistence of depression within individual students over time. In our study, regression analyses indicated no significant change for either men or women throughout the equivalent Core Science component of the course. Analysis of students in the Clinical component indicated a very small increase in mean scores for depression for men but not for women. These minor increases in mean depression scores may be related to the approach of finals examinations, or they may presage the known increase in depression seen amongst practising doctors.

For many students, the experience of depression was transient. Among repeat participants, 40 Core Science and 16 Clinical students recorded HADS-D scores indicating depression at some point. Of these 56 students, 37 did so on only one occasion. Nevertheless, 19 students (11 Core Science and 8 Clinical) showed evidence of repeated depression, with four men (2 in each component of the course) doing so in all three years of their respective course component. We found no significant difference in transient or persistent raised levels of depression between men and women.

The authors are not aware of any other studies using HADS-D of medical students against which to set these particular findings. However, their key implication is that whilst overall persistence of depression is low, there exists a small, important minority of students for whom depression is an ongoing experience. It is vital for medical schools to recognise and support all students experiencing depression, but in particular to consider how best to encourage this especially vulnerable group to seek help, given the evidence that suggests that they are reluctant to do so.[1,26,48,49]

The HADS-D is a well validated and widely used self-report instrument. The procedures for administering the survey were created to ensure anonymity and confidentiality.[50] This study is limited by being based on one UK university, providing a "traditional" course with a collegiate pastoral support structure. There may have been a systematic difference between those participating and those not participating (i.e. a non response bias) which may have affected our results. However, the missing value analysis supports the view that those continuing to participate could be considered representative of all student entrants in their year group and that continued participation was not influenced by scores for HADS-D recorded at the beginning of participation. We cannot exclude the possibility of an association between an unobserved change in depression and the missing values.

We tested for a linear relationship between year of course and depression which rests on the assumption that depression increases or decreases gradually over time. In reality this may not have been the case: mean scores could rise during one year and then decline during the next year. Unfortunately our sample size was too small and number of time points too few to test for quadratic or other polynomial relationships between individual course years and depression, but future studies may like to consider this. Future work should investigate the generalisability of these results to other medical schools in the UK and, in order to extend the relevance of findings to future patient care, the relationship between depression during undergraduate medical education and "burnout" after qualification. Further work is needed on identifying both transient and repeated experiences of depression among medical students and understanding possible causes related to course design and students' experience of it. For example, studies of students have found depressive symptoms to be related to prior mental health problems,[49] personality aspects such as maladaptive perfectionism,[51]and strong feelings of altruism and empathy.[52]

CONCLUSIONS

Overall, only a small proportion of the student body experienced depression. These findings do not support the view that medical students exhibit a higher prevalence of depression than other comparable groups or that differences in mean depression score or prevalence exist between men and women. Nevertheless, depression may start to become more prevalent as medical qualification approaches and a small number of students who experience depression do not recover from one year to the next. It is important that mechanisms should be in place to identify and support all students suffering from depression, but particularly the very few with persistent low mood. As part of this process, it remains important to challenge the stigma of mood disorder amongst health professionals to encourage students experiencing difficulty to seek and receive appropriate help.

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COMPETING INTERESTS STATEMENT

All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years; no other relationships or activities that could appear to have influenced the submitted work.

CONTRIBUTORSHIP STATEMENT

TQ, JB and DW were responsible for the conception and design of the study. TQ coordinated the study and managed the data collection. TQ and RP did the analyses, JB and DW contributed to interpretation of the findings. TQ wrote the first draft of the

manuscript. All authors had full access to all data and all were involved in critical revision of the manuscript.

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ETHICAL APPROVAL

The study was approved by the University of Cambridge Psychology Ethics Committee.

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1✓	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
	✓	(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2 ✓	Explain the scientific background and rationale for the investigation being reported
Objectives	3✓	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4✓	Present key elements of study design early in the paper
Setting	5✓	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6✓	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7✓	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*✓	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9✓	Describe any efforts to address potential sources of bias
Study size	10✓	Explain how the study size was arrived at
Quantitative variables	11✓	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12✓	(*a*) Describe all statistical methods, including those used to control for confounding
	✓	(*b*) Describe any methods used to examine subgroups and interactions
	✓	(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
	✓	(*e*) Describe any sensitivity analyses

Continued on next page

Results		
Participants	13*✓	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*✓	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*✓	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results	16✓	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17✓	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18✓	Summarise key results with reference to study objectives
Limitations	19✓	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20✓	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21✓	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22✓	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Dear Dr. Quince

MED-2012-0224
Depression among undergraduate medical students at one UK medical school.

Thank you for submitting your paper to Medical Education. I read it with great interest but I am afraid I am not able to offer publication.

With such a substantial literature already outlining the prevalence of depression and other clinical issues amongst medical students as well as examining which variables relate to prevalence rates it is difficult to discern what substantive advance is offered by the findings included in this report.

As you will appreciate we receive many more papers than we can accept and have to make some careful decisions about what to publish. This means making some difficult decisions based on originality, importance and academic rigour. I am sorry we cannot find space for your paper.

Thank you for giving us the opportunity to consider your work. Despite this disappointing outcome, I wish you every success with your continued research and educational activities.

Yours sincerely,

Dr Kevin Eva
Editor in Chief
Medical Education