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Amy M Fahrenkopf, Theodore C Sectish, Laura K Barger, Paul J Sharek, Daniel Lewin, Vincent W Chiang, Sarah Edwards, Bernhard L Wiedermann and Christopher P Landrigan

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Rates of medication errors among depressed and burnt out residents: prospective cohort study

Amy M Fahrenkopf,[1] Theodore C Sectish,[2] Laura K Barger,[3] Paul J Sharek,[2] Daniel Lewin,[4] Vincent W Chiang,[1] Sarah Edwards,[3] Bernhard L Wiedermann,[4] Christopher P Landrigan[1,3]

EDITORIAL by McLay and Ross

[1]Harvard Medical School, Department of Medicine, Children's Hospital Boston, Boston, MA 02115, USA
[2]Stanford Medical School, Lucile Packard Children's Hospital, Palo Alto, CA, USA
[3]Division of Sleep Medicine, Brigham and Women's Hospital, Boston, MA, USA
[4]George Washington University Medical School, Children's National Medical Center, Washington, DC, USA
Correspondence to: A M Fahrenkopf
amy.fahrenkopf@tch.harvard.edu

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ABSTRACT

Objective To determine the prevalence of depression and burnout among residents in paediatrics and to establish if a relation exists between these disorders and medication errors.

Design Prospective cohort study.

Setting Three urban freestanding children's hospitals in the United States.

Participants 123 residents in three paediatric residency programmes.

Main outcome measures Prevalence of depression using the Harvard national depression screening day scale, burnout using the Maslach burnout inventory, and rate of medication errors per resident month.

Results 24 (20%) of the participating residents met the criteria for depression and 92 (74%) met the criteria for burnout. Active surveillance yielded 45 errors made by participants. Depressed residents made 6.2 times as many medication errors per resident month as residents who were not depressed: 1.55 (95% confidence interval 0.57 to 4.22) compared with 0.25 (0.14 to 0.46, P<0.001). Burnt out residents and non-burnt out residents made similar rates of errors per resident month: 0.45 (0.20 to 0.98) compared with 0.53 (0.21 to 1.33, P=0.2).

Conclusions Depression and burnout are major problems among residents in paediatrics. Depressed residents made significantly more medical errors than their non-depressed peers; however, burnout did not seem to correlate with an increased rate of medical errors.

INTRODUCTION

Depression and burnout are highly prevalent among house officers worldwide and across specialties, possibly as a result of the stresses of resident training, such as sleep deprivation.[1-8] According to the Institute of Medicine, between 44 000 and 98 000 patients die each year in the United States as a result of medical errors,[9] and over 400 000 preventable adverse drug events may occur.[10] Adverse events are also common in the United Kingdom, occurring in more than 10% of hospital admissions; as many as half of these adverse events might have been preventable.[11] A few studies have examined the relation between burnout in residents and self reported medical errors,[1-13] but this relation has not been validated. Similarly, the relation between depression and medical errors has not been quantified systematically. We determined the prevalence of depression and burnout in residents and whether a relation exists between these disorders and medication errors.

METHODS

The study was advertised to residents in both paediatrics and medicine-paediatrics at the Children's Hospital Boston in Boston, Massachusetts; the Lucile Packard Children's Hospital in Palo Alto, California; and the Children's National Medical Center in Washington, DC. Participants were aware that we were collecting data on their health, safety, and performance. Precautions were taken to secure confidentiality, including the assignment of coded identification numbers. Participants were assured that only investigators would have access to the code key and that they would face no disciplinary action for any errors detected. They were also informed that the only instance in which confidentiality would be broken would be if they showed suicidal or homicidal ideation.

Participants logged their daily work and hours of sleep from mid-May through to the end of June 2003. They also completed a validated questionnaire on their health, quality of life, and self reported medical errors.[14-16] We used two screening tools—the Harvard national depression screening day scale[17] and the Maslach burnout inventory[18]—to assess the prevalence of depression and burnout. Burnout is a syndrome of mental exhaustion and personal detachment in response to chronic occupational stress. It differs from depression in that the symptoms affect the individual's relation to work and usually spare their personal life. The Maslach burnout inventory measures three components of burnout: emotional exhaustion, depersonalisation, and personal achievement. We defined participants as being depressed if they scored more than 9 on the depression scale and as being burnt out if they had a "high" combined score for emotional exhaustion (≥27) and depersonalisation (≥10) on the burnout inventory. We considered participants not to be depressed who reported a history of depression or who were being treated for depression but did not score more than 9 on the depression scale.

We were unable to collect data on medication errors that could be linked to participants at the Children's National Medical Center and therefore we excluded the centre from this facet of the study. A team of trained nurses and doctors collected data on medication errors using standardised methods.[19] They collected daily reports of medication errors that occurred on the wards from clinical staff and reviewed all charts and medication orders using structured data forms. The data extractors were unaware of the specific aims of the study or the status of the participants for depression or burnout. For each suspected medication error they

recorded a description of the event and whether the error involved a participant. Blinded reviewers (AMF and CPL) independently categorised incidents as adverse events, potential adverse events, or errors with little potential for harm (see bmj.com for definitions). Adverse events were further deemed preventable or non-preventable.

Statistical analysis

We used Fisher's exact tests to compare categorical responses of depressed and burnt out residents with those of their counterparts. Multivariate logistic regression analyses were then done controlling for sex, race, age, marital status, postgraduate year, and site of residency. Statistical tests were two tailed; we considered P values less than or equal to 0.05 to be significant.

Using a cluster adjusted Poisson analysis we compared the number of errors attributable to the different subpopulations (depressed *v* non-depressed residents and burnt out *v* non-burnt out residents) per resident month (four weeks). We determined confidence intervals and P values using the cluster analysis.

RESULTS

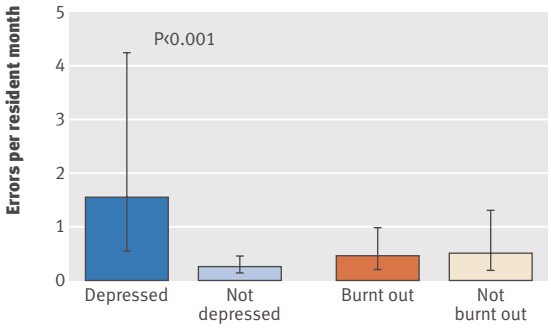
Overall, 123 of 246 eligible residents (50%) participated. No statistical difference was found between age, sex, or postgraduate year for participants (see bmj.com) and non-participants. In total, 125 errors were identified on review of 10 277 orders (error rate 1.2%). Participants wrote 6078 orders, with 45 errors (error rate 0.7%): 0 for adverse drug events, 28 for potential adverse drug events, and 17 for errors with little potential for harm (see bmj.com for examples of errors).

Depression

On the basis of scores on the Harvard national depression screening day scale 20% (n=24) of residents were at high risk for depression; 26% (n=7) of whom had a history of clinical depression. Eleven participants were taking antidepressants at the time of the study, three of whom screened positive for depression. No association was found between depression and age, sex, year of residency, ethnicity, marital status, or sleep and work hours.

On active surveillance at two of the sites the medication errors per resident month for depressed residents was 1.55 (95% confidence interval 0.57 to 4.22) and for non-depressed residents was 0.25 (0.14 to 0.46, P<0.001; figure). The cohort of 19 depressed residents made 24 errors (0 preventable adverse drug events, 12 potential adverse drug events, and 12 errors with little potential for harm) and the cohort of 82 non-depressed residents made 21 errors (0 preventable adverse drug events, 16 potential adverse drug events, and 5 errors with little potential for harm). See bmj.com for the total error count per resident and residents' self reports of medical errors.

Depressed residents were significantly more likely to report their health as poor (17% (n=4) *v* 4% (n=4), P=0.05), working in an impaired condition more than twice in the previous month (44% (n=10) *v* 20% (n=19), P=0.03), and difficulty concentrating at work (70% (n=16) *v* 38% (n=37), P<0.01; see bmj.com). Overall, 96% (n=23) of residents who met the criteria for depression also met the criteria for burnout.



Rates of medication errors per resident month for depressed compared with non-depressed residents and for burnt out compared with non-burnt out residents. T bars indicate 95% confidence intervals. P value determined using Poisson cluster analysis

Burnout

Ninety two residents (75%) met the criteria for burnout. Of these, 23 (25%) also met the criteria for depression. No association was found between burnout and age, sex, year of residency, ethnicity, marital status, or sleep and work hours.

Rates of errors per resident month detected on active surveillance did not differ significantly between burnt out and non-burnt out residents: 0.45 (0.20 to 0.98) compared with 0.53 (0.21 to 1.33, P=0.4; figure). Burnt out residents were significantly more likely to report making a "significant" error over the previous three months as a result of sleep deprivation: 29% (n=26) *v* 10% (n=3), P=0.05 (see bmj.com). They also reported a higher mean number of errors over the previous month (2.3 *v* 1.0, P=0.02).

Burnt out residents were significantly more likely to report difficulty concentrating on work (57% (n=51) *v* 7% (n=2), P<0.001) and concern about being depressed (37% (n=34) *v* 16% (n=5), P=0.04; see bmj.com).

DISCUSSION

In this tricentre study 20% of residents were depressed and 75% were burnt out. On active surveillance those who were depressed made more than six times as many errors in medication as their non-depressed peers. Furthermore, those who were depressed or burnt out reported poorer health and higher error rates than those who were not burnt out or depressed.

The prevalence of depression in our cohort of residents was nearly twice that expected in the general population[20] and was near the mid-point of previously reported rates of depression among residents (range 7%-56%).[1 2 12] Given the infrequency with which residents reported a history of depression, it seems residency itself may be associated with the onset of depression in a sizeable number of residents. Other authors have suggested that the commission of errors may itself lead to depression, making doctors a "second victim" in an apparent vicious cycle.[13 21] Nearly half of the depressed residents seemed unaware of their depression, and only a small number were receiving treatment.

Burnout had no objectively measurable association with medication errors. This is important, as burnt out residents reported making significantly more medical errors than their non-burnt out colleagues in several studies, including our own. It is difficult to determine whether non-burnt out residents underestimate their error rates or whether burnt out residents overestimate theirs or make an increased number of error types that were not captured in this study. As in other studies, nearly all the depressed residents were burnt out.[1-12]

Our study has several limitations. To do our statistical analysis assuming a Poisson distribution we had to make two assumptions: that the resident workload was evenly distributed across the subpopulations and that the depressed or burnt out residents were evenly distributed across the studied wards. We have data that support the first assumption from the resident work logs, showing no statistically significant difference in sleep or work hours between the subpopulations of residents. For the second assumption it is highly unlikely that such a chance distribution could explain the differences observed, given the magnitude of difference observed between depressed and non-depressed groups. We did consider the possibility that one or two outliers could be responsible for the higher error rate among depressed residents. On review of the data, errors were fairly evenly distributed across resident groups, with the exception of one resident responsible for 11 errors, who was burnt out and depressed. We undertook a cluster adjusted analysis to tackle this problem. In addition, we reanalysed our data in a sensitivity analysis to see if our primary results changed if this resident was excluded and found that although the number of errors per resident month was reduced for both depressed and burnt out residents, the statistically significant differences between them persisted. The difference between burnt out and non-burnt out residents also remained unchanged, with no statistically significant difference.

Secondly, this study focused on residents in paediatrics, so the manner in which depression and burnout may affect staff in other specialties is unclear. Thirdly, we were unable to use data on errors from one of our three sites (Children's National Medical Center), as the data were collected without the coded identifiers allowing us to link errors to specific residents. Although we had sufficient power to show a significant link between depressed residents and medication errors with data from two centres, the additional data would have improved the robustness of the study. Fourthly, we collected our data before the implementation of any work hour limits for residents in the United States. Although the link between depression and medical errors is unlikely to be affected by the change, the prevalence of mental health disorders could possibly have been affected by this intervention. Lastly, whereas the number of residents who volunteered to participate in this study was high, and although personal data suggest that our population of residents was typical of American paediatric residents,[22] our population may have differed from the national cohort of residents in certain non-measurable respects. Participants signed informed consent and were aware that we were collecting data on work hours, mental health, and medication errors, but they were not aware of the specific hypothesis of this study. Thus we have no reason to believe that they would have chosen to participate or not on the basis of whether they were depressed or burnt out, and data on errors were collected by investigators blinded to the residents' depression and burnout status.

This study raises important ethical concerns. Twenty four participants were found to be at high risk of major depression yet, as none of them expressed active suicidal or homicidal ideation, they could not be approached and encouraged to seek treatment owing to the confidentiality agreement. The presence of significant numbers of depressed residents on the paediatric wards, committing medical errors at a high rate, is a concern.

Mental health problems affect quality of life and lead to loss of productivity in the workplace. Depressed healthcare providers may also put patients at risk of unintentional harm.

We thank the residents for their time and the nurses and doctors who helped us in our efforts to collect the data.
Ethical approval: This study was approved by the institutional review boards at the three participating hospitals.
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Competing interests: None declared.
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WHAT IS ALREADY KNOWN ON THIS TOPIC

Depression and burnout are highly prevalent in doctors in training

Burnout is associated with a higher rate of self reported errors among residents

WHAT THIS STUDY ADDS

Depressed residents in paediatrics were more than six times as likely to make errors in medication as their non-depressed colleagues

Burnout did not seem to be associated with higher rates of medication errors

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Effectiveness of the diabetes education and self management for ongoing and newly diagnosed (DESMOND) programme for people with newly diagnosed type 2 diabetes: cluster randomised controlled trial

M J Davies,[1] S Heller,[2] T C Skinner,[3] M J Campbell,[4] M E Carey,[5] S Cradock,[6] H M Dallosso,[5] H Daly,[7] Y Doherty,[8] S Eaton,[8] C Fox,[9] L Oliver,[8] K Rantell,[4] G Rayman,[10] K Khunti,[10] on behalf of the Diabetes Education and Self Management for Ongoing and Newly Diagnosed Collaborative

EDITORIAL by Dinneen

[1]Department of Cardiovascular Sciences, University of Leicester, Leicester LE1 5WW
[2]Academic Unit of Diabetes, Endocrinology and Metabolism, University of Sheffield Medical School
[3]School of Health and Related Research, University of Sheffield
[4]DESMOND Programme, Diabetes Research Team, University Hospitals of Leicester NHS Trust, Leicester
[5]Diabetes Research Team, University Hospitals of Leicester NHS Trust, Leicester
[6]Diabetes Resource Centre, Northumbria Healthcare NHS Foundation Trust, Tyne and Wear
[7]Northampton General Hospital, Northampton
[8]Ipswich Diabetes Service, Ipswich General Hospital NHS Trust, Suffolk
[9]School of Psychology, University of Wollongong, Australia
[10]Department of Health Sciences, University of Leicester, Leicester General Hospital

Correspondence to: M J Davies
melanie.davies@uhl-tr.nhs.uk

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ABSTRACT

Objective To evaluate the effectiveness of a structured group education programme on biomedical, psychosocial, and lifestyle measures in people with newly diagnosed type 2 diabetes.

Design Multicentre cluster randomised controlled trial in primary care with randomisation at practice level.

Setting 207 general practices in 13 primary care sites in the United Kingdom.

Participants 824 adults (55% men, mean age 59.5 years).

Intervention A structured group education programme for six hours delivered in the community by two trained healthcare professional educators compared with usual care.

Main outcome measures Haemoglobin A_{1c} levels, blood pressure, weight, blood lipid levels, smoking status, physical activity, quality of life, beliefs about illness, depression, and emotional impact of diabetes at baseline and up to 12 months.

Main results Haemoglobin A_{1c} levels at 12 months had decreased by 1.49% in the intervention group compared with 1.21% in the control group. After adjusting for baseline and cluster, the difference was not significant: 0.05% (95% confidence interval −0.10% to 0.20%). The intervention group showed a greater weight loss: −2.98 kg (95% confidence interval −3.54 to −2.41) compared with 1.86 kg (−2.44 to −1.28), P=0.027 at 12 months. The odds of not smoking were 3.56 (95% confidence interval 1.11 to 11.45), P=0.033 higher in the intervention group at 12 months. The intervention group showed significantly greater changes in illness belief scores (P=0.001); directions of change were positive indicating greater understanding of diabetes. The intervention group had a lower depression score at 12 months: mean difference was −0.50 (95% confidence interval −0.96 to −0.04); P=0.032. A positive association was found between change in perceived personal responsibility and weight loss at 12 months (β=0.12; P=0.008).

Conclusion A structured group education programme for patients with newly diagnosed type 2 diabetes resulted in greater improvements in weight loss and smoking cessation and positive improvements in beliefs about illness but no difference in haemoglobin A_{1c} levels up to 12 months after diagnosis.

Trial registration Current Controlled Trials ISRCTN17844016.

INTRODUCTION

Several programmes have been developed in Europe[1 2] and North America[3] to educate patients about diabetes. The National Institute for Health and Clinical Excellence (NICE), however, found little evidence in the United Kingdom for the effectiveness of any educational approach in such patients,[4] a view reinforced in several reviews.[5 6] Evidence shows that education programmes with a theoretical basis and using cognitive reframing can improve outcomes.[7 8] Few programmes have been developed in a primary care setting and none has been designed specifically for patients from diagnosis.

We carried out a randomised controlled trial of the diabetes education and self management for ongoing and newly diagnosed (DESMOND) structured education programme. The preliminary phases of the trial are described elsewhere.[9] We evaluated the