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Research Article

Depression Symptoms and Risk Factors in Adult Emergency Department Patients: A Multisite Cross-Sectional Prevalence Survey

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Objectives. To identify the proportion of adult emergency department (ED) patients who screen positive for depression. Secondary aims were to identify factors associated with a positive depression screen and determine predictors of a positive depression screen. *Methods*. This cross-sectional, prevalence survey of ED patients was conducted at two inner-city hospitals. 350 ED patients were screened for depression using the Patient Health Questionnaire-9 (PHQ-9). Clinical and demographic risk factors were examined through medical records and additional questionnaires. *Results*. Of 350 participants screened, 50 (14.3%; 95% CI = 11.0–18.4%) screened positive. Independent predictors of depression risk included self-reported depression and/or a previous diagnosis of depression (OR = 8.345; 95% CI = 3.524–19.762), seeing a mental health service provider in the past 6 months (OR = 4.518; 95% CI = 2.107–9.690), and previous discussion about mental health with a local doctor (OR = 2.369; 95% CI = 1.025–5.475). *Conclusion*. ED patients were found to be at a higher risk of depression than the general population. ED-based depression screening, particularly of high-risk populations, has the potential to increase case detection rates and allow earlier management of these patients. Further research and validation of an ED-based depression screening tool are required.

1. Introduction

It is important to detect depression in the emergency department (ED). Depression may contribute to the clinical presentation via self-harm or somatisation; it may be an important focus for post-ED care, and even though its management is not usually the responsibility of the ED, ED staff can have an important role in informing patients of the nature of their problem and engaging them in appropriate care; and, like all health care sectors, the ED can contribute to the public health task of detecting depression, which is known to be widely underrecognised and undertreated. In detecting depression, the clinical assessment is primary, but screening using validated depression rating scales is an important complementary method.

Depression is highly prevalent in the general population but almost certainly of greater prevalence in the ED population. In the general population, depression is the second leading cause of disability worldwide [1], a significant risk factor for suicide [1], and associated with increased comorbidity and mortality [2, 3], decreased adherence to medication and treatment [4], higher healthcare utilization and costs [4], and reduced quality of life [5]. In Australia, depression prevalence in adults is approximately 6% [6], with many more undetected [6]. Lifetime prevalence is reportedly 20% [7]. There are good reasons to expect rates to be higher in the ED population [8–12], with higher rates of risk factors and comorbidities [8, 11–13]; advancing age; and higher levels of pain, substance abuse, and rates of self-harm [8, 11–13].

In line with such expectations, internationally, one-fifth to one-third of the ED adult population screens positive for depression [8–11, 13]. However, prevalence data for Australian EDs are scarce as are studies of this problem generally. One study documented that 20% of participants reported feelings of anxiety or depression [14]. Around 3–5% of annual ED presentations across Australia are mental health related [15, 16], and 76% of patients with depressed mood had a history of at least one visit to the ED every six months [17]. Approximately 12% of ED patients who were depressed reported a past suicide attempt [9]. This is important given the repeated finding that nearly 75% who die by suicide have seen a medical professional in the last year of their life (including medical professionals in the ED setting) [18]; however, less than a third received mental health treatment [18].

Currently, most Australian EDs lack a specific routine depression screening protocol, with mental health assessments geared toward those presenting with an overt mental health complaint rather than towards those with primarily a physical complaint. Tools validated specifically for ED-based depression screening are unavailable. Without routine screening procedures, depression is poorly detected by ED physicians unless patients present with depression or suicidal ideation as the chief complaint [12, 17]. Consequently, underlying depression often goes undetected and untreated, as ED staff are accustomed to an acute medical focus, dealing with physical demands first [19].

ED-based depression screening appears warranted. Screening for depression among these high-risk individuals may augment clinical assessment, allowing for proper and early referral to general practitioners and/or specialist mental health services for further definitive management. Early treatment of depression may reduce or avert the development or progression of associated comorbid conditions, thereby reducing the burden of disease on patients and the healthcare system.

Prior to implementing depression screening and referral programmes in the ED, it is important to know the prevalence of the disorder in this setting. Thus the primary aim of this initial study was to estimate the prevalence of Australian ED patients at risk of having depression. Secondary aims were to compare the estimated proportion to that reported for the general population, to identify associated clinical and demographic risk factors for depression, and to determine variables predictive of a positive screen in this population.

2. Methods

2.1. Study Design, Setting, and Ethics Approval. A multisite cross-sectional prevalence survey of depression risk in adult ED patients was undertaken in the EDs of two metropolitan adult tertiary referral hospitals in Melbourne, Australia. The population of one hospital is culturally diverse and socially disadvantaged, with high rates of drug and alcohol use among patients, while the other participating site is a major trauma centre. These EDs receive approximately 40,000 and 58,000 annual attendances, respectively. Ethics approval was obtained from the Human Research Ethics Committees of each hospital. A condition of ethics approval was that patients with deliberate self-harm be excluded.

2.2. Participants

Inclusion Criteria. Patients presenting to the EDs at either of the two participating sites during the sampling period were eligible to participate.

Exclusion Criteria. Patients aged less than 18, unable to adequately communicate in English, cognitively impaired, or medically unstable were excluded. Patients who were agitated, intoxicated, adversely affected by drugs, or who presented with self-harm were excluded to avoid exacerbation of acute behavioural disturbance or self-harm.

2.3. Measurement Instruments

Patient Health Questionnaire (PHQ). The Patient Health Questionnaire-9 (PHQ-9) consists of nine items and is used as a diagnostic and severity measure for depression in primary care [20]. Items cover five categories: depressed mood; fatigue; worthless guilt; concentration and agitation; and suicidal ideation. Patients rate symptoms occurring in the past two weeks on a four-point scale: not at all (0), several days (1), more than half the days (2), and nearly everyday (3). Item scores are summed and categorized into negative (0–4), mild depression (5–9), moderate depression (10–14), moderately severe depression (15–19), and severe major depression (20 or more) [20]. Patients with major depression rarely score less than 10 [20], and thus a score of 10 or more was considered *a priori* as a positive screen. At this cutoff, the PHQ-9 has a sensitivity of 88% and specificity of 88% for major depression in a primary care setting and a positive likelihood ratio of 7.1 [20, 21]. The PHQ-9 has high diagnostic accuracy for major depression, with an area under curve (AUC) value of 0.95, and for any depressive disorder an AUC of 0.90 [22].

Self-Administered Comorbidities Questionnaire (SCQ). The Self-Administered Comorbidities Questionnaire (SCQ) is a 14-item measure of comorbidity [23] with high test-retest reliability and moderately strong associations with a standard medical record-based comorbidity measure ($r = 0.55$) [23]. It embodies 13 common medical conditions, with an additional item allowing respondents to list unspecified conditions. Participants rated presence of disease (yes/no). Each item was analysed separately.

Personal and Family History Questions. A researcher-devised 14-item question series on personal and family history was administered to determine participants' mental health history and risk factors, which was used in analysis for predictors of depression risk. A binary response format (yes/no) was used for personal history items (previous diagnoses of mental health problems; current use of antidepressants; utilisation of mental health services; and alcohol and tobacco use). For items related to family history of mental health, the response format was multicategory (yes/no/not sure). This tool has not been previously validated.

2.4. Sample Size. The primary outcome was the proportion of participants screening positive. The prevalence of depression risk in ED patients was expected to be higher than the general population (6%) [6], due to higher prevalence and levels of risk factors [11–13]. Based on data which indicated a depression risk prevalence of 32% in ED patients [8, 9], the maximum prevalence of depression risk in ED patients was anticipated to be 35%. A sample size of 350 was required to estimate a depression risk prevalence of 35% to a confidence interval of 95% and a margin of error of 5% [24]. This sample size was also calculated as being sufficient to detect a minimum of an 11% difference between two groups with power set at 80% and alpha set at 0.05. Using the standard rule of thumb of 10 cases per predictor, a sample of 350 permitted the inclusion of up to 12 variables in multiple logistic regression analyses.

2.5. Sampling. The proportion of participants recruited from each ED was adjusted to reflect the differing annual attendance rate at each ED for the preceding 12 months. Quota sampling was used whereby patients were recruited according to clinical acuity using the Australasian Triage Scale (ATS). The percentage of patients recruited reflected the distribution in each triage category for each hospital in the preceding 12 months. This sampling strategy ensured a sample representative of the population in terms of acuity.

Sampling was undertaken by a single researcher from 11/10/2010 to 31/3/2011, between the hours of 9:00 a.m. and 6:00 p.m., and included weekdays and weekends. It was logistically unrealistic to recruit a consecutive sample. Once the quota for each triage category was reached, sampling ceased.

2.6. Procedure. Patients attending either ED during the sampling period were considered for recruitment. For those aged over 18, their eligibility and capacity to consent according to the inclusion and exclusion criteria were determined by the treating clinician. Eligible patients were approached by the researcher, who provided a patient information, consent form, and a verbal explanation of the study. Consenting participants were administered, in order, by the PHQ-9, SCQ, and personal and family history questions.

Participants scoring 10 or more on the PHQ-9 were deemed to have screened positive (primary outcome). The treating doctor was advised of participants that screened positive and determined treatment needs and management (including referral). Where possible, the researcher notified the participant's preferred local doctor of the positive screen via letter.

Further clinical and demographic data were retrieved through electronic medical records allowing collection of age; sex; marital status; country of birth; socioeconomic status (pension/health care card holder); mode of arrival; ATS code; presenting complaint; discharge diagnosis; further admission; and ED length of stay.

2.7. Data Analysis. Data were analysed using Predictive Analytics Software (PASW) Statistics 18 (Chicago, IL). The frequency and percentage (95% CI) of participants scoring in each classification group were calculated. The prevalence of positive screens in the sample population and the prevalence of depression in the general population as documented in the literature [25] were compared using the Z-test for independent proportions. Frequencies and percentages were calculated for clinical and demographic data, with the exception of continuous variables which were summarized using median (IQR) after assessing normality.

Clinical and demographic variables associated with a positive screen on each PHQ scale were explored using Fisher's exact test (for two-by-two contingency tables), Pearson's chi square test, or the Mann-Whitney U test (for continuous data which violated normality).

Variables identified as having significant associations with depression risk on univariate analyses ($P < 0.05$) were tested for intercorrelations prior to inclusion in backward stepwise logistic regression analyses. Variables were only included in the model when the correlation was $r < 0.7$. Eleven variables were entered in the final analysis where the probability for inclusion was 0.05 and the probability for exclusion of variables was 0.10. Odds ratio (95% CI) and goodness of fit are reported for the final model.

Table 1: Distribution of patients excluded from the study.

Reason for exclusion	n	%
Agitated	17	2.0
Altered consciousness or cognitive impairment	133	16.0
Affected by alcohol	79	9.5
Affected by drugs	37	4.5
Cannot communicate in English	271	32.6
Presented with self-harm	95	11.4
Under 18 years old	7	0.8
Unwell	53	6.4
Total ineligible	**692**	**83.3**
Refused consent	135	16.2
Withdrew consent*	4	0.5
Total excluded	**831**	**100**

*1 became unwell, 1 discharged before survey completion, and 2 changed their minds.

3. Results

3.1. Participation. A total of 1,181 patients (580; 601) were considered for eligibility. Of these, 692 (58.6%) were deemed ineligible and excluded (Table 1), leaving 489 patients (209; 280) approached. Overall, 350 patients were recruited across the two hospitals (144; 206), a participation rate of 71.6%.

3.2. Demographics. The study sample was comparable to data obtained for the preceding year at each site for most demographic variables (Table 2). Demographics are summarized in Table 3.

The majority of participants reported presence of at least one medical condition according to the SCQ. A large proportion of participants also self-reported depressive symptoms ($n = 119/350$; 34.0%) or had a previous depression diagnosis ($n = 114/350$; 32.6%).

Table 2: Comparison of sample to data for each site for the recruitment period.

	Hospital A Sample population	Hospital A Population	Hospital B Sample population	Hospital B Population
Age, median (IQR)	50.0 (33.0–66.0)	44.0 (29.0–65.0)	48.5 (32.0–69.0)	43.0 (28.0–65.0)
Gender (male), *n* (%)	76 (52.8%)	7519 (53.8%)	108 (52.4%)	4287 (54.7%)
Arrival (ambulance), *n* (%)	34 (23.6%)	4555 (32.6%)	116 (56.3%)	2869 (36.6%)
Modal presenting complaint	Abdominal pain	Chest pain	Trauma	Trauma

3.3. Depression Screen. Completion of the depression screen took approximately 3 minutes per patient. Of the 350 participants screened for depression using the PHQ-9, 14.3% ($n = 50/350$; 95% CI = 11.0–18.4%) screened positive, which is significantly greater than the reported prevalence for the general population ($P < 0.05$). The percentages of participants scoring in each classification group are shown in Table 4.

The association of clinical and demographic factors to depression risk for the PHQ-9, as well as its significance, is shown in Table 5.

A large proportion of participants who screened positive for depression also self-reported depression or had been previously diagnosed. Detection rate among these suspected groups, however, was low. Of those who self-reported depression and those who had a previous depression diagnosis, 64.7% ($n = 77/119$; 95% CI = 55.8–72.7%) and 64.0% ($n = 73/114$; 95% CI = 54.9–72.3%), respectively, screened negative on the PHQ-9. In addition, 61.7% ($n = 58/94$; 95% CI = 51.6–70.9%) of participants who reported treatment for depression also screened negative on the PHQ-9, with 63.0% ($n = 33/54$; 95% CI = 47.8–73.0%) who used antidepressant and 53.3% ($n = 32/60$; 95% CI = 40.9–65.4%) who had seen a mental health service provider in the past 6 months screening negative. Overall, 69.2% ($n = 101/146$; 95% CI = 61.3–76.1%) who fell into one or more of these four groups were not considered to be at risk of depression according to the PHQ-9, which accounts for 33.7% ($n = 101/300$; 95% CI = 28.6–39.2%) of the total number of negative screens.

In terms of treatment, only 56.3% ($n = 67/119$; 95% CI = 47.3–64.9%) who self-reported depression and 78.6% ($n = 33/42$; 95% CI = 63.9–88.5%) who reported depression and screened positive used antidepressants and/or had seen a mental health service provider in the past 6 months.

3.4. Predictors of Depression Risk. Preliminary analyses of intercorrelation indicated a strong and significant association between self-reported depression and previous diagnosis of depression ($r = 0.935$), resulting in these items being combined for further analyses. Along with the covariates, age, and gender, nine variables significantly associated with a positive screen were included in a backward stepwise logistic regression to identify the most parsimonious predictive model. These included self-reported depression and/or depression diagnosis; anxiety diagnosis; other mood disorder diagnoses; other mental illness diagnoses; current use of antidepressants; discussion of mental health with local doctor; recent access of a mental health service provider; smoking; and family history of anxiety. Discharge diagnoses were excluded from the model due to sample size constraints, and self-reported liver disease was excluded due to being a likely artefact of sampling.

After eight steps, four variables were retained in the final model, meeting the rule of thumb for logistic regression of 10 cases per predictor variable. Of those retained, self-reported depression and/or depression diagnosis (OR = 8.345; 95% CI = 3.524–19.762; $P < 0.001$), discussing mental health with a local doctor (OR = 2.369; 95% CI = 1.025–5.475; $P = 0.044$), and seeing a mental health service provider in the past 6 months (OR = 4.518; 95% CI = 2.107–9.690; $P < 0.001$) were independent predictors of depression risk.

This model had a strong goodness of fit (Hosmer and Lemeshow: $\chi^2 = 4.978$; $P = 0.547$) and correctly classified 89.4% of participants. The variance accounted for by the final model ranged between 24.2% (Cox and Snell's R square) and 43.3% (Nagelkerke's R square).

4. Discussion

Research and information on ED-based depression screening in Australia and internationally are scarce. Most research in this area focuses on associated risk factors. This is the first study to assess depression risk in an Australian ED setting, document a prevalence of depression risk, and implement the PHQ-9 as an ED screening tool.

The total prevalence of ED patients screening positive for depression in this study was 14.3% ($n = 50/350$; 95% CI = 11.0–18.4%), more than twice that of the Australian general population (6%) [6]. Notably, the PHQ-9 assesses over a two-week period while the national surveys obtained data over one month and twelve months; our results therefore are likely to underestimate the true prevalence. The prevalence was, however, lower than depression risk documented for ED settings internationally (22–32%) [8–10] and in an Australian study of patients who reported feelings of anxiety or depression (20%) [14]. Differences in exclusion criteria may account for this; unlike other studies, we excluded known high-risk [1, 26] patients who were agitated, intoxicated, affected by drugs, or presented with self-harm. The true prevalence of depression risk in the ED setting is therefore likely to be higher than that measured here. Additionally, the exclusion of a large proportion of those unable to communicate in English ($n = 271/831$; 32.6%) may have affected our prevalence estimates. While rating scales are available in other main languages, their use alone without interpreters and a system of care and referral would be problematic and thus was not explored in this initial study.

Table 3: Demographic and clinical characteristics for sample population (data are presented as number and percentage unless otherwise specified).

	Total
Demographic	
Gender (male)	184 (52.6%)
Age, median (IQR)	49.0 (31.5–66.5)
Country of birth	
Australia	248 (70.9%)
Europe	60 (17.1%)
Asia	22 (6.3%)
Middle East and North Africa	8 (2.3%)
Oceania	7 (2.0%)
North America	2 (0.6%)
Sub-Saharan Africa	2 (0.6%)
Unknown	1 (0.3%)
Marital status	
Married	134 (38.3%)
Single/never married	131 (37.4%)
Widowed	33 (9.4%)
Separated/divorced	32 (9.1%)
De facto	17 (4.9%)
Unknown	3 (0.9%)
Socioeconomic status (concession card holder)	121 (34.6%)
Mode of arrival (ambulance)	150 (42.9%)
Triage score	
1	10 (2.9%)
2	44 (12.6%)
3	139 (39.7%)
4	138 (39.4%)
5	19 (5.4%)
Modal presenting complaint	Abdominal pain
Modal discharge diagnosis	Musculoskeletal fracture/injury
ED length of stay, median (IQR)	297 (193–456)
SCQ	
Heart disease	70 (20.0%)
Hypertension	102 (29.1%)
Lung disease	82 (23.4%)
Diabetes	38 (10.9%)
Ulcer or stomach disease	95 (27.1%)
Kidney disease	44 (12.6%)
Liver disease	20 (5.7%)
Anaemia or other blood diseases	56 (16.0%)
Cancer	49 (14.0%)
Depression	119 (34.0%)
Osteoarthritis or degenerative arthritis	110 (31.4%)
Back pain	173 (49.4%)
Rheumatoid arthritis	17 (4.9%)
Other medical problems	210 (60.0%)
Personal and family history survey	
Depression diagnosis	114 (32.6%)
Anxiety diagnosis	123 (35.1%)
Other mood disorder diagnoses	6 (1.7%)
Other mental illness diagnoses	7 (2.0%)
Current use of antidepressants	54 (15.4%)
Discussion of mental health with local doctor	136 (38.9%)
Seen mental health service provider in past 6 months	60 (17.1%)
Smoking	
Current	83 (23.7%)
Former	59 (16.9%)
Alcohol	212 (60.6%)
Family history of depression	121 (34.6%)
Family history of anxiety	83 (23.7%)
Family history of other mood disorders	35 (10.0%)
Family history of other mental illnesses	39 (11.1%)

Table 4: Classification of participant PHQ-9 screen.

Classification	%	95% CI
Negative (0–4)	54.3	49.1–59.4
Mild depression (5–9)	31.4	26.8–36.5
Moderate depression (10–14)	6.6	4.4–9.7
Moderately severe depression (15–19)	3.4	1.9–6.0
Severe major depression (20+)	4.3	2.6–7.0

The fact that the tool did not identify many patients with a suspected risk of depression based on self-reported depression, previous diagnoses of depression, current antidepressant use, and recent access to mental health services suggests that we may have underestimated the true prevalence of depression in this population. More than two-thirds of these patients did not screen positive on the PHQ-9, accounting for over a third of total negative screens. Although these patients may not have been presently depressed, due to the effects of treatment or natural remission of depressive illness, depressive disorders (notably major depressive disorder) tend to be chronic relapsing/remitting illnesses, so that these patients remain at ongoing risk. If all these participants were considered to have a risk of depression, this could mean that at least 40% of the ED population have depression risk.

Asking a patient whether they are currently suffering from depression could identify a majority of patients who may need help. Of participants who screened positive, 84% self-reported depression and 82% had previously been diagnosed with depression, suggesting that those who screen positive on the PHQ-9 are likely to be depressed. However, only 56% who self-reported depression and 79% who reported depression and screened positive used antidepressants and/or had seen a mental health service provider in the past 6

Table 5: Association of clinical and demographic factors to the outcome of the PHQ-9 (data are number and percentage unless otherwise specified).

	Negative screen	Positive screen	*P* value
Variable			
Age, median (IQR)	51.0 (33.0–69.0)	42.0 (30.5–60.0)	0.066
Gender (male)	158 (52.7%)	26 (52.0%)	1.000
Country of birth (Australia)	208 (69.3%)	40 (80.0%)	0.552
Marital status			
Married	117 (39.0%)	17 (34.0%)	
Single/never married	107 (35.7%)	24 (48.0%)	
Widowed	32 (10.7%)	1 (2.0%)	0.293
Separated/divorced	27 (9.0%)	5 (10.0%)	
De facto	14 (4.7%)	3 (6.0%)	
Unknown	3 (1.0%)	0 (0.0%)	
Concession card holder	106 (35.3%)	15 (30.0%)	0.523
Arrival mode (ambulance)	129 (43.0%)	21 (42.0%)	1.000
Triage category			
1	9 (3.0%)	1 (2.0%)	
2	36 (12.0%)	8 (16.0%)	
3	122 (40.7%)	17 (34.0%)	0.545
4	115 (38.3%)	23 (46.0%)	
5	18 (6.0%)	1 (2.0%)	
Presenting complaint (abdominal pain)	43 (14.3%)	5 (10.0%)	0.410
Diagnosis (musculoskeletal)	67 (22.3%)	9 (18.0%)	**<0.001**
ED length of stay, median (IQR)	296.0 (189.3–450.8)	301.5 (211.0–487.5)	0.440
Further admission	222 (74.0%)	35 (70.0%)	0.604
SCQ			
Heart disease	61 (20.3%)	9 (18.0%)	0.849
High blood pressure	89 (29.7%)	13 (26.0%)	0.737
Lung disease	68 (22.7%)	14 (28.0%)	0.470
Diabetes	33 (11.0%)	5 (10.0%)	1.000
Ulcer or stomach disease	79 (26.3%)	16 (32.0%)	0.396
Kidney disease	37 (12.3%)	7 (14.0%)	0.817
Liver disease	10 (3.3%)	10 (20.0%)	**<0.001**
Anaemia or other blood conditions	44 (14.7%)	12 (24.0%)	0.099
Cancer	44 (14.7%)	5 (10.0%)	0.510
Depression	77 (25.7%)	42 (84.0%)	**<0.001**
Osteo/degenerative arthritis	96 (32.0%)	14 (28.0%)	0.625
Back pain	143 (47.7%)	30 (60.0%)	0.127
Rheumatoid arthritis	15 (5.0%)	2 (4.0%)	1.000
Other medical problems	178 (59.3%)	32 (64.0%)	0.640
Personal and family history survey			
Depression diagnosis	73 (24.3%)	41 (82.0%)	**<0.001**
Other mood disorder diagnoses	3 (1.0%)	3 (6.0%)	**0.040**
Anxiety diagnosis	88 (29.3%)	35 (70.0%)	**<0.001**
Other mental illness diagnoses	3 (1.0%)	4 (8.0%)	**0.009**
Use of antidepressant	33 (11.0%)	21 (42.0%)	**<0.001**
Discuss mental health with local doctor	97 (32.3%)	39 (78.0%)	**<0.001**
Seen mental health service provider in past 6 months	32 (10.7%)	28 (56.0%)	**<0.001**
Smoking			
Current	61 (20.3%)	22 (44.0%)	**0.001**
Former	56 (18.7%)	3 (6.0%)	
Alcohol use	182 (60.7%)	30 (60.0%)	1.000
Family history of depression	98 (32.7%)	23 (46.0%)	0.091
Family history of anxiety	63 (21.0%)	20 (40.0%)	**<0.001**
Family history of other mood disorders	26 (8.7%)	9 (18.0%)	0.056
Family history of other mental illnesses	31 (10.3%)	8 (16.0%)	0.164

months. This highlights that treatment among high-risk ED patients may be improved through screening and linkage to appropriate services. In the busy emergency department, clinicians may be reluctant to undertake universal screening for conditions unrelated to the presenting complaint. Further study into methods by which to facilitate screening may be warranted.

Our study did not replicate previous findings of an association of depression risk with increasing age [9] or heart disease [5]. The reasons for this are unclear. Family history of psychiatric disturbance, including depression, was also not shown to be significant. As it was difficult to obtain medical diagnoses of family members, we relied heavily on the participant's report. This may not have been accurate, as some participants were disconnected from their families and were unaware of any family history of mental health disorders, while others suspected a history but were not aware of any formal diagnosis.

4.1. Limitations. We did not use a gold standard (such as structured psychiatric interview) to verify diagnoses of depression and therefore cannot claim validity of the PHQ-9 in an ED setting.

Due to the limited time availability of the sole recruiting researcher, a consecutive sample was not obtained. The ED operates for 24 hours per day, and thus the sample is likely not to adequately represent patients attending outside sampling hours. The exclusion of those who were cognitively impaired, drug or alcohol affected, or were presented with deliberate self-harm resulted in a large number of patients being excluded from the study, affecting the representativeness of the sample and most likely resulting in an underestimate of depression risk.

4.2. Future Research and Directions. ED-based depression screening could yield an overall benefit to the general population and the healthcare system. However ideally there should be a tool validated specifically for the ED. This study was powered to estimate prevalence to within a 5% level of precision in the overall sample. In order to more reliably determine the prevalence of depression within subgroups, future studies should employ a larger sample enabling stratification for age and other key clinical and demographic factors, whilst retaining precision within each group. Depression screening in non-English speakers through the use of translatable tools and interpreters also deserves further exploration, as they form a substantial proportion of the ED population. In addition, a cost-benefit analysis should be performed to assess the acceptance of depression screening among patients and staff and determine how well ED doctors refer those who screen positive. This will allow us to predict the feasibility and practicality of routine depression screening in an ED setting. Most EDs operate 24 hours per day, so future studies need to be adequately resourced to sample subjects overnight.

5. Conclusion

We have shown that ED patients are at considerably higher risk of having depression than the general population, even allowing for high-risk groups excluded from this study. From a clinical perspective, although most cases of depression can be ascertained by simple clinical interview, using questions about current mood and past psychiatric history, an important and substantial subset failed to be detected by routine ED assessment. Thus depression screening needs to be developed and evaluated as a potentially valuable complement to ordinary clinical assessment. The ED is a health system setting which can make a very useful contribution to reducing the population burden of depression.

Conflict of Interests

The authors declare that they have no conflict of interests.

Authors' Contribution

Tracey J. Weiland and George A. Jelinek conceived the study. Nancy Khav, Tracey J. Weiland, George A. Jelinek, and Michael Salzberg designed the methodology. Nancy Khav and Tracey J. Weiland obtained research funding and ethics approval. Tracey J. Weiland, George A. Jelinek, and Jonathan C. Knott supervised the conduct of the study and data collection. Nancy Khav undertook recruitment of participants and managed the data. Tracey J. Weiland, George A. Jelinek, and Jonathan C. Knott provided statistical advice on the study design. Nancy Khav and Tracey J. Weiland analysed the data. Nancy Khav drafted the paper, and all the authors contributed substantially to its revision. Nancy Khav takes responsibility for the paper as a whole.

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