Prevalence of Major Depressive Episodes in Rural Women Using Primary Care

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Abstract: Women carry a disproportionate burden of depression in part because situational and other factors enhance their risk. Rural women may be at particular risk because of poverty and lack of treatment opportunities. For this study we investigated the rate of current major depressive episodes (MDE) in impoverished rural women seeking care in a community health center (CHC) in the rural South. We screened 982 women for MDE during a routine primary care visit: about half were positive for depressive symptoms. Of women positive at screening, 194 were then assessed for psychiatric disorder. A current MDE was observed in 14.3% of women screened for depression and 72.2% of women assessed for psychiatric disorder. Recognizing that neither of these percentages reflects the likely rate of MDE among the larger population of rural impoverished women, we used probability theory and binary logistic regression to estimate a depression rate that could be applied as one factor associated with unmet need in this population of women. We estimate that 44.3% of the population of women using the CHC had MDE. These findings underscore the need for mental health services in rural primary care, especially in facilities serving impoverished women.

Key words: Women, depression, rural, epidemiology.

According to data from the 2000 Global Burden of Disease study, unipolar major depression is the most disabling illness in the United States, accounting for 8% of all disability adjusted life-years.[1] The most recent of several nationally representative surveys, the National Comorbidity Study Replication (NCS-R) has shown an overall 6.7% prevalence rate for major depressive episode (MDE).[2] Women's lifetime rate for a major depressive episode (MDE) in the NCS-R was 70% higher than that of men, but there was no statistically different sex difference in 12 month prevalence rates.[3] Consistent across these surveys was the association of high rates of MDE with several risk factors, including age, sex, marital status, education, income, and being non-Hispanic White.[2] A limitation of the scope of nationally representative studies, however, is their

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inability to capture the prevalence of a disorder within smaller populations, especially those with multiple risk factors. This is reflected in the findings of several studies showing rates of current MDE ranging from 8% to 45% in populations with multiple risk factors for MDE.[4–9]

Particular risk factors for women. Among people of all backgrounds and cultures, women are at greatest risk of having a MDE in their lifetime.[2–3,10] Sex differences in risk for depression appear at menarche and remain until menopause.[10] Persistent poverty has also been associated with higher rates of MDE[4,11] and women are more likely to be impoverished than men. In one community-based study, for example, the 12 month prevalence of depression mirrored that of the NCS-R but was 12.5% in impoverished women.[4,12] Further, 39% of low-income women had persistent depressive symptoms over two years of follow-up.

Race may also correlate with prevalence rates. Among a predominately female population from public housing fully 48% of African American and Hispanic women reported that they were depressed.[13] Data from the National Comorbidity Study (NCS) and a more recent version of the NCS (NCS-R) show that fewer African Americans than non-Hispanic Whites report any psychiatric disorders.[2,14] These studies showed that 21.3% of non-Hispanic White women reported a lifetime episode of MDE, while only 15.5% of African American women did so. Rates may be higher among African Americans with multiple risk factors for MDE. For example, Dressler and Badger[15] found that 27.2% to 34.3% of rural African American women studied had significant depressive symptoms, while Brown and colleagues[16] found higher rates of current MDE and other psychiatric disorders in low-income African American men and women than in low-income non-Hispanic Whites. Latinas with multiple risk factors also have increased rates of MDE. For example, current MDE was found in 14% of low-income women, most of whom were Latina, and sub-syndromal MDE in another 59%.[17] In another predominantly Latina sample, 21% met criteria for major depressive disorder.[7] It is interesting to note that across ethnic groups, women reporting little social support or family conflict were most likely to have current MDE or to report significant depressive symptoms.[18–22]

Women with a history of abuse have also been found to have high rates of MDE. Data from the NCS showed that among the 10.5% of women who reported sexual abuse as children, the lifetime prevalence of MDE was 39.3%.[8] In another study of adult women victimized both physically and sexually during childhood, the current rate of MDE was 25% and the lifetime rate was 71.5%.[6]

The role of the rural environment. Rural women may be at greater risk for MDE because of poverty, isolation, and limited access to mental health services. For example, the rate of MDE in a predominantly female, low-income population using rural primary care was found to be 35.3%;[23] a prospective study[24] in Canada showed a 10% prevalence rate of MDE among women; and in two rural primary care settings more than 26% of women met the diagnostic criteria for MDE.[25,26] A large study of Appalachian and rural women using gynecological services showed that 14.5% were using a prescribed antidepressant.[27] Among another low-income Appalachian sample of women 51% responded affirmatively to the question "Do you often feel sad and depressed?"[19] Recent work in a large nationally representative sample also shows that rural women, when compared

with urban and suburban women, are more likely to report their mental health as fair to good, while women in these other groups had a greater tendency to rate their mental health as very good to excellent.[28] Previous research by Hauenstein and Boyd[29] showed that 41.4% of low-income rural women had significant depressive symptoms.

The poorly developed rural mental health treatment system and certain characteristics of rural women may intersect to reduce overall treatment for MDE and consequently contribute to a high rate of MDE in this population. The rural mental health treatment system is a loosely woven net of poorly integrated formal, informal, and lay providers that result in sporadic and often limited treatment.[30,31] Chronic shortages of specialty mental health providers in rural areas shift mental health treatment to primary care settings where the unique challenges of rural primary care practice reduce both detection and treatment of common mental health problems.[32–34] Recent research by one of the authors and by others has demonstrated that women residing in small and remote rural areas receive less mental health treatment from any health care or specialty mental health providers than those living in urban areas and less rural areas.[27,35,36] Under-treatment of depression often leads to frequent exacerbations and incomplete remissions and this likely contributes to increased rates in rural populations.

Rural community characteristics and values also may contribute to under-treatment and subsequent higher rates of MDE. There is evidence that rural residents eschew formal health care systems generally and especially stigmatize mental illness.[38,39] Stigma in rural areas is an enduring problem and serves as a barrier to obtaining care for mental health problems.[39–41] Philo, Parr and Burns[39] note that in many rural places there is only one mental health facility, making any use of it plainly visible to other community members. Perceived stigma may be one reason that 2.3% of respondents to the prescription drug survey mentioned earlier reported using St. John's Wort, a purported herbal and over-the-counter remedy for depression.[27] Rural individuals have been shown to label mental health help-seekers negatively and perceive cultural dissimilarities between providers and consumers.[42] In rural areas in particular, smaller social networks may reinforce perceptions that the mental health system is hostile or beliefs that mental health problems are the domain of family and church.[37,43–46]

The role of poverty in psychiatric illness. A classic study conducted with single mothers established the link between poverty and MDE; this study showed that financial hardship doubled the risk for the onset of a depressive disorder.[18] In a large sample from family planning clinics located in the South, unemployed women were more than three times as likely as employed women to report depression.[47] Another study showed that among urban African American women, 43% had income below the poverty line, and 40% had depression at baseline; economic disadvantage predicted continued depression six months later.[48] Income was an important factor in explaining depression in a large, nationally representative sample of mothers with young children.[11] Investigators in this study found statistically significant differences between women who had never been clinically depressed and those who had always been clinically depressed on poverty status; low-income and poor mothers were more likely to be depressed. Further, income increases, especially those lifting the mother from poverty, were associated with improvement in depressive symptoms. Taken together, these findings show that poverty is a substantial risk factor for depression for women.

A role for probability theory in estimating MDE. Many of the studies referred to above were conducted on mixed urban-rural populations; some do not report rates by sex. Their widely varying MDE rates may reflect the design of population-based studies, which often preclude accurate estimates of MDE. Probability theory, however, may make it possible to obtain more accurate rates of disorders in a discrete population when not all information about that population is known. In particular, the probability that a disorder will be present under certain conditions can generate a prevalence estimate, the accuracy of which depends on the availability of observable data and the precision of the model used to estimate unknown probabilities. Probability theory has great utility for understanding various problems in health care. Probability theory underlies most logistic regression analytic techniques where the odds of one event occurring is estimated relative to the odds of another event occurring.[47,48] Here, we predict the presence or absence of depression based on several conditions; precedent for such research in estimating psychopathology already are present in the literature. For example, applications based on probability theory have been used to differentiate patterns of psychopathology in people with MDE.[49,50] As in the present study, probability theory was used in a study of alcohol dependence to classify patients as having a fatigue syndrome or not; an important component of the fatigue syndrome was the presence of MDE.[51]

In the study reported here, almost half of the impoverished rural women receiving primary care were positive on a screen for depressive symptoms, but the proportion of the sample with MDE verified by diagnostic exam was 14.3% (similar to other studies reported earlier). We believed this percentage to be inaccurate, because only 40% of women positive on screen completed the diagnostic interview to verify the presence of MDE while, of the number of women who completed the diagnostic examination, 72.2% were determined to have MDE. The purpose of this paper is to report the estimated prevalence rate for MDE in this low-income rural population of women using probability theory.

Methods

Setting. The study was conducted from 1994 to 1998 in a federally funded community health center (CHC) located in the rural South that provides primary care services to a largely impoverished population, approximately half of whom are African American.* Patients using the facility predominately were uninsured; unemployment among the users when this study was conducted approached 30%. We conducted the study in this setting because it was the only setting providing health care to impoverished residents of a large geographic region encompassing five rural counties and, thus, was best suited for recruiting the desired sample. At the time of the study, the CHC provided no formal mental health services.

Sample. The research sample was drawn from that of a larger study that tested the effects of a home-based treatment for MDE.[52–54] The purpose of the original study was

*Statistics are derived from the annual report of the CHC, 1996–1998 for Central Virginia Health Services, New Canton, Virginia.

to compare two treatment programs for rural women who had current MDE determined by a standardized diagnostic interview. There were three stages, or tiers, in the original study: screening for depression, formal diagnostic assessment via clinical interview, and treatment. Participants in the study reported here were drawn from the first two tiers of the original study. The original sample included 1,010 women, aged 16 to 71 years, 982 of whom were included in the current study. Almost half of these women (49.1%, n=482) screened positive for depressive symptoms on the Center for Epidemiologic Studies Depression Scale (CES-D)[55] (described below), making them eligible for the diagnostic phase of the research; 179 (37.1%) completed a diagnostic interview. Twenty-five women who either refused further participation or had missing data and three additional subjects who identified their race as other than Caucasian or African American were excluded from the study due to small sample sizes (two subjects identified their background as Hispanic, one as Asian). Among the 25 women excluded were those receiving mental health services elsewhere, those who had an active drug or alcohol problem requiring substance abuse treatment, and those who had an unstable chronic illness. To establish a control group, we randomly selected 15 women whose score on the depression screener revealed few depressive symptoms, bringing the total number of women in the sample to 194.

Procedure. After the study had been approved by the health sciences internal review board of the University of Virginia, we approached women consecutively while they were waiting in the CHC for routine health care for themselves or their children. Women were invited to participate by an indigenous health care worker, hired specifically for screening potential subjects. The screener was trained in human subjects' protections, administering the CES-D, and emergency management procedures. We informed the potential subjects both orally and in writing about the study's purpose and its requirements. We obtained consent for each tier of the research; the screener obtained consent for the screening portion of the study. A masters-prepared psychiatric nurse was on site and available to the screener during all screening and consent procedures. Each woman was then screened for depressive symptoms in a 10-minute face-to-face interview, using the CES-D. The CES-D is a widely used depression screening measure designed for use in non-clinical populations[55,56] with strong psychometric properties for women and racial/ethnic minorities.[57,58] The 20-item scale rates the frequency and duration of common symptoms of depression occurring in the week before administration of the scale. A criterion score of 16 is used to identify subjects as potentially depressed ("above criterion"). This criterion score has been shown to maximize the sensitivity and specificity of the instrument. The internal consistency of the CES-D in the present sample was 0.93.

We informed the women immediately of the results from the CES-D and the screener invited those whose CES-D scores were above criterion to participate in the diagnostic phase of the research. Before starting the diagnostic phase, we again explained the purpose of the research, carefully describing the extent and limits of confidentiality, and obtained informed consent. Each woman then completed a diagnostic interview and was given a battery of face-to-face psychological tests. Nurses prepared at the master's level in psychiatric nursing or doctoral-level students in clinical psychology administered these tests after receiving training in diagnostic methods and crisis management. All

study personnel were supervised by the first author weekly through case consultation and group and individual sessions. The subjects were not compensated for their participation. Women who failed to keep their assessment appointments were contacted and the appointments were rescheduled. Before we excluded a subject, a total of three contacts were made or attempted.

Using random number selection we identified 40 women from the below-criterion group to recruit as a control group. Members of the control group were recruited by telephone and scheduled for diagnostic assessment after their oral agreement to participate. We attempted to contact all 40 women; when that list was exhausted, we generated an additional list of 40 women using the same method. Although we paid control group members $20 for their participation, the difficulty of recruiting rural samples and the two hour time commitment required for participation thwarted our attempts to obtain a larger control group sample. Once the subjects were recruited, all the subsequent procedures were identical for both groups.

Measures. We used the Quick Diagnostic Interview Schedule III-R, Version I (QDIS)[59] to diagnose psychiatric disorders. The QDIS is a widely used computer-based interview that establishes the presence of 16 acute psychiatric disorders by comparing patient reports with criteria described in the Diagnostic and Statistical Manual of Mental Disorders, third edition, revised (DSM-IIIR*).[60–62] The QDIS improves the accuracy of diagnosis, since most diagnostic decisions in the course of the interview are made by computer algorithm. Except for three anxiety disorders, the sensitivity of the QDIS for other psychiatric disorders measured ranges from 0.78 to 1.0.[59] The specificity of the QDIS ranges from 0.67 to 1.0. For MDE the congruence between the clinician administered Diagnostic Interview Schedule[63] and the QDIS was strong (kappa=.76).

Statistical analyses of sample characteristics. Demographic and other indicators including age, education, income, race, marital status, number of children, and source of referral to the research study were used to improve the precision of the model we would be using to estimate the unknown probabilities. Age and education were recorded in years. Analyses reported below included only non-Hispanic White and African American women: 3 respondents who were of a different ethnic minority background were excluded. Marital status was coded 1 if the subject was single, 2 if married, and 3 if separated, divorced, or widowed. The number of children included those not living in the household. Income was coded 1 if the respondent had income at or below the poverty line (range $0–$18,220 for a family of 4), 2 if 101% to 149% of the line, and 3 if at 150% or more above the line.[64] We imputed data on income for 65 (6.6%) of the 982 subjects using the following criteria: 1=is on Medicaid or unemployed and is single with children; 5=has insurance, is married and employed; and 3=meets some criteria from both categories. We preferred this protocol to mean substitution because income was not normally distributed (mode=1). An independent observer used the same criteria to replace missing data. The correlation (Pearson's r) between the investigators' rating and the independent rater's was 0.64, $p<.0001$. We used mean substitution for 3 (>1%) missing CES-D scores of subjects who had completed the diagnostic assessment.

*At the time of the study, a version based on the DSM-IV was not yet available.

We performed descriptive statistical analysis on each of the demographic variables and CES-D scores aggregated by criterion and by group membership (assessed/not assessed/normal control) within each criterion. The results appear as Tables 1 and 2. Cross-tabulations and analysis of variance were then used to compare CES-D scores by criterion and group membership on each of the demographic indicators.

Applying the total probability formula. The prevalence estimate for current MDE in rural, impoverished women using primary care (P (A)) was derived by means of the total probability formula:

$$P(A) = [P(B_1) * P(B_{1a} \text{ given } B_1) * P(A \text{ given } B_1 \text{ and } B_{1a})] + [P(B_1) * P(B_{1b} \text{ given } B_1) * P(A \text{ given } B_1 \text{ and } B_{1b})] + [P(B_2) * P(B_{2a} \text{ given } B_2) * P(A \text{ given } B_2 \text{ and } B_{2a})] + [P(B_2) * P(B_{2b} \text{ given } B_2) * P(A \text{ given } B_2 \text{ and } B_{2b})].$$

Table 1.

DEMOGRAPHIC CHARACTERISTICS BY CRITERION AND GROUP

Characteristics	Below criterion				Above criterion			
	Not assessed		Normal control		Not assessed		Assessed	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age	31.3	8.6	32.3	10.8	31.4	9.3	34.7	8.1
Education	11.9	1.7	12.3	2.1	11.3	2.1	11.4	2.3
# of children	1.7	1.5	1.5	1.8	1.9	1.5	2.2	1.4
	N	%	N	%	N	%	N	%
Race								
Black	254	52.7	9	60.0	181	59.5	81	45.5
White	228	47.3	6	40.0	123	40.5	97	54.5
Marital status								
Single	217	44.7	9	60.0	146	49.7	46	27.4
Married	188	38.8	3	20.0	92	31.3	77	45.8
Previously married	80	16.5	3	20.0	56	19.0	45	26.8
Income								
Poverty	223	46.0	7	50.0	95	54.0	95	54.0
125% of line	77	15.9	5	35.7	32	18.2	32	18.0
150% or greater	185	38.1	2	14.3	49	27.8	49	27.8
Employment								
Full-time	236	49.0	4	26.7	36	36.4	64	34.6
Part-time	73	15.1	2	13.3	24	13.6	24	13.5
Unemployed	173	35.9	9	60.0	88	50.0	88	50.0
Referral Source								
Physician	21	4.4	1	6.7	81	45.5	81	45.5

Table 2.

CES-D[a] SCORES BY CRITERION AND GROUP

Evaluation instrument	Below criterion				Above criterion			
	Not assessed		Normal control		Not assessed		Assessed	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
CES-D	6.6	8.6	7.5	5.8	29.7	10.3	34.7	8.1

[a]CES-D = Center for Epidemiologic Studies Depression Scale

The formula denotes the likelihood of MDE under certain conditions for women who are above and below the criterion score on the CES-D. For 8 out of 10 conditions probability estimates are simple proportions derived from the observed data; the remaining two conditions (*A given* B_1 *and* B_{1b} and *A given* B_2 *and* B_{2b}) must be estimated. These are the probabilities of having MDE in the above criterion not assessed group and below criterion not assessed group. Each of the conditions expressed in the equation with their corresponding probabilities are defined in Table 3.

The simplest means of obtaining probability estimates for the two unknown conditions was to regress depression status (0=not depressed, 1=depressed) on CES-D scores and then average the generated probability scores for the 2 groups in question. Unfortunately, we expected that a selection bias might characterize our sample because subjects self-selected into the diagnostic tier of the research and into the control group. It seemed possible that this self-selection could inflate prevalence estimates because women with greater symptom severity may be more likely to seek diagnostic information. To manage potential bias, we used binary logistic regression to identify sociodemographic and referral factors that may have influenced subjects' selection into either of these 2 groups (conditions). We found that for women in the above criterion condition, marital status and referral source were the 2 statistically significant predictors of participation in diagnostic assessment: women who were separated or divorced and who were referred to diagnostic assessment by their primary care physician were more likely to participate ($\chi^2=60.1$, df=7, $p<.0001$). For women in the below criterion condition, employment was the only factor that distinguished women who volunteered for the control group from those who did not, although it is likely that the analysis was insufficiently powered to detect more subtle differences. Nine (60%) of the 15 normal controls were unemployed, and 2 (13.3%) were diagnosed with MDE. Although we used a random number table to select women for the control group, the presence of MDE in this group suggests that women may not have selected themselves into the control group randomly. Thus, the estimation *A given* B_2 *and* B_{2b} may be inflated.

Once we identified factors that may control for selection bias we estimated probabilities for the two conditions that were not informed by the observed data, using data from the 194 subjects who completed the diagnostic interview. The model used

Table 3.

CONDITIONAL PROBABILITY ESTIMATION

Notation	Condition	Observed/ estimated	P
B_1	The event that a randomly selected woman will be above criterion.	O	.491
B_{1a}	The event that a randomly selected woman, above criterion, will complete assessment.	O	.369
A given B_1 *and* B_{1a}	The event that a randomly selected woman, above criterion, who completes assessment, will have MDE.	O	.722
B_{1b}	The event that a randomly selected woman, above citerion, will not complete assessment.	O	.631
A given B_1 *and* B_{1b}	The event that a randomly selected woman, above criterion and not assessed, will have MDE.	E	.632
B_2	The event that a randomly selected woman will be below criterion.	O	.509
B_{2a}	The event that a randomly selected woman, below criterion, will be assessed.	O	.032
A given B_2 *and* B_{2a}	The event that a randomly selected woman, below criterion, who completes assessment, will have MDE.	O	.006
B_{2b}	The event that a randomly selected woman, below criterion, will not be assessed.	O	.968
A given B_2 *and* B_{2b}	The event that a randomly selected woman, below criterion and not assessed, will have MDE.	E	.235

MDE = Major depressive episode

to generate probability estimates included MDE status (0=not present, 1=present) regressed on CES-D scores, and the 3 variables controlling for selection biases (marital, employment, and referral status). A constant was included in the model. This model was statistically significant (χ^2=52.8, df=4, p<.0001). Goodness of fit diagnostics showed that the data fit the model well and that the constant was statistically insignificant. The analysis produced probability scores for the entire sample of 982 women (range of scores=0–57). The two estimated probabilities were 0.632 (*A given* B_1 *and* B_{1b}) and 0.235 (*A given* B_2 *and* B_{2b}).

Results

Sample characteristics. The women in the sample were young (age=31.9 years, SD=8.9), nearly half were single (42.5%, n=418/982) and, on average, they had two

children (median=2, SD=1.5). They were educated at the high school level (median=12 years), were employed full or part time (56.6%, n=556/982), and had incomes below the federal poverty line (51.4%, n=505/982). More than half the sample consisted of African American women (53.2, n=523/982). One subject was Asian, and two were Hispanic. The average sample CES-D score was 18.9 (SD=14.9).

As expected, there were significant differences in CES-D scores between the above- (mean=31.7, 10.5) and below-criterion groups (mean=6.6, SD=4.6; F=2317, df=1, $p<.001$). There were also statistically significant between-criterion group differences on the demographic variables of age, education, number of children, marital and employment status, and income. Above-criterion women were older (F=5.7, df=1/980, $p<.02$), had more children (F=8.9, df=1/980, $p<.003$), and were less educated (F=21.6, df=1/979, $p<.001$) than women in the below-criterion group. They also were more likely to have incomes below the poverty line than women in the below-criterion group ($\chi^2=15.6$, df=2, $p<.0001$). Twenty-five percent of those in the above-criterion group were separated, widowed or divorced, compared with 16% of the below-criterion group ($\chi^2=10.1$, df=2, $p<.006$); single or married women were more likely to have CES-D scores below criterion. Similarly, the unemployed were over-represented in the above-criterion group ($\chi^2=17.0$, df=2, $p<.001$). These findings indicate that risk factors for MDE were disproportionately distributed in the above-criterion group.

Women in the above-criterion group were more likely to be referred by their physicians (87.1%) than those in the below-criterion group ($\chi^2=116.7$, df=1, $p<.0001$); however, non-Hispanic White women were more likely to receive such a referral (21.5%) than were African American women (12.9.%) ($\chi^2=12.6$, df=1, $p<.001$).

Prevalence. This application of probability theory yielded an estimate of MDE of 44.3% in this sample of women using the CHC. This figure differs dramatically from the 14.3% we had calculated using a simple proportion of verified MDE cases in the entire sample of 982 women. Of the 194 women participating in assessment, 72.2% (n=140) were diagnosed with MDE.

Discussion

Prevalence. This study resulted in the estimate that 44.3% of women seeking care in a rural community health center had MDE. This is very close to the figure shown in an earlier report on a similar population in which CES-D scores alone were used to estimate rates of depressive symptoms.[29] It is higher than the rate found in the rural sample described by Sears et al.[18] but that sample also included men, who tend to have lower rates of MDE than women. Our estimate of MDE is considerably higher than that of the sample of Canadian rural women cited earlier,[24] but that sample was randomly selected and had few specific risk factors.

The six risk factors for MDE noted in nationally representative samples[2-3] were common in our sample, and were especially prevalent among the women who participated in the diagnostic assessment. The high rates of MDE in the present sample are consistent with prior research showing that women with multiple risk factors for depression have high rates of MDE.[6,16-18] Brown et al.[16] found that 64% of their sample met the diagnostic criteria for MDE; the figure is 72% in the present sample. Miranda et al.[7]

reported a rate of 21.5% in their sample; that is well above the rate found in the NCS for women but considerably lower than our population estimate. This may be because Miranda et al.'s study had a different racial/ethnic distribution from the present sample: fully 44% of the population was Latina, 30% were African American, and 18% were non-Hispanic White women. In contrast, a report examining treatment use by those with dual diagnoses showed no racial differences in rates of MDE.[65]

High rates of MDE and other psychiatric disorders also are associated with early childhood abuse.[8,6] In one study conducted with Appalachian women obtaining routine care in an urban primary care practice, fully 35.1% reported some form of child abuse and this was associated with an almost fourfold increased risk of depressive symptoms.[66] Another study showed that 19% of low-income prenatal patients reported recent abuse; 51% of women in this primary care population reported depressive symptoms.[19] In our sample, the rate of childhood abuse of any type reported by a sub-set of women in our sample who completed diagnostic assessment (n=108) was 70.4%. It may be that the high rate of MDE that we report here reflects the effects of early childhood abuse, rather than rural residence or low income.

Estimation accuracy. Mathematical evidence also supports the accuracy of the prevalence estimate reported here. Eight of the 10 probabilities used to estimate the prevalence rate in the population under study were from observed data. As a result, only 20% of the total probability estimate is subject to error.

Selection bias. We recognized that selection bias likely characterized our sample and limited its effects by generating a logistic model identifying factors associated with such participation in diagnostic assessment, and we then controlled for these factors in generating probability estimates. An unconstrained predictive model generated higher mean sample probabilities (0.47) than did our controlled model (0.45). While race was not a significant predictor in our regression model of participation in diagnostic assessment, MDE rates were higher in non-Hispanic White women than in African American women, and these women were also more likely than the African American women to complete assessment. As a consequence, the population estimate may be more accurate for non-Hispanic White women than for African American women.

The ideal means of managing selection bias would have been to ensure full participation of eligible women in the diagnostic interview. The single most powerful predictor of participation in diagnostic assessment was encouragement by a woman's primary care provider; women most likely to be referred by their physician were sicker, had more risk factors, and were more likely to be non-Hispanic White than women less likely to be referred. The extent to which race was a factor in physician's lower referral rate of African American women is not clear. While a recent report showed no racial/ethnic or gender biases in detection of depression in primary care[67] other research shows that racial disparities in diagnosis and treatment of psychiatric disorders do exist; counterbalancing the latter point, however, for depression, standardized depression assessment were not subject to misattribution by race.[13,65,68-69] Clinical judgments by physicians are considered crucial to detection and diagnosis of MDE and it is possible that cultural insensitivity to racial differences in symptom presentation by the predominantly non-Hispanic White professional staff of the CHC may have led to fewer referrals of African American women for diagnostic assessment.[67,69] African American women in

our study also presented with fewer symptoms of depression than did non-Hispanic White women ($F=9.811$, df 1/183, $p<.002$) so it is also possible that primary care providers failed to detect milder MDE.

Obstacles to participation were evident. All women who were above criterion at screening were contacted on three separate occasions, either by telephone or letter, and many of them rescheduled their appointments at least once, but again failed to attend the interview. Perceived stigma or other barriers may have discouraged some women from participating. For example, we conducted our interviews in a trailer renovated specifically to conduct the research, but behind and separate from the CHC; Philo et al.,[39] point out how the transparency of mental health services in rural communities can hinder obtaining treatment. Such an instance was evident in the 60% of rural parents who reported concern about what others might think of the their children obtaining mental health treatment.[70] Perceived stigma also has been shown to interfere with obtaining treatment, and to persist despite mental health treatment.[71,72] In this low-income group of women, transportation and the requisite travel distance to participate in the diagnostic assessments also may have served as a barrier.[73,74]

On the issue of medical co-morbidity, it has been argued that the high rates of psychiatric disorders seen in primary care are due to the co-occurrence of medical illnesses with other illnesses that lead individuals to seek health care. In the present research, 14.9% of women had a chronic illness. We specifically excluded women whose medical illness was severe, or currently unstable, to avoid misdiagnosis of depression, so it is unlikely that medical co-morbidity inflated the estimate of MDE in our population.

Finally, it is possible that population estimates for MDE may be inflated by self-selection in the normal control group. Because 2 of the 15 women in that group had MDE, it is possible that selection bias influenced the estimate of the rate of MDE for those below criterion.

The validity of our prevalence estimates is challenged by potential selection biases despite our efforts to manage them. Recruiting research samples in rural populations is complicated by individual, community, and health system factors unique to these populations. Although we did not specifically collect data on stigma and other attitudes held by rural residents that may have affected their participation in the study, anthropological research in the same rural area revealed that models of mental illness held by rural residents substantially differed from those held by local health care professionals.[37] Participation by African American women may have been adversely affected by historical events unique to the rural communities served by the CHC, including forced sterilizations and significant resistance to desegregation of the schools. These events contributed to a persistent distrust of health care professionals. The dearth of health facilities serving this area contributed to severe space problems, making it impossible to provide diagnostic assessment in a space less visible to the rural community. Taken together, these difficulties in conducting research with diverse rural populations in a seriously distressed rural health care system undoubtedly contributed to selection biases operating in our sample.

Measurement error. Probability estimates were generated using CES-D scores; therefore estimation accuracy can also be affected by measurement error. The CES-D was originally developed to identify depression in community samples.[39] Many others

have employed it in population-based studies to estimate depression rates,[19,29,75-77] as we have done; however, the extent to which the CES-D is a reliable predictor of MDE is the focus of some debate. Some studies have found the CES-D to be a reliable predictor, concordant with more precise diagnostic tests.[78,79] Others have found that the CES-D both over- and underestimated MDE and had poor concordance with standardized diagnostic interviews.[80-82] Devins and Orme[80] showed a high false positive rate using the CES-D. Because the accuracy of the CES-D as an estimator is still uncertain, findings from the current study should be interpreted with caution.

Conclusion

Both the high prevalence of MDE and the severity of psychiatric illness in the population under scrutiny in this study have important effects on the women themselves, their families, their communities, and the local, state, and federal entities that fund mental health treatment. Major depressive episode produces significant disability, interfering with marital, parental, social, and work roles, and this disability worsens with each episode of illness, significantly affecting the functioning of families and the economy of the communities they live in. The total cost of care for recurrent depressive illness also increases with each episode, with fewer and fewer successful outcomes. Perceived stigma, transportation, and other barriers to care also contribute to non-treatment and ultimately to higher rates of depression because of incomplete remissions and exacerbations associated with under-treatment of this disorder.

Already-stretched service delivery systems in rural areas may be faced with an overwhelming number of psychiatrically ill women who are difficult and costly to treat; in fact, the poor system of mental health care in many rural areas contributes to the high rates of depression we report here. Many rural community health centers cannot provide adequate services for economic reasons: in CHCs and other primary care centers providing indigent care, mental health care has been too costly to incorporate into existing organizational structures. While there are exceptions, mental health care tends to be more readily available only in those settings that have a sizeable number of insured clients.

Population-based studies such as this one can inform mental health policy on the distribution of scarce mental health resources. The identification of vulnerable populations will enable the distribution of resources to those most in need and most likely to benefit; the design of the resulting mental health services can also be tailored to reduce risk factors within specific populations in which psychiatric disorder is prevalent.

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Notes

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