Validity of the PHQ-8 and PHQ-6 During Pregnancy:

A Longitudinal Study Possible Risk Factors and Screening for Antenatal Depression

by

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Abstract

The aim of this study was to assess the validity of new modifications of the Patient Health Questionnaire (PHQ) to screen for antenatal depression throughout the three trimesters of pregnancy. Over 18% of women report depressive symptoms during pregnancy, and undiagnosed antenatal depressioncan lead to consequences such as low birth weight and increased severity of postnatal depression. However, there is no definitive screening method for antenatal depression (Hübner-Liebermann, et al., 2012). The PHQ is a questionnaire commonly used in large clinical settings to assess feelings related to depressive symptoms. This study evaluated the accuracy of the PHQ-8 at various cut-offs, but also tested a modification: the PHQ-6. This scale eliminates questions related to appetite and fatigue, as they are commonly symptoms associated with pregnancy. The PHQ-6 was found to be especially accurate in screening for antenatal depression, particularly in the second trimester, with a sensitivity and specificity of 92.86% and 62.64% respectively. This study also investigated the possible risk factors for antenatal depression, including perceived partner support and pregnancy intention, while controlling for income and education level. Low levels of perceived partner support and unplanned pregnancy were associated with increased levels of depressive symptoms.

Keywords: Patient Health Questionnaire, Edinburgh Postnatal Depression Scale, reported depression, antenatal depression, perceived partner support

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Though pregnant women seek medical consultation ten times more often than women of comparable ages, insufficient attention is given to depression and other mental health issues that could affect the well-being of both the mother and child (Bergink et al., 2010). Children born to mothers diagnosed with a psychiatric condition, such as depression, had a lower birth weight compared to children born to psychologically healthy mothers (Wolkind et al., 1981). Evans et al. (2001) found that antenatal depression has been also associated poor clinical attendance, substance misuse, low birth weight, and preterm delivery. It is also critical to diagnose depression early, particularly during pregnancy, because untreated antenatal depression is likely to continue, and become more severe postpartum (Heron, O'Conner, Evans, Golding & Glover, 2004).

Depressive diseases are the leading cause of illness in women of childbearing age worldwide, and the most observed psychiatric disorder before and after birth, with 18.4% of women reporting depressive symptoms during pregnancy (Hübner-Liebermann, et al., 2012). Additionally, children born to depressed mothers were more likely to suffer from birth complications, including preterm birth, abnormal heart rate and long-term difficulties associated with impaired cognitive and emotional development (Hübner-Liebermann et al, 2012). Women who receive effective prenatal treatment for depression can avoid many of these risk factors (Hübner-Liebermann, et al., 2012). Due to the significant potential for physical as well as emotional impairments in both the mother and child, finding an effective screening tool for depression during pregnancy is essential to improving the overall health of both.

Although accurately identifying antenatal depression during pregnancy is considered essential, it is poorly conducted in the clinical setting (Bennett et al., 2008). Prenatal depression has been reported in the range of 6.5-12.9%, and is more likely to be overlooked in pregnant than nonpregnant women (Smith et al., 2010; Ko, Furr, Dietz, & Robbins, 2012). Consequently, it is essential to determine an accurate scale that can be used to screen for depression in women.

Due to the lack of studies investigating depression in pregnancy, there is uncertainty about the best tool to accurately measure prenatal depression. For postnatal depression, the Edinburgh Postnatal Depression Scale (EPDS) has been considered the standard (Yawn et al., 2009). The EPDS is a 10-item self-report scale that screens for postnatal depression, asking questions such as "I have been worried or anxious or worried for no good reason" and "I have been so unhappy that I have had difficulty sleeping" (Cox et al., 1987). Each answer is scored on a scale of 0-4, with varying scoring methods for each question. Recently, the EPDS has been renamed to the EDS, eliminating the "postnatal" term and suggesting its use as a tool for screening for depression in other settings (Bergink et al., 2011). The majority of previous research tested depression in women postpartum, and therefore used the EPDS with a universally accepted cut-off of 13 on a X point scale indicating depression.

However, studies that have used the EPDS to screen for depression during pregnancy have proposed a variety of cut-offs (Bennett et al., 2008). A previous study tested the effectiveness of the EPDS during all three trimesters of pregnancy (Bergink et al., 2010). Using only women who were diagnosed with depression, the EPDS was found to be a valid measure of depression in pregnant women if the cut-off was changed for each trimester. In the first trimester, a cut-off of 11 was found to accurately predict half of the women with a major depressive episode, with a sensitivity and specificity of 79% and 97% respectively, and a PPV of 51. For

the second and third trimesters, the cut-off was lowered to 10, accurately predicting less than one third of women with a major depressive disorder, with a sensitivity and specificity of 70% and 96% respectively in the second trimester and a PPV of 39 in the second trimester and 29 in the third trimester (Bergink et al., 2010). Bergink (2010) also found that depression decreased further into the pregnancy, with the lowest rate occurring during the third trimester. However, though the EPDS shows adequate specificity and sensitivity for depressed women prenatally, it was designed to screen specifically for postnatal depression, and has a limited ability to directly screen for major depressive episode (Eberhard-Gran et al., 2001).

Another approach to depression screening is the Patient Health Questionnaire (PHQ) (Kroenke et al., 2009). This scale, the PHQ-9, includes nine items, such as "Feeling bad about yourself – or that you are a failure or have let yourself or your family down," and "Trouble concentrating on things, such as reading the newspaper or watching television" (Kroenke et al., 2009). Each question is answered on a scale of 0-3, with 0 indicating "not at all," 1 indicating "several days," 2 indicating "more than half the days," and 3 indicating "nearly every day" (Kroenke et al., 2009). The PHQ-8 is a modification of the PHQ-9 that is widely used in the general population (Kroenke et al., 2009). The single variation is the omission of the 9th question relating to suicidal ideation, which does not affect the accuracy of the survey (Kroenke et al., 2002). In the general population, the PHQ-8 has been well established in accurately screening for depressive symptoms, with a specificity and sensitivity of 88% for cut-off scores ≥ "10" indicating major depression (Kroenke et al., 2009).

However, despite the change in the cut-offs established by Smith et al. (2010), the PHQ-8 still had a lower specificity and specificity for pregnant women than the general population (Smith et al., 2010). Several studies have attempted to raise the cut-offs of the PHQ-8 for women

during pregnancy to eliminate error arising from responses that are normal symptoms related to pregnancy. The present study seeks to adapt the PHQ for pregnant patients with a modified version of the PHQ-8, the PHQ-6. For the PHQ-6, the two items "Feeling tired or having little energy," and "Poor appetite or overeating," were eliminated. These questions are common symptoms during pregnancy, and have the potential to increase the rate of false positives as a depsression screen. No previous studies have attempted to use a PHQ-6 for depression screening, whether for the general population or pregnancy. Therefore, the present study attempts to test this modified scoring system for women during pregnancy.

Importantly, with the exception of Bergink et al. (2011), all of the studies testing the accuracy of the EPDS or PHQ-8 have only evaluated women at one point in their pregnancy. This limits the ability to determine whether the test is accurate in all three trimesters. In addition, these studies did not account for whether the participants received effective depression treatment during the study. While there was a trend toward a decrease in depression throughout pregnancy, it is unclear whether this was attributable to treatment, or to other factors.

In this study, a longitudinal method was used to test women with the PHQ questionnaire during each trimester of pregnancy, allowing an analysis of the variation of depressive symptoms throughout the pregnancy. A consistent trend in recent studies has been a decrease in rates of depression over the pregnancy, with the highest rates occurring during the first trimester (Perren, von Wyl, Burgen, Simoni, & von Klitzing, 2005; Teixeira, Figueiredo, Conde, Pacheco, & Costa, 2009). Teixeira et al. (2009) confirmed a decrease in rates of depression throughout pregnancy, peaking at the first trimester, which has been attributed to stresses related to making adjustments, both physical and emotional, to pregnancy.

Another component of this study is the investigation of risk factors involved in depression during pregnancy. One possible factor is perceived partner support as reported by the mother. Having a supportive partner relationship during pregnancy is predicted to contribute to improved maternal and infant well being postpartum, particularly psychologically, providing a possible role for partner relationships in mental health interventions (Stapleton et al., 2012). Furthermore, increased social support has been found to buffer other stresses of pregnancy and lead to increased fetal growth (Hoffman & Hatch, 1996). Increased social support during pregnancy has also been related to increased well-being of the mother, allowing for fewer birth complications (Gjerdingen, Froberg, & Fontaine 1991; Rini, Dunkel-Schetter, Hobel, Glynn & Sandman, 2006). Kemp & Hatmaker (1989) also found that women in the low-risk group for antenatal depression experienced less anxiety, which is often comorbid with depression, when they felt they had the support of their partner.

More specifically, Dennis & Ross (2006) found that women who reported lower levels of perceived partner support were more likely to experience depressive symptoms postpartum. Decreased social support appears to be a significant risk factor for depression during pregnancy (Zuckerman, Amaro, Bauchner, & Cabral, 1989) and postnatally (Paykel, Emms, Fletcher, Rassaby, 1980). Another study also found that difficulties in social environment, including decreased partner support, are associated with antenatal depression (Pajulo, Savonlahti, Sourander, Helenius, & Piha 2001). A decreased level of partner support was one of the strongest independent antenatal predictors of postnatal depression, comparable to a previous history of depression. Therefore, it is hypothesized that low levels of perceived partner support during pregnancy is a risk factor for depression.

Another potential risk factor is unplanned pregnancy, defined as a pregnancy that occurs earlier than desired or occurs when no children are desired at the time of conception (Yanikkerem, Ay, & Piro, 2013). Women who experience an unwanted pregnancy are at an increased risk of experiencing complications with pregnancy as compared to women with desired pregnancies (Kroelinger & Oths, 2000). Antenatal depression was found to occur in greater incidence among women who did not plan to get pregnant, with 71% of women who reported an unplanned pregnancy reporting depression, while 20% of women with a planned pregnancy reported depression (Kitamura, Shima, Sugawara, & Toda, 1993; Martin, Brown, Golderberg, & Brockington, 1989). Bunevicius et al., (2010) found unplanned pregnancy to be a risk factor in antenatal depression, particularly in the first trimester. Demographics also influenced the result of studies related to unplanned pregnancies, with women in lower-income areas having a higher risk for depression (Westdahl et al., 2007). However, there is insufficient research related to unplanned pregnancies as a risk factor in depression, and variation in methodologies. For instance, some studies define an unplanned pregnancy as an unwanted pregnancy while others define an unplanned pregnancy as not intended at the time of conception (Leathers & Kelley, 2000). The present study explores the relationship of depressive symptoms to maternal reports of whether the pregnancy was a planned one.

Method

Participants

This study includes a total of 137 participants in the first trimester, 105 in the second trimester and 73 in the third trimester. 62.3% of participants were middle-income, 79.1% had some form of higher level of education and 71% were Caucasian. The participants from this study were obtained from a larger ongoing study through a perinatal registry maintained by the Department of Psychiatry's Women's Mental Health Program. Patients receiving OB-GYN care

through a midwestern University's Healthcare System (UMHS) were asked whether they are willing to participate in the study. If an expectant mother gave her consent, her partner was then contacted. If both the expectant mother and father are willing to participate, and they have not had any previous children, they were enrolled in the study.

Materials

The primary measures utilized for this study were the Patient Health Questionnaire (PHQ-8), the Significant Others Scale, as well as questions related to income level, and education level.

PHQ-8. The PHQ is an instrument used for the diagnosis of depressive disorders. In the general population, the PHQ has an extremely high specificity and sensitivity and has been widely used in clinical studies and other settings. Originally, the PHQ contained nine items, relating to frequency of depressive symptoms for more than half of the days in the past two weeks (Kroenke et al., 2009). However, the final item of the PHQ-9 was eliminated after it was seen to have minimal effect on the accuracy of the tool (Kroenke et al., 2009). As shown in Appendix A, scores for the PHQ-8 range from 0-24, with a total score of 0-4 representing no significant depressive symptoms, 5-9 representing mild depressive symptoms, 10-14 representing moderate depressive symptoms, and scores of 20-24 representing severe depressive symptoms (Kroenke et al., 2009)(see Appendix A).

PHQ-6. The PHQ-8 contains two items related to depressive symptoms that are often normal symptoms of pregnancy. These questions are "feeling tired or having little energy" and "poor appetite or overeating." Therefore, these two questions were removed to create a PHQ-6, which has not been previously tested in any population. Women still answer the questions on a

scale of 0-3, for each question. Moreover, due to the elimination of two questions, it is predicted that a lower cut-off score will be required to screen for depression.

Perceived partner support. Perceived partner support, as reported by the mother, takes into account physical, emotional, and financial support. The study asked women to complete an online survey, rating how they perceived their partner support on a scale of 1-7, with 1 indicating never receiving support and 7 indicating always receiving support (Appendix B). Perceived partner support was analyzed via an online survey in which participants answered a total of ten questions related to physical, emotional, and financial perceived partner support, such as "Lean on and turn to your partner in times of difficulty," "Get interest, reassurance, and a good feeling about yourself from your partner," and "Get physical comfort from your partner." It is expected that mothers who report decreased levels of partner support will have increased risk of depressive symptoms.

Unplanned pregnancy. Women were only asked whether the pregnancy was planned at the first trimester and were given a range of options. Women were asked, "How did you feel about becoming pregnant before the current pregnancy" and answered on a scale of 1-5. 1 indicated "I wanted to be pregnant sooner," 2 indicated "I wanted to be pregnant now," 3 indicated "I wanted to be pregnant later," 4 indicated "I did not want to be pregnant now or at any time in the future," and 5 indicated "I was unsure how I felt." For this study, women who indicated "I wanted to be pregnant later," "I did not want to be pregnant now or at any time in the future" or "I was unsure how I felt," were considered to have an unplanned pregnancy.

Procedure

This study took place throughout the entirety of the participants' pregnancies. Participants were recruited via telephone and email to complete an online survey, administered

through Qualtrics, that was individually sent to each participant. Participants were given three waves of surveys, at separate time points, via email. Recruitment was conducted individually for each wave of surveys.

The first wave of the survey, which includes the PHQ, the Significant Others Scale, related to perceived partner support, questions about whether the mother currently in depression treatment, and whether the pregnancy was planned, is given to the mother between 8-18 weeks of gestation, before the mother receives a routine prenatal ultrasound (Power, Champion, & Aris, 1988; Kroenke et al., 2009; Tolman et al., RWJ HSSP grant). The second wave of the survey, was given after the ultrasound, at 16-22 weeks' gestation. The third wave of the survey was given to the mother between approximately 34-36 weeks' gestation, prior to delivery.

Participants were limited to women who had not had any children prior to the study. Only women who completed all of the questions contained in the survey were included in analysis.

Results

Upon removal of participants who did not complete the entire survey, there were 137 participants for the first trimester, 105 participants for the second trimester, and 73 participants in the third trimester. Data obtained from the PHQ-8 and PHQ-6 of this study were compared to findings for PHQ-8 in previous studies. However, this was the first study to test the PHQ-6, so its specificity and sensitivity were evaluated separately.

Analysis

PHQ-8. The criterion used for evaluation of the PHQ-8 was that women who indicated they are currently enrolled in depression treatment were considered to be depressed. This information was used to calculate the sensitivity, specificity, Positive Predictive Value (PPV),

Negative Predictive Value (NPV), and diagnostic odds ratio for various cut-offs during each trimester. For the first trimester, a cut-off of 4 allowed for a sensitivity, specificity, and PPV of 70%, 61.54%, and 23.74%, respectively (Table 1). For the second trimester, a cut-off of 3 allowed for a sensitivity, specificity and PPV of 64.29%, 56.04%, and 18.34% respectively (Table 2). For the third trimester, a cut off of 3 produced a sensitivity, specificity, and PPV of 80%, 48.39%, and 20% respectively.

In addition to these values, the percentage of correctly diagnosed individuals was calculated for optimal cut-offs. As shown in Figures 1, 2, and 3, the areas under the ROC curves for the PHQ-8 were 0.697, 0.721, and 0.582 for the first, second, and third trimesters respectively. This indicates that the PHQ-8 can be used to screen for depression during pregnancy with a fair level of accuracy. However, in the third trimester, the PHQ-8 loses accuracy and is considered to be poor accuracy (See Figure 3).

PHQ-6. The criterion used for evaluation of the PHQ-8 was that women who indicated they are currently enrolled in depression treatment were considered to be depressed. This information was used to calculate the sensitivity, specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV), and diagnostic odds ratio for various cut-offs during each trimester. As shown in Tables 4 and 5, the PHQ-6 was fairly consistent in requiring a lower cut-off of 2 for the first and second trimesters. The PHQ-6 had a sensitivity of 60%, specificity of 72.03% and a PPV of 26.67% when used in the first trimester. For the second trimester, the PHQ-6 had a sensitivity, specificity, and PPV of 92.86%, 62.64%, and 27.66%, respectively. However, for the third trimester, a higher cut-off of 3 was marginally more accurate in screening for depression, allowing for a sensitivity of 55.56%, specificity of 60.32%, and PPV 16.67%

(Table 6). The number of accurately diagnosed individuals was also calculated for each trimester at optimal cut- offs.

As shown in Figures 4, 5, and 6, the areas under the ROC curves were 0.688, 0.768, and 0.586 for the first, second and third trimesters respectively. The PHQ-6 also lost accuracy in the third trimester. These show that the measures are considered to be fairly accurate for the first two trimesters, but less accurate for the third trimester.

Perceived partner support. Women were asked about their feelings of partner support during each trimester, allowing data to be analyzed separately for each trimester (See Table 7). When education and income level were controlled for, hierarchical regression analysis demonstrated that increased partner support was associated with with decreased levels of depression in the second trimester (β=-0.26, t=-3.04, p=0.003) and third trimester (β=-0.37, t=-2.98, p=0.004). However, perceived partner support did not significantly predict depression in the first trimester (β=-0.164, t=-1.94, p=0.054). For this analysis, the PHQ-6 scores were used, as they were found to be more accurate in the second and third trimesters.

Unplanned pregnancy. Unplanned pregnancy correlated with an increase of depressive symptoms in the second trimester (β=0.19, t=2.13, p= 0.036) (See Table 7). For this analysis, the PHQ-6 scoring was also used for analysis.

Discussion

The present study sought to investigate a method to screen for depression in pregnant women, focusing on the PHQ-8 and a newly established PHQ-6, while also evaluating possible risk factors for antenatal depression. Participants were given PHQ-8 and perceived partner support surveys during each trimester of pregnancy in a longitudinal design. The primary purpose of the study was to establish a valid cut-off for the PHQ-8, and to create a modification

called the PHQ-6 to allowing for an accurate antenatal depression screening tool. This was achieved, particularly with the PHQ-6. At a lower cut-off score than that used for the PHQ-8, the PHQ-6 provided a high sensitivity and specificity, particularly in the second term. The PHQ-8 was also accurate in screening for depression, with fairly high sensitivities and specificities for all trimesters. However, the PHQ-6 was slightly better for screening in the second and third trimesters. Consistent with previous studies, the cut-off of the PHQ-8 was highest for the first trimester, but remained the same for the second and third trimesters.

These findings correspond to a similar study testing the validity of the EPDS at each trimester. The cut-off was highest for the first trimester, but stayed constant for the second and third trimesters (Bergink et al., 2011). The sensitivities obtained in the present study were equal or higher than those achieved by Bergink et al. (2011) for the PHQ-8 at all three trimesters. However, the sensitivities achieved using the PHQ-8 and PHQ-6 in this study were lower than those of the EPDS study for the first and third trimester. The EPDS study which achieved a sensitivity of 79% for the first trimester, 70% for the second trimester, and 76% for the third trimester. Notably, the EPDS study had greater specificities for all three trimesters, with values of 97%, 96%, and 94% for each trimester, respectively, as well as higher areas under the ROC curves, (Bergink et al., 2011). Moreover, this discrepancy between the amount accurately diagnosed, and the sensitivities and specificities calculated as well as the variance in the area under the ROC, can be attributed the diagnostic criterion that was used in this study.

The second hypothesis of this study was that an increased level of perceived partner support is associated with a lower risk for depression. This hypothesis was supported for two of the three trimesters, with women in the study who reported higher levels of perceived partner support having decreased incidence of depression. The majority of previous studies have tested

the role of social support more generally as opposed to perceived partner support as risk factors. Additionally, the majority of studies have asked women about social or partner support at one point during pregnancy, or at a postnatal time point. Therefore, the present study demonstrates that perceived partner support is a risk factor for depression throughout the majority of the pregnancy. This indicates that establishing a stronger level of partner support may influence the psychological well-being of the mother, and potentially the physical health of the baby. This may also suggest interventions that would work to increase partner support early in the pregnancy.

A third hypothesis was that unplanned pregnancy is correlated with increased risk of depressive symptoms. This hypothesis was supported for the second trimester in the study. Participants who reported that the pregnancy was unplanned had a higher incidence of depression in the second trimester. Women who did not plan to become pregnant, but who received greater levels of partner support, could have had a decreased incidence in depressive symptoms. Moreover, in the third trimester, only partner support was significantly correlated with increased incidence in depression. It is important for future research to confirm whether unplanned pregnancies are correlated with depression because depressive symptoms can lead to difficulties with parenting as well as emotional and behavior problems in children (Leathers et al., 2000; Gelfand & Teti, 1990; Webster-Stratton, 1988; Dumas, Gibson, & Albin, 1989; Lahey et al., 1988; Webster-Stratton, 1988).

The study was limited in its scope by a lack of diversity in income and education among the participants. However, the primary limitation of this study was the criterion that women who reported that they were currently receiving support or treatment for depression were considered to be depressed for analysis. In future studies, it would be ideal to know the rates of women in a

study sample diagnosed with depression to compare rates provided by the PHQ-8 and PHQ-6 at each trimester. Additionally, future research should investigate whether administering the PHQ-8 during the first trimester, before symptoms of fatigue and change in appetite appear for most women, and the PHQ-6 during the second and third trimesters would increase accuracy in antenatal depression screening. This would create screening method more targeted towards pregnant women, focusing on symptoms of depression rather than common symptoms of pregnancy.

Additionally, for future research, it would be beneficial to test whether healthcare providers should use the PHQ-8 during the first trimester, before most women experience changes in appetite and fatigue, followed by the use of the PHQ-6 in the second and third trimester, eliminating these variables from screening. Kroenke et al. (2002) developed a diagnostic algorithm for the general population that screens for depression when using the PHQ-9. For this diagnostic algorithm, a patient is diagnosed with a particular depressive syndrome based on answers to a specific set of questions within the PHQ-9. For instance, if answers to the first two items summate to a score of five or the majority of the answers are "more than half of the days," then the patient is considered to have major depressive disorder (Kroenke et al., 2002). This more extensive screening process may prove useful in future investigations of the optimal cut-off for antenatal depression screening using the PHQ.

Conclusion

This study has demonstrated that use of the PHQ-6 is optimal for antenatal depression screening in the second and third trimesters. The PHQ-6 contains fewer questions than the previously used EPDS and PHQ-8, allowing for an efficient method for preliminary depression screening. This study also demonstrated that receiving increased partner support reduces the risk

of antenatal depression, even if the pregnancy was unplanned. Unplanned pregnancy was correlated with an increased incidence of depression in the second trimester. Nonetheless, partner support proved to be a more significant variable in predicting the risk of antenatal depression. Given the observed effects of antenatal depression on the health of both of the mother and child, this research promises to improve the quality of life in pregnant women, and to prevent and screen for risk factors of depression during all trimesters of pregnancy.

Table 1
Psychometric Characteristics of the PHQ-8 during the first trimester of the study sample (N=137)

Cut Off Score	Sensitivity	Specificity	PPV	NPV	Diagnostic Odds Ratio
24	5.00	99.15	50	85.93	6.11
15	5.00	98.29	33.33	85.82	3.03
14	10.00	97.44	40.00	86.36	4.22
12	10.00	96.58	33.33	86.26	3.14
11	25.00	95.73	50.00	88.19	7.47
9	25.00	93.16	38.46	87.90	4.54
8	35.00	91.45	41.18	89.17	5.67
7	45.00	86.32	36.00	90.18	5.17
6	55.00	67.92	24.44	88.89	4.32
5	**70.00**	**61.54**	**23.73**	**92.31**	**2.98**
4	80.00	51.28	21.92	93.75	3.73

Table 2
Psychometric Characteristics of the PHQ-8 during the second trimester of the study sample (N=105)

Cut Off Score	Sensitivity	Specificity	PPV	NPV	Diagnostic Odds Ratio
17	0	98.90	0	86.54	0
11	0	97.80	0	86.41	0
9	0	96.70	0	86.27	0
8	0	94.51	0	86.00	0
7	7.14	91.21	11.11	86.46	0.79
6	14.29	89.01	16.67	87.10	1.35
5	21.43	81.32	15	87.06	1.18
4	42.86	71.43	18.75	89.04	1.875
3	**64.29**	**56.04**	**18.37**	**91.07**	**2.295**

Table 3
Psychometric Characteristics of the PHQ-8 during the third trimester of the study sample (N=73)

Cut Off Score	Sensitivity	Specificity	PPV	NPV	Diagnostic Odds Ratio
12	0	98.41	0	86.11	0
10	0	93.65	0	85.51	0
9	0	90.48	0	85.07	0
8	20.00	88.89	22.22	87.50	2
7	40.00	82.26	26.67	89.47	3.09
6	40.00	74.19	20	88.46	1.92
5	50.00	64.52	18.52	88.89	1.82
4	50.00	51.61	14.29	86.49	1.07
3	**80.00**	**48.39**	**20.00**	**93.75**	**3.75**

Table 4
Psychometric Characteristics of the PHQ-6 during the first trimester of the study sample (N=137)

Cut Off Score	Sensitivity	Specificity	PPV	NPV	Diagnostic Odds Ratio
15	5.00	99.15	50.00	86.03	6.16
8	10.00	99.15	66.67	86.67	13.00
7	10.00	98.31	50.00	86.57	6.44
6	15.00	95.76	37.50	86.92	3.99
5	25.00	93.22	38.46	88.00	4.58
4	40.00	90.83	42.11	90.88	6.61
3	50.00	84.75	35.71	90.91	5.56
2	**60.00**	**72.03**	**26.67**	**91.40**	**3.86**

Table 5

Psychometric Characteristics of the PHQ-6 during the second trimester of the study sample (N=105)

Cut Off Score	Sensitivity	Specificity	PPV	NPV	Diagnostic Odds Ratio
13	0	98.9	0	86.54	0
7	0	97.8	0	86.41	0
6	0	96.7	0	86.27	0
5	0	94.51	0	86	0
4	35.71	87.91	31.25	89.89	4.04
3	57.14	78.02	28.57	92.21	4.73
2	**92.86**	**62.64**	**27.66**	**98.28**	**21.79**

Table 6

Psychometric Characteristics of the PHQ-6 during the third trimester of the study sample (N=73)

Cut Off Score	Sensitivity	Specificity	PPV	NPV	Diagnostic Odds Ratio
9	0	97.44	40	86.36	0
8	0	96.58	33.33	86.26	0
6	10	86.32	36.00	90.18	1.35
5	10	81.2	31.25	90.48	1.18
4	55.56	88.68	45.45	92.12	7.83
3	**55.56**	**60.32**	**16.67**	**90.48**	**1.52**
2	50.00	63.20	16.62	88.37	1.52

Table 7: *Regression Analysis for Perceived Partner Support and Pregnancy Intention Across Three Trimesters*

Trimester	Variable	B	SE(B)	β	ΔR^2	Adjusted R^2
1	Step 1				0.105*	0.109*
	Education	-0.774	0.350	-0.202*		
	Income	-0.316	0.161	0.178		
	Step 2					
	Education	-0.675	0.365	-0.176	0.006	0.091
	Income	-0.319	0.161	-0.180		
	Perceived Partner Support	0.191	0.197	0.083		
	Step 3				0.024	0.109
	Education	-0.583	0.364	-0.152		
	Income	-0.282	0.161	-0.159		
	Perceived Partner Support	0.138	0.197	0.060		
	Pregnancy Intention	-0.042	0.022	-0.164		
2	Step 1				0.185*	0.168*
	Education	-0.561	0.283	-0.192*		
	Income	-0.400	0.122	-0.320*		
	Step 2				0.090*	0.253*
	Education	-0.523	0.269	-0.180		
	Income	-0.367	0.116	-0.293*		
	Perceived Partner Support	-0.062	0.018	-0.302*		
	Step 3				0.032*	0.279*
	Education	-0.381	0.272	-0.131		
	Income	-0.380	0.114	-0.304*		
	Perceived Partner Support	-0.054	0.018	-0.264*		
	Pregnancy Intention	0.295	0.139	0.190*		
3	Step 1				0.026	-0.003
	Education	-0.368	0.424	-0.109		
	Income	-0.144	0.201	0.090		
	Step 2				0.135*	0.123*
	Education	-0.035	0.410	-0.010		
	Income	-0.006	0.192	-0.004		
	Perceived Partner Support	-0.067	0.021	-0.396*		
	Step 3				0.129*	0.129*
	Education	0.077	0.418	0.023		
	Income	-0.016	0.192	-0.010		
	Perceived Partner Support	-0.062	0.021	-0.366*		
	Pregnancy Intention	-0.289	0.237	-0.145		

Note: Total F (4, 133)=5.209* *for step 3 Trimester 1,* Total F (4, 97)=10.747*, Total F (4, 66) *for Step 3 Trimester 3= 3.601*, *p<0.05*

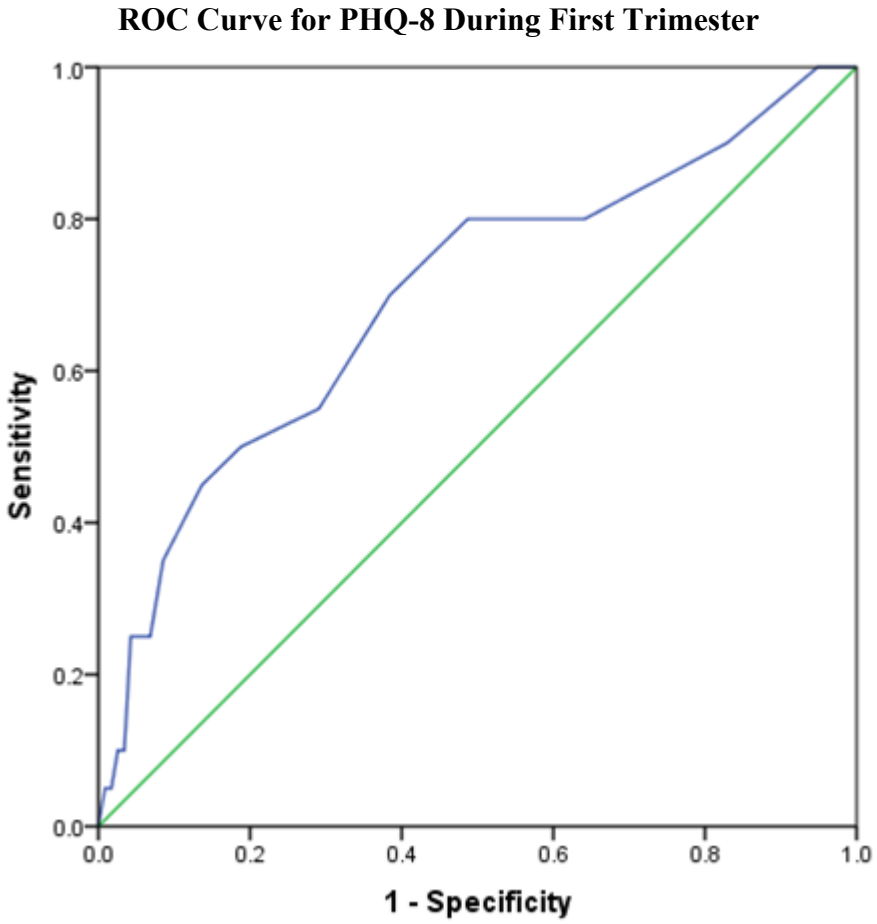

Figure 1: ROC Curve for PHQ-8 During First Trimester. This figure illustrates the effectiveness of the PHQ-8 during the first trimester (Area under curve = 0.697).

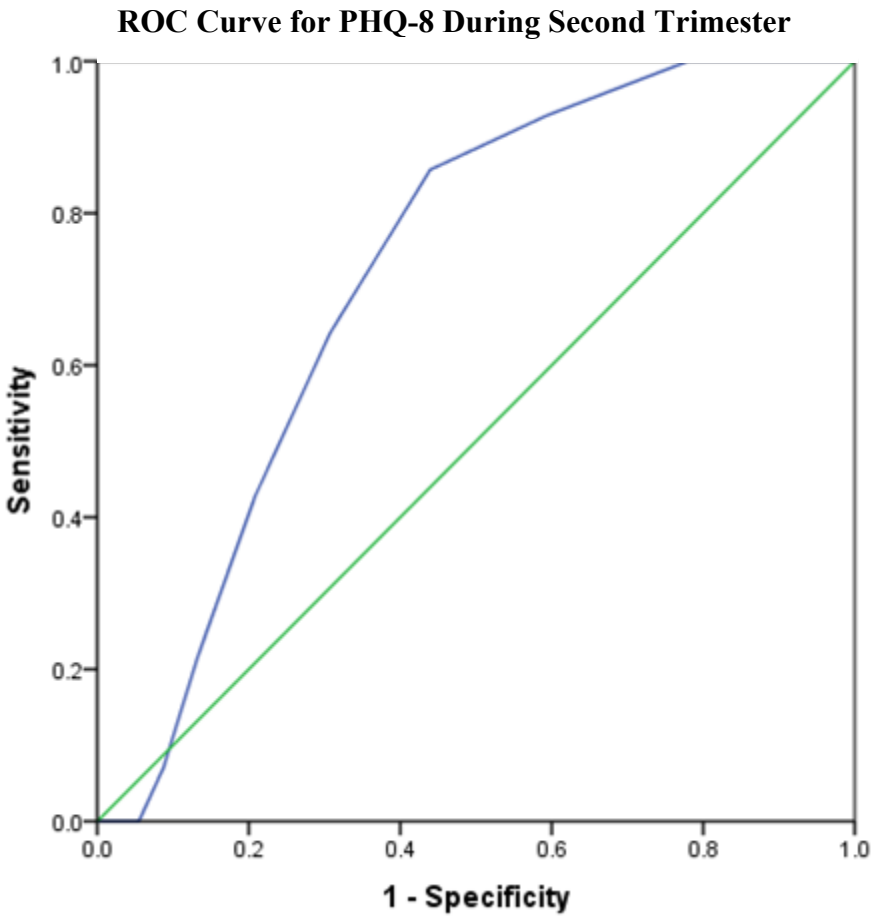

Figure 2: ROC Curve for PHQ-8 During Second Trimester. This figure illustrates the effectiveness of the PHQ-8 during the second trimester (Area under curve = 0.721)

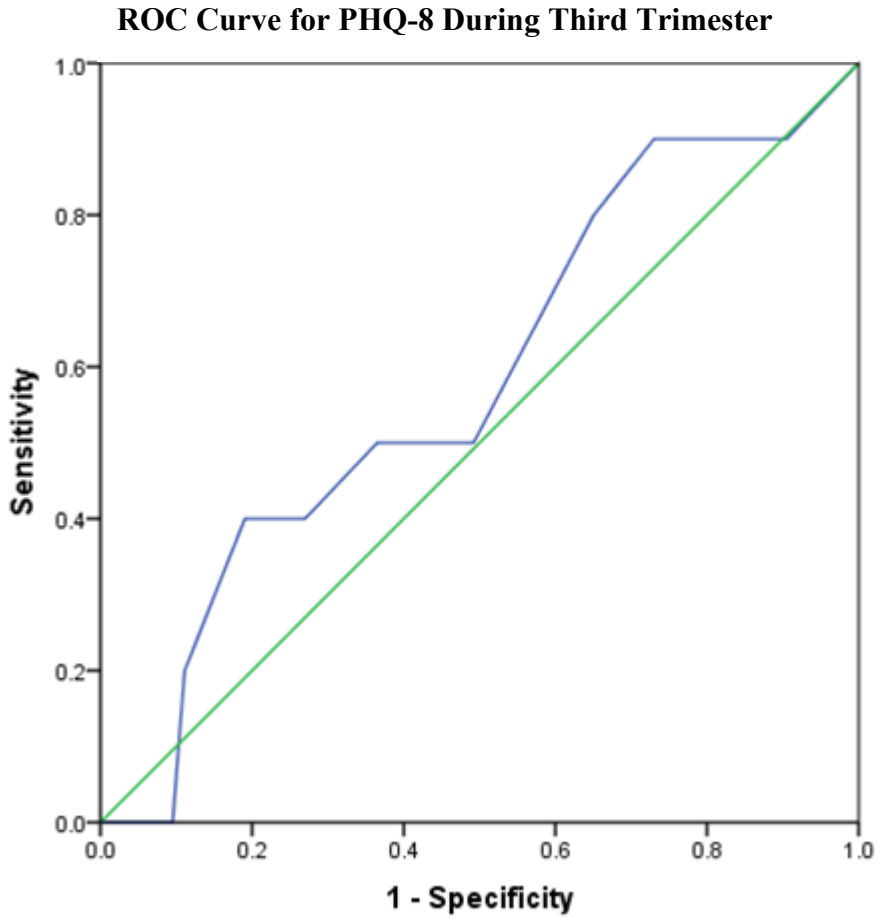

Figure 3: ROC Curve for PHQ-8 During Third Trimester. This figure illustrates the effectiveness of the PHQ-8 during the third trimester(Area under curve = 0.582).

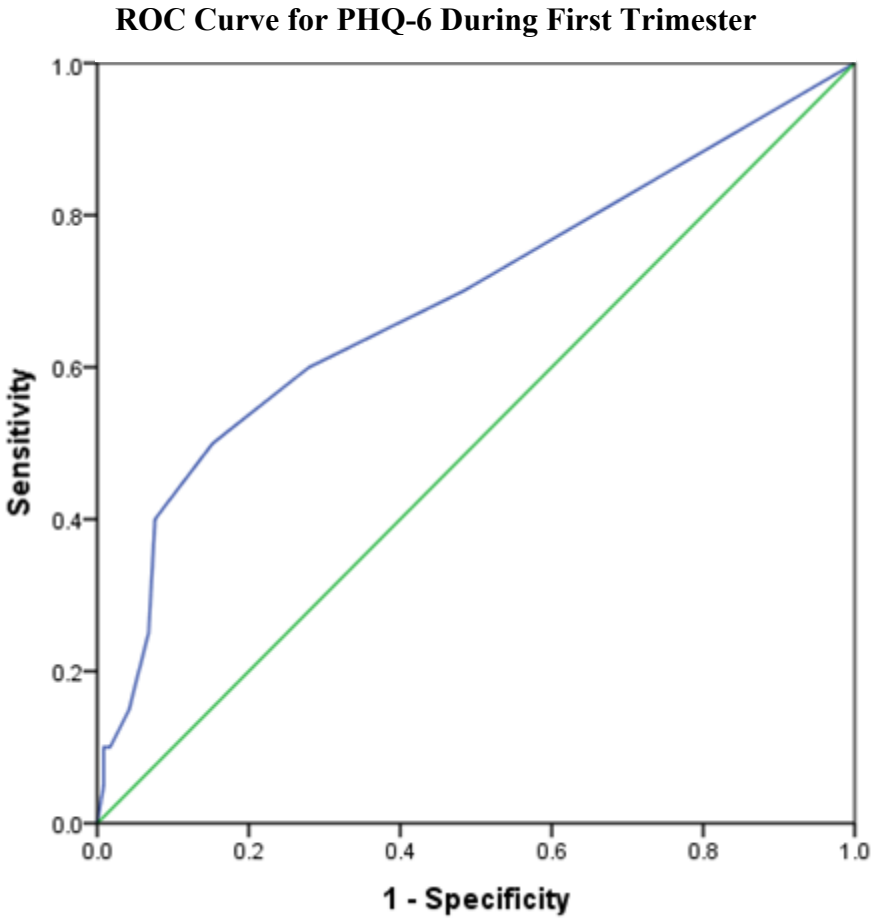

Figure 4: ROC Curve for PHQ-6 During First Trimester. This figure illustrates the effectiveness of the PHQ-6 during the first trimester (Area under curve = 0.688).

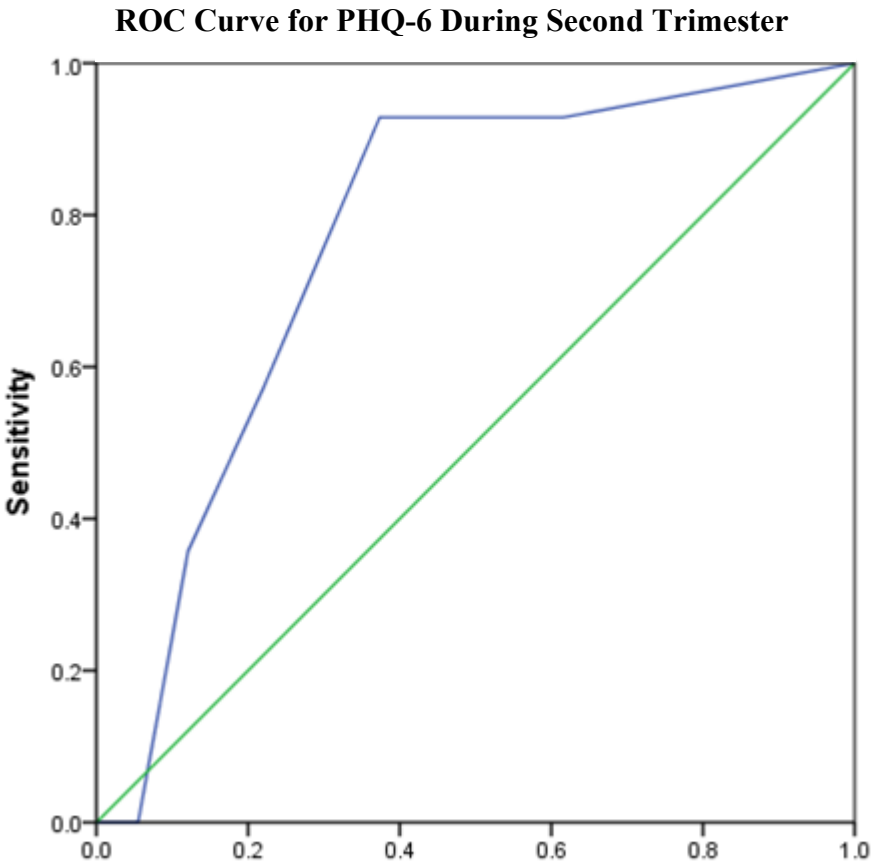

Figure 5: ROC Curve for PHQ-6 During Second Trimester. This figure illustrates the effectiveness of the PHQ-6 during the second trimester (Area under curve = 0.768).

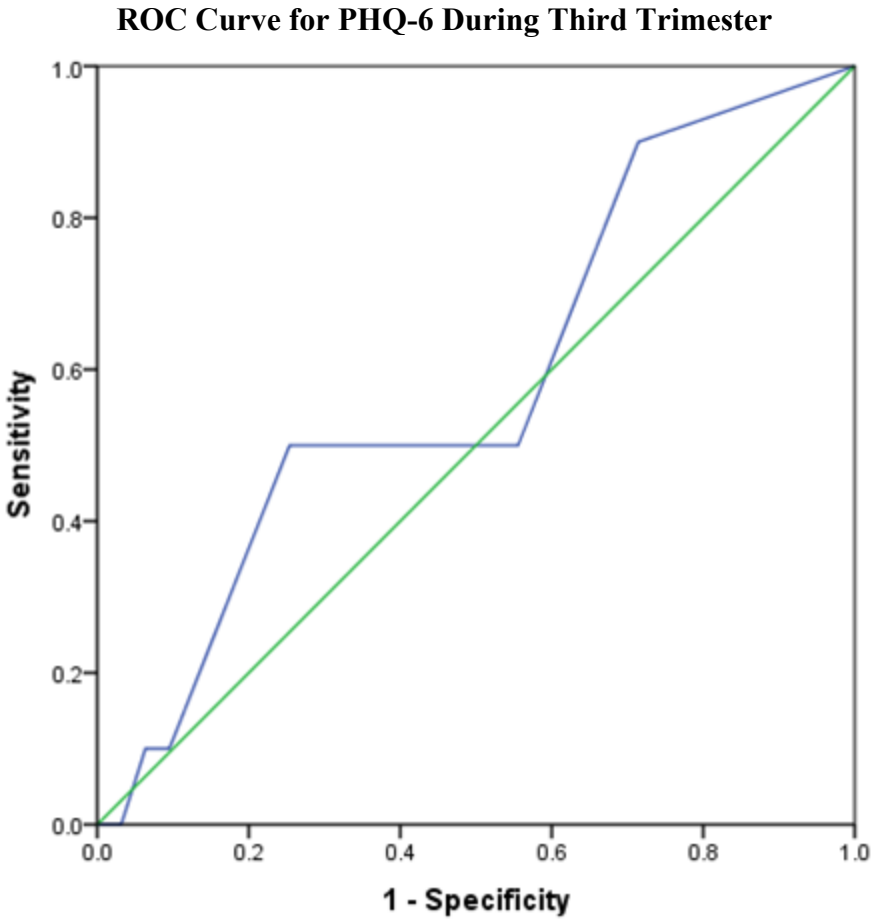

Figure 6: ROC Curve for PHQ-6 During Third Trimester. This figure illustrates the effectiveness of the PHQ-6 during the third trimester (Area under curve = 0.586).

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Appendix A

Sample PHQ-8 Survey

Over the *last two weeks*, how often have you been bothered by any of the following:

	Not at all (0)	Several days (1)	More than half the days (2)	Nearly every day (3)
1. Little interest or please in doing things?.....	☐	☐	☐	☐
2. Feeling down, depressed, or hopeless?.....	☐	☐	☐	☐
3. Trouble falling or staying asleep, or sleeping too much?.....	☐	☐	☐	☐
4. Feeling tired or having little energy?.....	☐	☐	☐	☐
5. Poor appetite or overeating?.....	☐	☐	☐	☐
6. Feeling bad about yourself – or that you are a failure or have let yourself or your family down?	☐	☐	☐	☐
7. Trouble concentrating on things, such as reading the newspaper or watching television?	☐	☐	☐	☐
8. Moving or speaking so slowly that other people could have noticed? Or the opposite – being so fidgety or restless that you have been moving around a lot more than usual?.....	☐	☐	☐	☐

Note: This sample PHQ-8 was adapted from Kroenke, K. & Spitzer, R.L. (2002). The PHQ-9: A new depression and diagnostic severity measure.

Appendix B

Sample Perceived Partner Support Survey

Please respond to each question using the following scale:
1=never
4=usually
7 = always

	1	2	3	4	5	6	7
1. Trust, talk to frankly, and share feelings with your partner?	☐	☐	☐	☐	☐	☐	☐
2. Lean on and turn to your partner in times of difficulty?	☐	☐	☐	☐	☐	☐	☐
3. Get interest, reassurance, and a good feeling about yourself from your partner?	☐	☐	☐	☐	☐	☐	☐
4. Get physical comfort from your partner?	☐	☐	☐	☐	☐	☐	☐
5. Resolve unpleasant disagreements with your partner	☐	☐	☐	☐	☐	☐	☐
6. Get financial and practical help from your partner	☐	☐	☐	☐	☐	☐	☐
7. Get suggestions, advice, and feedback from your partner	☐	☐	☐	☐	☐	☐	☐
8. Spend time with your partner socially?	☐	☐	☐	☐	☐	☐	☐
9. Get help from your partner in an emergency?	☐	☐	☐	☐	☐	☐	☐
10. Share interests and hobbies and have fun with your partner	☐	☐	☐	☐	☐	☐	☐