



RESEARCH ARTICLE

Predictive statistical model for the factors associated with prenatal depression among pregnant adolescents in Maha Sarakham province, Thailand [version 1; peer review: awaiting peer review]

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Abstract

Background: The rate of adolescent pregnancy has steadily increased in Thailand over the years and depression is considered an important psychological problem in many pregnant adolescents. The aims of this study were to determine the proportion of pregnant adolescents with depressive symptoms and to identify a predictive statistical model for the factors related to prenatal depression among adolescents at antenatal care clinics in 10 community health centers in Maha Sarakham Province.

Methods: A cross-sectional study was conducted in 230 randomly selected participants who were pregnant adolescents who volunteered to participate in the research, those aged ≤ 19 years, and had an estimated gestational age of ≤ 18 weeks. Those with severe obstetrics complications or a psychiatric disorder were excluded. The subjects were asked to complete a demographic questionnaire and the Thai version of the Edinburgh Postnatal Depression Scale. The mean age of participants was 17.0 (± 1.4) years.

Results: Overall, 43.9% of the adolescents had a cut off score of ≥ 11 , suggestive of prenatal depressive symptoms. Multivariate analysis identified that pregnant adolescents at a primary school education level were 6.5 times more likely to experience depression symptoms than those with a diploma. Those who were emotionally supported by their husband or partner compared to relatives had a five times higher chance of presenting depressive symptoms, and those with a perceived bad relationship with their husband or partner seven times higher. The model was well-calibrated (goodness-of-fit test, $p = 0.675$) and had high discriminative power (ROC curve = 0.73 (95%CI = 0.67 to 0.79)).

Conclusions: More attention is needed to reduce the known problems with pregnant adolescents and to ensure they continue with their education. Lastly, public education to support mental health initiatives for individuals and families should be encouraged.

Keywords

Adolescent pregnancy, Community hospital, Prenatal depression, Thai Edinburgh Postnatal Depression Scale

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Any reports and responses or comments on the article can be found at the end of the article.

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Introduction

Adolescents can develop health problems during pregnancy that adversely affect both physical and psychological health (UNFPA, 2014b). Pregnant adolescents commonly experience depressive symptoms (Lancaster *et al.*, 2010); the prevalence has been estimated to be approximately 20% (Abajobir *et al.*, 2016; Nasreen *et al.*, 2011; Roomruangwong & Epperson, 2011). Pregnant adolescents with depression and their infants are at a higher risk of increased morbidity (Tzilos *et al.*, 2012), resulting in a greater risk for preterm labor and intrauterine fetal growth retardation (Field, 2017; Grote *et al.*, 2010; Orr *et al.*, 2007). Depressed pregnant adolescents also have a greater risk of suicidal ideations and suicide attempts than those without depression (Hodgkinson *et al.*, 2010).

Risk factors predisposing adult pregnant women to depressive symptoms include daily maternal stress, loss of self-confidence, and inadequate social support and emotional coping (Da Costa *et al.*, 2000; Dennis *et al.*, 2007). Risks factors for depression among pregnant adolescents include not only those listed for adult women but also include unplanned pregnancy, low education, non-marital status, alcohol and drug use, inadequate income, and a history of emotion, sexual, and physical abuse (Koniak-Griffin *et al.*, 1996; Meltzer-Brody *et al.*, 2013; Siegel & Brandon, 2014; Uthaisaisanwong *et al.*, 2015). Because prenatal depression in adolescence is a significant factor for predicting postpartum depression (Dennis *et al.*, 2007), the ability to identify prenatal depression at the earliest stage of pregnancy is particularly important for the health and well-being of mothers and infants and for public health in general.

Thailand has a high rate of adolescent pregnancy (Ministry of Public Health, 2017). Studies by Limlomwongse & Liabsuetrakul (2006), and Uthaisaisanwong *et al.* (2015) in Bangkok and the South of Thailand have shown that the incidence of prenatal depression among adolescents is 46% and 20.5%, respectively. Little research, however, has been conducted in northeastern Thailand, especially in Maha Sarakham province, where the rate of adolescent pregnancy is reported to be high. Therefore, the aim of this study was to estimate the proportion of prenatal depressive symptoms among adolescents in the Maha Sarakham Province, Thailand, and to identify factors associated with prenatal depression symptoms in adolescents.

Methods

Study subjects and data collection

This cross-sectional study was conducted from July to October 2017 with 230 pregnant adolescents. The participants were selected using simple randomization in order to avoid sampling bias. Every week, two to three pregnant adolescents were recruited from each antenatal clinic in 10 community hospitals in the Maha Sarakham province, Thailand by randomizing HN numbers (patient identification numbers were drawn as lots) among all of the pregnant adolescents who met the inclusion criteria. Inclusion criteria were 1) pregnant adolescents who volunteered to participate, 2) those ≤ 19 years of age, 3) and those with an estimated gestational age of ≤ 18

weeks. The exclusion criteria were pregnant adolescents with obstetric complications or those who had been diagnosed with a psychiatric disorder. Initially, a sample size of 209 adolescents was calculated (Hsieh *et al.*, 1998) assuming a prenatal depression prevalence of 46% (Uthaisaisanwong *et al.*, 2015) with an alpha error of 0.05 and a power of 80%. An extra 21 adolescents (10%) were added to compensate for possible incomplete data, giving a total sample of 230 participants. All participants were recruited in person during their first appointment at the antenatal clinic. After receiving informed consent, participants provided their demographic and socioeconomic information on a written questionnaire (available as *Extended data*; Jantasin *et al.*, 2019b, Jantasin *et al.*, 2019c) then completed the Thai version of the Edinburgh Postnatal Depression Scale (Pitanupong *et al.*, 2007).

The Edinburgh Postnatal Depression Scale (EPDS) is an assessment tool available in Thailand to screen for depressive symptoms. Originally developed to detect possible depressive symptoms in the postpartum period (Cox *et al.*, 1987), the EPDS has been successfully used to identify depressive symptoms in prenatal women (Eberhard-Gran *et al.*, 2001; Lee *et al.*, 2004). In 2003, the EPDS was translated to Thai by Pitanupong *et al.* (2007). Three doctorally prepared Thai experts in midwifery reviewed the translation for content validity and approved all items without recommendations. Published psychometric testing supports the 10-item self-assessment questionnaire's validity and reliability among Thai pregnant women (Pitanupong *et al.*, 2007; Vacharaporn *et al.*, 2003). Preliminary testing for internal reliability using 30 people, not part of the study, showed a Cronbach's alpha = 0.76.

Each of the ten EPDS items has four response options ranging from 0 to 3. The response descriptors vary somewhat depending on the item's wording. The participants choose the descriptor most closely indicating their emotions during the prior seven days. Seven items require reverse scoring so that higher total scores are more suggestive of depressive symptoms. A total score can range between 0 and 30. The cutoff score for the EPDS that indicates the presence of depression symptoms has been reported between 10 and 14 (Bolton *et al.*, 1998; Evans *et al.*, 2001). We defined an EPDS score of 11 or greater as a positive screen for depressive symptoms (Uthaisaisanwong *et al.*, 2015).

Statistical analysis

Data analysis were conducted with descriptive statistics to present demographic data. Multivariable analysis through unconditional multiple logistic regression was used to identify factors associated with prenatal depression among pregnant adolescents and to determine potential associations of socio-demographic information with prenatal depressive symptoms (EPDS $\geq 11=1$ and $<11=0$). Crude analysis through simple logistic regression analysis was used. After that, all variables with p-values less than 0.25 (Hosmer & Lemeshow, 2000) were selected to include an initial regression model for the assessment of multicollinearity. Then, backward elimination for a fitted regression model was performed. The model was

developed and its goodness-of-fit was evaluated by determining the predictive accuracy and cut-off that was suitable for clustering towards depressive symptoms among pregnant adolescents using a receiver operating characteristics (ROC) curve. Statistical significance was set at $p < 0.05$. Analyses were done with Statistical Package for the Social Sciences (SPSS) software, version 18.0 (SPSS®, Chicago, USA).

Ethical considerations

The study was approved by the Institutional Ethics Committee at Mahasarakham University, Thailand. (Ref No. 054/2560; 21 July 2017). Adolescents of legal age offered their informed consent volunteering to participate in the study. Parents of adolescents younger than 18 years of age provided written informed consent prior to their child's participation.

Results

Association between depressive symptoms and participant variables

Of the 230 participants, 101 adolescents (43.9%) met the EPDS cutoff score of ≥ 11 suggestive of prenatal depressive symptoms. The remaining 129 adolescents (56.1%) scored below the cutoff score (Table 1).

The mean age of the 101 adolescents was 17.0 (SD \pm 1.4) years old. The majority of those were >15 years old ($n=80$, 80.0%) and 21 (20.0%) were ≤ 15 of age. In bivariate analysis, depressive symptoms were significantly correlated with receiving less education, being a single mother with one supporter, having a husband as a supporter, and having a poor relationship with a husband, their family and friends. Pregnant adolescents who only finished primary school were 7.3 times more likely to have prenatal depressive symptoms than those with education to diploma level. In terms of marital status, the adolescents who were single mothers were at 9.4 times higher risk of depressive symptoms than those living together with their partner, with or without being married. Pregnant adolescents who had one supporter were 2.8 times more likely to be at risk of depressive symptoms compared to those with three supporters. The adolescents who had a husband as a supporter tended to be 3.7 times higher at risk of depressive symptoms when compared to those who were supported by relatives. Moreover, pregnant adolescents who reported a bad relationship with their husband, family, and friends were 5.5 times, 2.2 times, 2.8 times higher at risk of depressive symptoms than those with good relationship, respectively (Table 1). Responses to each question from each participant are available as *Underlying data* (Jantasin *et al.*, 2019a).

Linear regression analysis

According to Table 1, eight variables with a p -value of less than 0.25 were selected and included in the initial regression model. From the multiple logistic regression analysis, there were only three factors that were significantly associated with prenatal depressive symptoms: level of education, the perceived support from a husband or partner, and the perceived relationship with a husband or partner (Table 2). Those pregnant adolescents with a primary school education level were 6.5

times more likely to develop prenatal depressive symptoms compared to those with a diploma degree [AOR=6.5 (95% CI: 1.5 to 28.7)]. The pregnant adolescents who perceived support from their husband or partner were five times more likely to have prenatal depressive symptoms compared to those with relatives' support [AOR=5.1 (95% CI: 1.9 to 14.5)]. The chance of developing prenatal depressive symptoms in those with a bad relationship with the husband was approximately seven times higher than pregnant adolescents who reported a good relationship [AOR=7.4 (95% CI: 3.1 to 17.8)].

Three variables in the final model influencing with prenatal depressive symptoms significantly were as follows:

$$P(Y=1/X) = 1/[1+\text{EXP}(-1.99+ 1.88 \text{ Education; Primary} + 0.85 \text{ Education; Secondary} + 1.65 \text{ Supporter; Husband/partner} + 0.45 \text{ Supporter; Their family} + 2.00 \text{ Relationship with a husband/partner}]$$

To validate how well the model fits a set of observations, Hosmer-Lemeshow's goodness-of-fit test was used and the results showed that the model was well-fit data (p -value = 0.675). The results of testing the model's predictive power by creating the relational graph of sensitivity and 1-specificity showed that the model had a good predictive power with ROC of 0.73 (95% CI 0.67 to 0.79) (Figure 1) at the cut point of -0.11, a sensitivity of 57.43, a specificity of 81.40, and an accuracy of 71.30.

Discussion

There was an unexpectedly high proportion of pregnant adolescents with prenatal depression symptoms in the ten community hospitals in the Maha Sarakham Province, at 43.9%. This proportion is twice the number reported worldwide (Abajobir *et al.*, 2016; Nasreen *et al.*, 2011; Roomruangwong & Epperson, 2011). However, the findings are similar to the studies reported by Uthaipaisanwong *et al.* (2015) and Nirattharadorn *et al.* (2005), with the risk for prenatal depression from EPDS screening at 46% and 47.1%, respectively. Findings indicate that the underlying reasons are associated with the adolescents' low level of education, the husband or partner who supports her, and the relationship she has with him. Bunevicius *et al.* (2009) and Lydsdottir *et al.* (2014) also found that pregnant adolescents with a low level of education are more at risk of having depressive symptoms (see also Field (2017) and Osok (2016)). In Thailand, pregnancy in adolescents often leads to dropping out from school. Consequently, a low level of education limits the opportunities for better employment and earning a higher income, which results in increased stress levels of these pregnant adolescents (Kaewjanta, 2012).

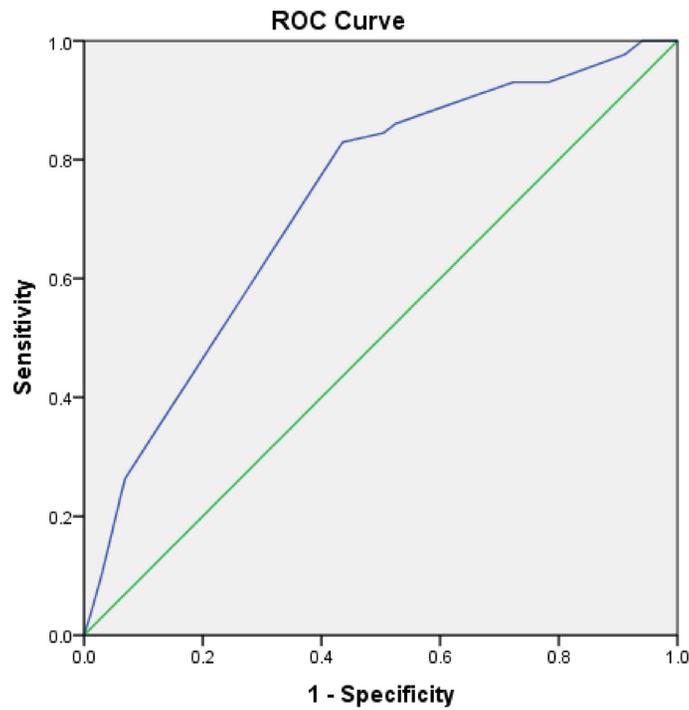
We found that not only was the emotional support coming from a husband or partner (compared to the pregnant adolescent's family) a risk factor for depressive symptoms, but also a poor relationship with that person contributes to her depression. This finding seemingly contradicts Stapleton *et al.* (2012) who found that a husband's support reduces stress and positively

Table 1. Simple logistic regression assessing whether factors among participants were associated with depressive symptoms.

Factors	Depressive symptoms (n = 101) n (%)	Not depressive symptoms (n = 129) n (%)	Crude OR (95%CI)	p- value
Age (years)				0.231
≤15 years	21 (52.5)	19 (47.5)	1.5 (0.8, 3.0)	
>15 years	80 (42.1)	110 (57.9)	1	
Education				0.006
Primary	17 (70.8)	7 (29.2)	7.3 (1.9, 27.9)	
Secondary	79 (42.5)	107 (57.5)	2.2 (0.8, 6.3)	
Diploma	5 (25.0)	15 (75.0)	1	
Return to study				0.886
No return to study	58 (45.3)	70 (54.7)	1.2 (0.6, 2.4)	
Return to formal education	26 (42.6)	35 (57.4)	1.1 (0.5, 2.3)	
Return to non-formal education	17 (41.5)	24 (58.5)	1	
Occupation				.545
Unemployed	86 (44.8)	106 (55.2)	1.2 (0.6, 2.5)	
Employee	15 (39.5)	23 (60.5)	1	
Personal income				0.545
No	86 (44.8)	11 (52.4)	1.2 (0.6, 2.5)	
Yes	15 (39.5)	118 (56.5)	1	
Marital status				<0.001
Single mom	13 (86.7)	2 (13.3)	9.4 (2.1, 42.6)	
Living together with or without marriage	88 (40.9)	127 (59.1)	1	
Living with				0.553
Husband/partner	13 (50.0)	13 (50.0)	1.4 (0.6, 3.3)	
Adolescent's family	26 (48.2)	28 (51.9)	1.3 (0.7, 2.5)	
Husband/partner's family	62 (41.3)	88 (58.7)	1	
Pregnancy planning				0.720
Yes	10 (47.6)	11 (52.4)	1.2 (0.5, 2.9)	
No	91 (43.5)	118 (56.5)	1	
Number of supporters				0.087
1	41 (51.9)	38 (48.1)	2.8 (1.1, 7.4)	
2	53 (42.1)	73 (57.9)	1.9 (0.7, 4.8)	
>=3	7 (28.0)	18 (72.0)	1	
Supporters				0.013
Husband/partner	23 (65.7)	12 (34.3)	3.7 (1.4, 9.6)	
Adolescent's family	64 (41.6)	90 (58.4)	1.4 (0.7, 2.8)	
Adolescent's relatives	14 (34.2)	27 (65.8)	1	
Relationship with a husband/partner				<0.001
Bad	27 (77.1)	8 (22.9)	5.5 (2.4, 12.8)	
Good	74 (37.9)	121 (62.5)	1	
Relationship with adolescent's family				0.016
Bad	28 (59.6)	19 (40.4)	2.2 (1.2, 4.3)	
Good	73 (39.9)	110 (60.1)	1	
Relationship with adolescent's friends				<0.001
Bad	64 (56.6)	49 (43.4)	2.8 (1.6, 4.8)	
Good	37 (31.6)	80 (68.4)	1	

Table 2. Multiple logistic regression of the factors associated with prenatal depressive symptoms during adolescent pregnancy.

Factors	Co-efficient	SE	Adjusted OR	95% CI	p-value
Education (ref=diploma)					0.013
Primary	1.88	0.75	6.5	1.5-28.7	
Secondary	0.85	0.60	2.3	0.7-7.6	
Supporter (ref=relative)					0.002
Husband/partner	1.65	0.52	5.1	1.9-14.5	
Their family	0.45	0.41	1.5	0.7 – 3.5	0.269
Relationship with a husband/partner (ref=good)	2.00	0.45	7.4	3.1-17.8	<0.001
Constants	-1.99	0.68	-	-	-



Diagonal segments are produced by ties.

Figure 1. Graph shows associations between sensitivity with the 1-specificity of the model. Area under ROC curve = 0.73 (95%CI 0.67 to 0.79).

affects pregnant women emotions. However, the perceived emotional support experienced by a pregnant adolescent from her husband or partner needs to be interpreted simultaneously with the finding of the poor relationship she experiences with him. The perceived adverse support from a husband or partner and the negative relationship with him likely increases the adolescents’ depressive symptoms.

From the predictive model of prenatal depression symptoms by determining ROC, it was found that level of education,

the perceived support from a husband or partner, and the perceived relationship with a husband or partner could predict prenatal depression symptoms well.

The 95% CI of the narrow ROC reflects that the model had predictive accuracy. Although the sensitivity was not adequate, specificity was at a high level. The model of three variables could be applied in operational planning to prevent and solve the problem of pregnant adolescents with prenatal depression symptoms.

The current Thai cultural norm is not to provide support to adolescents who become pregnant at a young age; society does not consider them to be ready for motherhood or a marital relationship. Adolescents who become pregnant may prefer to hide their condition from the family. Some may need to leave or transfer to a new school. They may lose their job and income as a result of the pregnancy or because of the change in living arrangements. Frequently, adolescent couples lack the maturity and emotional intelligence to begin a marital relationship, which might lead to domestic violence, although the latter was not part of the study's investigation or findings. In more agreement with our findings are the reports (Muangpin *et al.*, 2010; UNFPA, 2014a) that pregnant adolescents with depressive symptoms and other mental health problems are adversely affected by the lack of emotional support and a negative relationship with a husband.

This cross-sectional study does not permit a closer understanding of the long-term trajectory of adolescents who become pregnant and develop depressive symptoms, nor can it examine how their pregnancy might affect their adult lives. This information could come from longitudinal and qualitative studies. In addition, the sample in this study was confined to only one region of the country; therefore, the findings may not be generalizable to other parts of Thailand. Future research might be conducted in other areas, which should consider adult women who became pregnant in adolescence and have shown depressive symptoms and what meaning that held for them in their later lives. Similarly, the husbands or partners of the adolescents should be studied as to their perceptions of the experiences related to unexpected fatherhood with adolescent women.

In conclusion, the adolescent pregnancy rate in Thailand is increasing and adolescents are vulnerable to suffer from depressive symptoms during pregnancy. As a matter of public health, more attention is needed to help reduce known problems with pregnant adolescents. Efforts to keep adolescents in school or ensure they return to school after delivery of the newborn may be an important step in improving the mental health of adolescent mothers. Public advocacy and education to support

mental health initiatives for individuals and couples should be encouraged as a matter of health policy. If couples have become isolated from their families, attempts to reconcile and reunite them by public health personnel may promote better mental health.

Data availability

Underlying data

Figshare: Raw data - factors associated with depression. <http://doi.org/10.6084/m9.figshare.10072898.v2> (Jantasin *et al.*, 2019a).

This project contains the following underlying data:

- Raw-data-factors-associated-with-depression-edit.csv (raw data for each participant extracted in this study).
- Raw data Dictionary.docx (data dictionary defining all abbreviations and values)

Extended data

Figshare: Demographic questionnaire and EPDS in English. <http://doi.org/10.6084/m9.figshare.10073012> (Jantasin *et al.*, 2019b).

Figshare: Demographic questionnaire and EPDS in Thai. <http://doi.org/10.6084/m9.figshare.10073009> (Jantasin *et al.*, 2019c).

Data are available under the terms of the [Creative Commons Zero "No rights reserved" data waiver](#) (CC0 1.0 Public domain dedication).

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