Prevalence and factors related to postpartum depression among women in Dong Nai Province, Vietnam in COVID-19 pandemic

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Abstract

Objectives: Depression has been proven as one of the most predominant medical disorders of the perinatal period. The harms associated with depression in the postpartum period on the health of mothers and their babies have important implications with policy of public health. In Vietnam, postpartum depression in women has been presented in several reports, in which, the rates are ranging from 8.2 to 48.1% of the total number of pregnant women. This study aimed to identify the possible risks of developing postpartum depression in Dong Nai province, Vietnam, during the fourth wave of COVID-19 pandemic.

Materials and Methods: A cross-sectional study conducted between 15 November 2021 and 15 February 2022 at Dong Nai General Hospital in Dong Nai province, using a structured questionnaire and an Edinburgh Postpartum Depression Scale. Each research subject interviewed twice: in hospitalization period (when woman was in hospital) with the survey questionnaire and in postpartum period (within 4 - 12 weeks after birth) with EPDS scale. Data processing using SPSS 26 software (IBM Corp.). Chi-squared, and Fisher's exact tests were performed to compare the proportions. Multiple regression analysis models were used identify the possible risk factors for postpartum depression. Threshold of significance was set at 0.05.

Results: Of 414 women who met the inclusion criteria of this study, 124 were COVID-19 positive. The rates of postpartum depression during the pandemic was 14.5%. The risk of postpartum depression was lower in the planned pregnancy group than in the unplanned group (OR = 0.53; 95% CI (0.34 - 0.85)). Besides, the risk of postpartum depression was higher in the group of weak children/postnatal death than in the group with healthy children (OR = 3.03; 95% CI (1.67 - 5.49)). People with COVID-19 was found with higher risk of postpartum depression than those without (OR = 1.73; 95% CI (1.04 - 2.88)). Family violence was found to correlate with postpartum depression (p = 0.03). A good spousal relationship after childbirth reduced the risk of postpartum depression (OR = 0.22; 95% CI (0.13 - 0.35)). There was an association between educational level and postpartum depression (OR = 2.05; 95% CI (1.30 - 3.25)). Regarding pregnant women with COVID19, the higher the education, the higher the risk of depression (p = 0.002). The risk of depression economically difficult group is higher than in the normal group (OR = 3.29; 95% CI (1.61 - 6.73)). In the group with COVID-19 and family violence, there was a 2.46 times higher risk of postpartum depression compared with the group without family violence (p = 0.05). Economic difficulties increase the risk of depression (p < 0.001). Women diagnosed with COVID-19 in the late stage of pregnancy have higher rates of postpartum depression compared to their counterparts in the earlier stage (OR = 3.72; 95% CI (1.24 - 11.18)).

Conclusions: Major cities in Vietnam have examined postpartum depression, but Dong Nai hospitals still paid minimal attention to this issue. Integrated reproductive health care can aid in the early diagnosis of postpartum depression and the prevention of its negative effects on the patient, the individual, and the community. Pregnant women are frequently affected by postpartum depression and should be evaluated early with quick, reliable, and inexpensive screening. This problem of postpartum depression in Dong Nai could be tackled with the involvement of psychiatrists, psychologists, sociologists, and obstetricians in the prevention period.

Keywords: Postpartum Depression, COVID-19 (CoronaVirus Disease 2019).

1. INTRODUCTION

Depression has been proven as one of the most predominant medical disorders of the perinatal period. The harms associated with depression in the postpartum period on the health of mothers and their babies have important implications for the policy of public health. In Vietnam, postpartum depression (PD) in women has been presented in several reports, in which, the rates are ranging from 8.2 to 48.1% of the total number of pregnant women [1], [2]. This study is aimed to identify the possible risks of developing postpartum depression in Dong Nai province, Vietnam, during the fourth wave of COVID-19 pandemic. Objectives: (1) To determine the rates and factors associated with PD among women in Dong Nai province - Vietnam during the COVID-19 pandemic. (2) To determine the possible risk factors increasing the likelihood of PD in pregnant women with COVID-19 in Dong Nai Province, Vietnam.
2. MATERIALS AND METHODS

Study population: Women who had given birth between 15 November 2021 and 15 February 2022 at Dong Nai General Hospital in Dong Nai province.

Research design: The study is a descriptive cross-sectional study. The required sample size for the study is 412.

Data collection and processing: All hospitalized pregnant women have been tested for COVID-19 rapidly. Those who have COVID-19 rapid test (+) confirmed to have COVID-19 when RT-PCR test results (+) are available. Each research subject was interviewed with the survey questionnaire and EPDS scale in postpartum period within 4 - 12 weeks after birth. Data processing using SPSS 26 software (IBM Corp.). The threshold of significance was set at 0.05. The Edinburgh Postpartum Depression Scale (EPDS) cut off point used in the study was 13. From 13 to 30: most likely to have postpartum depression.

3. RESULTS

3.1. Descriptive characteristics of participants

During the study period, 414 women were recruited and met the inclusion criteria including 124 (29.9%) women with COVID-19 and 290 (70.1%) women without COVID-19. We obtain the following results:

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Population (N = 414)</th>
<th>COVID-19 (N1 = 124)</th>
<th>Without COVID (N2 = 290)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Socio-demographic characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 20</td>
<td>23 (5.56)</td>
<td>8 (6.45)</td>
<td>15 (5.17)</td>
<td></td>
</tr>
<tr>
<td>20 – &lt; 35</td>
<td>314 (75.86)</td>
<td>97 (78.23)</td>
<td>217 (74.83)</td>
<td></td>
</tr>
<tr>
<td>≥ 35</td>
<td>77 (18.60)</td>
<td>19 (15.32)</td>
<td>58 (20.00)</td>
<td>0.49</td>
</tr>
<tr>
<td>Location</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>195 (47.10)</td>
<td>68 (54.84)</td>
<td>127 (43.79)</td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>219 (52.90)</td>
<td>56 (45.16)</td>
<td>163 (56.21)</td>
<td>0.04</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>143 (34.54)</td>
<td>59 (47.58)</td>
<td>84 (28.97)</td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>188 (45.41)</td>
<td>51 (41.13)</td>
<td>137 (47.24)</td>
<td></td>
</tr>
<tr>
<td>Higher education</td>
<td>83 (20.05)</td>
<td>14 (11.29)</td>
<td>69 (23.79)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Job</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have a job</td>
<td>301 (72.71)</td>
<td>83 (66.94)</td>
<td>218 (75.17)</td>
<td>0.09</td>
</tr>
<tr>
<td>Unemployed/Housewife</td>
<td>113 (27.29)</td>
<td>41 (33.06)</td>
<td>72 (24.83)</td>
<td></td>
</tr>
<tr>
<td>Stable jobs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td>222 (53.62)</td>
<td>55 (44.35)</td>
<td>167 (57.59)</td>
<td></td>
</tr>
<tr>
<td>Unstable</td>
<td>192 (46.38)</td>
<td>69 (55.65)</td>
<td>123 (42.41)</td>
<td>0.01</td>
</tr>
<tr>
<td>Economics (income)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No difficulty</td>
<td>289 (69.81)</td>
<td>87 (70.16)</td>
<td>202 (69.66)</td>
<td></td>
</tr>
<tr>
<td>Difficulty</td>
<td>125 (30.19)</td>
<td>37 (29.84)</td>
<td>88 (30.34)</td>
<td>0.92</td>
</tr>
<tr>
<td>Current marriage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live together</td>
<td>401 (96.86)</td>
<td>120 (96.77)</td>
<td>281 (96.90)</td>
<td></td>
</tr>
<tr>
<td>Separate</td>
<td>13 (3.14)</td>
<td>4 (3.23)</td>
<td>9 (3.10)</td>
<td>0.99*</td>
</tr>
<tr>
<td>Family violence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>21 (5.07)</td>
<td>12 (9.68)</td>
<td>9 (3.10)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>393 (94.93)</td>
<td>112 (90.32)</td>
<td>281 (96.90)</td>
<td>0.01</td>
</tr>
</tbody>
</table>
Obstetric characteristics of this birth

<table>
<thead>
<tr>
<th>Planned pregnancy</th>
<th>N = 414</th>
<th>PD (n, %)</th>
<th>OR (CI 95%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>282 (68.12)</td>
<td>77 (62.10)</td>
<td>205 (70.69)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>132 (31.88)</td>
<td>47 (37.90)</td>
<td>85 (29.31)</td>
<td>0.09</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gestational age at birth</th>
<th>N = 414</th>
<th>PD (n, %)</th>
<th>OR (CI 95%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 - 36⁶/7 weeks</td>
<td>35 (8.45)</td>
<td>12 (9.68)</td>
<td>23 (7.93)</td>
<td></td>
</tr>
<tr>
<td>37 - 39⁶/7 weeks</td>
<td>300 (72.46)</td>
<td>88 (70.97)</td>
<td>212 (73.10)</td>
<td></td>
</tr>
<tr>
<td>40 weeks</td>
<td>79 (19.08)</td>
<td>24 (19.35)</td>
<td>55 (18.97)</td>
<td>0.83</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Method of delivery</th>
<th>N = 414</th>
<th>PD (n, %)</th>
<th>OR (CI 95%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaginal delivery</td>
<td>185 (44.69)</td>
<td>82 (66.13)</td>
<td>103 (35.52)</td>
<td></td>
</tr>
<tr>
<td>Caesarean</td>
<td>229 (55.31)</td>
<td>42 (33.87)</td>
<td>187 (64.48)</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Child's health status</th>
<th>N = 414</th>
<th>PD (n, %)</th>
<th>OR (CI 95%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>394 (95.17)</td>
<td>120 (96.77)</td>
<td>274 (94.48)</td>
<td></td>
</tr>
<tr>
<td>Weak or dead</td>
<td>20 (4.83)</td>
<td>4 (3.23)</td>
<td>16 (5.52)</td>
<td>0.32</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spousal relationship after birth</th>
<th>N = 414</th>
<th>PD (n, %)</th>
<th>OR (CI 95%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remaining the same or better</td>
<td>395 (95.41)</td>
<td>121 (97.58)</td>
<td>274 (94.48)</td>
<td></td>
</tr>
<tr>
<td>Worsening</td>
<td>19 (4.59)</td>
<td>3 (2.42)</td>
<td>16 (5.52)</td>
<td>0.17</td>
</tr>
</tbody>
</table>

*: Fisher’s exact test

The rates of women living in the inner city was significantly lower in the group with COVID-19 than in the group without COVID-19 (p = 0.04). In the group with COVID-19, the rates of education from high school and above was lower than that of the group without COVID-19 (p < 0.001). Economic characteristics: the difference between the two groups is statistically significant in stable occupational characteristics (p = 0.01). Domestic violence in the group with COVID-19 was higher than in the group without COVID-19 (p = 0.01). Obstetric characteristics: the rates of cesarean section was higher in the group without COVID-19 than those with COVID-19 (p < 0.001).

3.2. Rates and factors associated with postpartum depression in women in the COVID-19 pandemic

3.2.1. Rates of postpartum depression among women during the COVID-19 pandemic:
The rates of PD among women during the COVID-19 pandemic was 14.49%. The risk of PD in women with COVID-19 (19.35%) was 1.56 times (OR = 1.56; CI95%: 0.97 - 2.50) higher than in women without COVID-19 (12.41%). However, this difference is not statistically significant (p = 0.07).

3.2.2. Factors associated with postpartum depression during the COVID-19 pandemic:
Table 2. Relationship between postpartum depression and socio-demographic and obstetric characteristics during the COVID-19 pandemic

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>PD (n, %)</th>
<th>OR (CI 95%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 20</td>
<td>16 (69.57)</td>
<td>7 (30.43)</td>
<td></td>
</tr>
<tr>
<td>20 – &lt; 35</td>
<td>272 (86.62)</td>
<td>42 (13.38)</td>
<td>0.44 (0.22 - 0.87)</td>
</tr>
<tr>
<td>≥ 35</td>
<td>66 (85.71)</td>
<td>11 (14.29)</td>
<td>0.47 (0.21 - 1.07)</td>
</tr>
<tr>
<td>Location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>189 (86.30)</td>
<td>30 (13.70)</td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>165 (84.62)</td>
<td>30 (15.38)</td>
<td>0.89 (0.56 - 1.42)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>----------------------</td>
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<td>--------</td>
<td>----------</td>
</tr>
<tr>
<td>Primary</td>
<td>122 (85.31)</td>
<td>21 (14.69)</td>
<td>0.94 (0.55 - 1.60)</td>
</tr>
<tr>
<td>Secondary</td>
<td>162 (86.17)</td>
<td>26 (13.83)</td>
<td>1.07 (0.56 - 2.02)</td>
</tr>
<tr>
<td>Higher education</td>
<td>70 (84.34)</td>
<td>13 (15.66)</td>
<td>0.66 (0.41 - 1.06)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Occupation (group)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Have a job</td>
<td>256 (85.05)</td>
<td>45 (14.95)</td>
<td>1.13 (0.65 - 1.94)</td>
<td>0.67</td>
</tr>
<tr>
<td>Unemployed/Housewife</td>
<td>98 (86.73)</td>
<td>15 (13.27)</td>
<td>0.66 (0.41 - 1.06)</td>
<td>0.08</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stable jobs</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable</td>
<td>196 (88.29)</td>
<td>26 (11.71)</td>
<td>0.66 (0.41 - 1.06)</td>
<td>0.08</td>
</tr>
<tr>
<td>Unstable</td>
<td>158 (82.39)</td>
<td>34 (17.71)</td>
<td>0.66 (0.41 - 1.06)</td>
<td>0.08</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Economics (income)</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-difficulty</td>
<td>260 (89.97)</td>
<td>29 (10.03)</td>
<td>2.47 (1.56 - 3.92)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Difficulty</td>
<td>94 (75.20)</td>
<td>31 (24.80)</td>
<td>2.47 (1.56 - 3.92)</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current marriage</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Live together</td>
<td>345 (86.03)</td>
<td>56 (13.97)</td>
<td>0.45 (0.19 - 1.06)</td>
<td>0.10*</td>
</tr>
<tr>
<td>Separate</td>
<td>9 (69.23)</td>
<td>4 (30.77)</td>
<td>0.45 (0.19 - 1.06)</td>
<td>0.10*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Family violence</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>13 (61.90)</td>
<td>8 (38.10)</td>
<td>2.88 (1.58 - 5.25)</td>
<td>0.01*</td>
</tr>
<tr>
<td>No</td>
<td>341 (86.77)</td>
<td>52 (13.23)</td>
<td>2.88 (1.58 - 5.25)</td>
<td>0.01*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pregnancy in the plan</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>250 (88.65)</td>
<td>32 (11.35)</td>
<td>0.54 (0.34 - 0.85)</td>
<td>0.01</td>
</tr>
<tr>
<td>No</td>
<td>104 (78.79)</td>
<td>28 (21.21)</td>
<td>0.54 (0.34 - 0.85)</td>
<td>0.01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gestational age at birth</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>22 - 36(^{6/7}) weeks</td>
<td>28 (80.00)</td>
<td>7 (20.00)</td>
<td>0.75 (0.37 - 1.54)</td>
<td>0.43</td>
</tr>
<tr>
<td>37 - 39(^{6/7}) weeks</td>
<td>255 (85.00)</td>
<td>45 (15.00)</td>
<td>0.75 (0.37 - 1.54)</td>
<td>0.43</td>
</tr>
<tr>
<td>40 weeks</td>
<td>71 (89.87)</td>
<td>8 (10.13)</td>
<td>0.51 (0.20 - 1.29)</td>
<td>0.15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Delivery method</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaginal delivery</td>
<td>158 (85.41)</td>
<td>27 (14.59)</td>
<td>1.07 (0.56 - 2.02)</td>
<td>0.84</td>
</tr>
<tr>
<td>Caesarean</td>
<td>196 (85.59)</td>
<td>33 (14.41)</td>
<td>0.99 (0.61-1.58)</td>
<td>0.96</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Child's health status</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>342 (86.80)</td>
<td>52 (13.20)</td>
<td>0.99 (0.61-1.58)</td>
<td>0.96</td>
</tr>
<tr>
<td>Weak or dead</td>
<td>12 (60.00)</td>
<td>8 (40.00)</td>
<td>3.03 (1.67 - 5.49)</td>
<td>0.004*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spousal relationship after birth</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Remaining the same or better</td>
<td>350 (88.61)</td>
<td>45 (11.39)</td>
<td>0.14 (0.10 - 0.21)</td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>Worsening</td>
<td>4 (21.05)</td>
<td>15 (78.97)</td>
<td>0.14 (0.10 - 0.21)</td>
<td>&lt; 0.001*</td>
</tr>
</tbody>
</table>

*: Fisher's exact test

There is a relationship between PD and age group characteristics, the rates of depression in the age group 20 ≤ 35 is 56% lower than in the age group < 20 (p = 0.02). The rates of depression in the age group ≥ 35 is 53% lower than in the age group < 20, but there is no statistical significance with p = 0.07. The rates of depression in economically difficult women is 2.47 times higher than in the economically stable women group (p < 0.001). There is a relationship between...
There was a relationship between PD and the characteristics of expected pregnancy (OR = 0.54; p = 0.01) weak child/postpartum death (OR = 3.03; p = 0.004), postnatal marital relationship (OR = 0.14; p < 0.001)

The relationship between postpartum depression and some characteristics of women during the COVID-19 pandemic in a multivariate model:

Variables related to the variable COVID-19 disease or PD will be included in the multivariate model. After that, variables with large p-values and no more than 10% change in OR of the association of COVID-19 and depression will be eliminated. The final model is presented in the following table:

**Table 3** Relationship between postpartum depression and characteristics in women during the COVID-19 pandemic in a multiple logistic regression analysis

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>OR</th>
<th>95% CI</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID 19 (Positive/Negative)</td>
<td>1.73</td>
<td>1.04</td>
<td>2.88</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 - 35/&lt; 20</td>
<td>0.59</td>
<td>0.30</td>
<td>1.16</td>
</tr>
<tr>
<td>&gt; 35/&lt; 20</td>
<td>0.67</td>
<td>0.29</td>
<td>1.51</td>
</tr>
<tr>
<td>Economics (income)</td>
<td>1.52</td>
<td>0.90</td>
<td>2.56</td>
</tr>
<tr>
<td>Family violence (yes/no)</td>
<td>2.03</td>
<td>1.07</td>
<td>3.85</td>
</tr>
<tr>
<td>Pregnancy (planned/unplanned)</td>
<td>0.71</td>
<td>0.44</td>
<td>1.15</td>
</tr>
<tr>
<td>Delivery method (C-section/natural)</td>
<td>1.16</td>
<td>0.91</td>
<td>1.47</td>
</tr>
<tr>
<td>Child’s health status (bad/good)</td>
<td>1.34</td>
<td>0.96</td>
<td>1.85</td>
</tr>
<tr>
<td>Spousal relationship after childbirth (good/bad)</td>
<td>0.22</td>
<td>0.13</td>
<td>0.35</td>
</tr>
</tbody>
</table>

After controlling for the variables in the model, the results show that in pregnant women during the COVID-19 pandemic: (1) People with COVID-19 had a 1.73 times higher risk of PD than those without (p = 0.03). (2) Family violence has a 2.03 times higher risk of PD compared with non-family violence (p = 0.03). (3) Good spousal relationship after childbirth reduced the risk of PD (p < 0.001).

3.3. Ratio of postpartum depression and risk factors for increased postpartum depression among women with COVID-19 during the COVID-19 pandemic

The study results showed that out of 124 women infected with COVID-19, 25.81% (n = 32) were infected during pregnancy, 73.39% (n = 91) were infected during labor, and 0.81% (n = 1) had it later when giving birth.

3.3.1. The ratio of postpartum depression among women with COVID-19 during the pandemic:
Rates of PD among women with COVID-19 during the COVID-19 pandemic was 19.35% (Table 3)

3.3.2. Risk factors for increased depression in women with COVID-19 during the COVID-19 pandemic:

**Table 4.** Risk factors for increased depression in women with COVID-19 during the COVID-19 pandemic

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N = 124</th>
<th>PD (N, %)</th>
<th>OR (CI 95%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social-demographic characteristics</td>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>6 (75.70)</td>
<td>2 (25.00)</td>
<td>0.78 (0.22 - 2.79)</td>
</tr>
<tr>
<td>20 – &lt; 35</td>
<td>78 (80.41)</td>
<td>19 (19.59)</td>
<td>0.63 (0.13 - 3.11)</td>
<td>0.57</td>
</tr>
<tr>
<td>≥ 35</td>
<td>16 (84.21)</td>
<td>3 (15.79)</td>
<td>1.03 (0.50 - 2.11)</td>
<td>0.94</td>
</tr>
<tr>
<td>Location</td>
<td></td>
<td>45 (80.36)</td>
<td>11 (19.64)</td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>55 (80.88)</td>
<td>13 (19.12)</td>
<td>1.03 (0.50 - 2.11)</td>
<td>0.94</td>
</tr>
<tr>
<td>Urban</td>
<td></td>
<td>53 (89.83)</td>
<td>6 (10.17)</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td>39 (76.47)</td>
<td>12 (23.53)</td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>8 (57.14)</td>
<td>6 (42.86)</td>
<td>2.05 (1.30 - 3.25)</td>
<td>0.002</td>
</tr>
<tr>
<td>Secondary</td>
<td>6 (10.17)</td>
<td>42 (89.83)</td>
<td>1.03 (0.50 - 2.11)</td>
<td>0.94</td>
</tr>
<tr>
<td>Occupation (group)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Have a job</td>
<td>63 (75.90)</td>
<td>20 (24.10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployed/Housewife</td>
<td>37 (90.24)</td>
<td>4 (9.76)</td>
<td>2.47 (0.90 - 6.76)</td>
<td>0.06</td>
</tr>
<tr>
<td>Stable jobs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td>43 (78.18)</td>
<td>12 (21.82)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unstable</td>
<td>57 (82.61)</td>
<td>12 (17.39)</td>
<td>1.25 (0.61 - 2.57)</td>
<td>0.54</td>
</tr>
<tr>
<td>Economics (income)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non difficulty</td>
<td>77 (88.51)</td>
<td>10 (11.49)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty</td>
<td>23 (62.16)</td>
<td>14 (37.84)</td>
<td>3.29 (1.61 - 6.73)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Current marriage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live together</td>
<td>97 (80.83)</td>
<td>23 (19.17)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not living together</td>
<td>3 (75.00)</td>
<td>1 (25.00)</td>
<td>0.77 (0.14 - 4.35)</td>
<td>0.58*</td>
</tr>
<tr>
<td>Family violence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>7 (58.33)</td>
<td>5 (41.67)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>93 (83.04)</td>
<td>19 (16.96)</td>
<td>2.46 (1.12 - 5.38)</td>
<td>0.05</td>
</tr>
<tr>
<td>Obstetrics...</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time of getting COVID</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When pregnant</td>
<td>29 (90.63)</td>
<td>3 (9.38)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During labor</td>
<td>71 (78.02)</td>
<td>20 (21.98)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After giving birth</td>
<td>0 (0.00)</td>
<td>1 (100.0)</td>
<td>2.77 (1.00 - 7.65)</td>
<td>0.049</td>
</tr>
<tr>
<td>Planned pregnancy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>65 (84.42)</td>
<td>12 (15.58)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>35 (74.47)</td>
<td>12 (25.53)</td>
<td>0.61 (0.30 - 1.25)</td>
<td>0.17</td>
</tr>
<tr>
<td>Time in hospital</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 days</td>
<td>98 (80.99)</td>
<td>23 (19.01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 7 days</td>
<td>2 (66.67)</td>
<td>1 (33.33)</td>
<td>1.75 (0.34 - 9.06)</td>
<td>0.48</td>
</tr>
<tr>
<td>Gestational age at birth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22 - 36 weeks</td>
<td>9 (75.00)</td>
<td>3 (25.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>91 (81.25)</td>
<td>21 (18.75)</td>
<td>0.75 (0.26 - 2.15)</td>
<td>0.70*</td>
</tr>
<tr>
<td>How to give birth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>67 (81.71)</td>
<td>15 (18.29)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caesarean</td>
<td>33 (78.57)</td>
<td>9 (21.43)</td>
<td>1.17 (0.56 - 2.45)</td>
<td>0.68</td>
</tr>
<tr>
<td>Child’s health status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strong</td>
<td>98 (81.67)</td>
<td>22 (18.33)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weak or dead</td>
<td>2 (50.00)</td>
<td>2 (50.00)</td>
<td>2.73 (0.95 - 7.80)</td>
<td>0.17</td>
</tr>
<tr>
<td>Spousal relationship after childbirth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Same or better</td>
<td>100 (82.64)</td>
<td>21 (17.36)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worsening</td>
<td>0 (0.00)</td>
<td>3 (100.00)</td>
<td>0.17 (0.12 - 0.26)</td>
<td>0.01*</td>
</tr>
</tbody>
</table>

*: Fisher’s exact test

Education increases by one level, the rates of PD increases 2.05 times (p = 0.002). Economic difficulties increase PD by 3.29 times (p < 0.001). Domestic violence increases PD by 2.46 times (p = 0.05). Good postnatal marital relationship reduced the risk of PD by 83% (p = 0.01). Diagnosed of COVID-19 at the later stage of pregnancy, the women have the higher rates of PD means that from pregnancy increases to labor and from labor increases to postpartum, with p = 0.049.
Risk factors for increased postpartum depression among women with COVID-19 during the COVID-19 pandemic in a multiple logistic regression model:

The variables related to the PD variable will be included in the multivariate model. Then, the variables with large p-values will be gradually removed and do not change the OR by more than 10% of the depression associations. The final model is presented in the following table form:

**Table 5. Risk factors for increased postpartum depression among women with positive COVID-19 (124 participants) during the pandemic in a multiple logistic regression model**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>OR</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>1.95</td>
<td>1.31</td>
<td>2.89</td>
</tr>
<tr>
<td>Job</td>
<td>2.14</td>
<td>0.85</td>
<td>5.37</td>
</tr>
<tr>
<td>Economics (income)</td>
<td>2.74</td>
<td>1.35</td>
<td>5.56</td>
</tr>
<tr>
<td>Diagnosed of COVID-19</td>
<td>3.72</td>
<td>1.24</td>
<td>11.18</td>
</tr>
<tr>
<td>Family violence</td>
<td>1.50</td>
<td>0.79</td>
<td>2.85</td>
</tr>
</tbody>
</table>

After controlling for the variables in the model, the results show that in pregnant women with COVID-19:

The higher the education, the higher the risk of depression (OR = 1.95; p = 0.001); Difficult economic group increases the risk of depression 2.74 times compared to the normal economic group (OR = 2.74; p = 0.01); Diagnosed of COVID-19 positive after delivery has 3.72 times higher risk of PD compared to before delivery (OR = 3.72; p = 0.02).

4. DISCUSSION

4.1. Review of research samples

**Demographic characteristics**

The average age of pregnant women in this study was lower than studies in Italy [3], and Iran [4]. As compared to a study in Vietnam the mean age of the sample in this study, there was no significant difference [5]. In the aspect of residency, the rates of women in the inner city infected with COVID-19 was 45.2% lower than the rates of 54.8% of women living in the suburbs. This is similar to a study by Hoan MN at Dong Nai General Hospital (2021) [2]. This problem can be explained by the transfer of all pregnant women infected with COVID-19 from localities in the province to Dong Nai General Hospital for treatment, thus increasing the ratio difference between infected and non-infected groups.

In this study, 72.7% of women are employed, of which 79.1% are physical workers. However, during the pandemic, the percentage of women with stable jobs was lower than in the pre-pandemic period [2]. On the other hand, when comparing the two groups infected and uninfected with COVID-19, it was found that the infected group had a stable employment, which was higher than that of the uninfected group. This can be explained by the majority of women in Dong Nai work as physical workers or office employees in companies, so the risk of COVID-19 infection is high due to the increased risk of infection from contact in the work environment and outside the community. On the other hand, the proportion of women living as workers in cramped and crowded dormitories is also an environment where there is a risk of infection due to contact in daily life.

**Obstetric features**

Methods of delivery, the rates of caesarean section is higher at the Department of Obstetrics and Gynecology at Dong Nai General Hospital in the first 6 months of 2021. The reason is due to the rates of cesarean section in the group infected with COVID-19 higher than in the non-infected group, the difference was statistically significant. According to the data from the medical records in the study, the cesarean section was mainly due to the indication for an obstetric emergency because of the critical progression of the COVID-19 disease.

The results show that after giving birth 69% of women are satisfied with the support from their husbands and 95.4% find that the relationship between husband and wife after giving birth is better than before having a baby. Hoan MN study (2020) reported that good postpartum relationship is a protective factor against postpartum depression [2]. However, no statistically significant association could be found in this study.

4.2. Rates and factors associated with postpartum depression in women in the COVID-19 pandemic

**Rates of postpartum depression among women during the COVID-19 pandemic**

In this study, the rates of PD at 4 -12 weeks postpartum was 14.5%, less than a systematic review by Usmani S (2021) with 36% [6]. However, the rates was higher compared to the study of Koutra et al, using the similar EPDS threshold (≥ 13), showed that the rates of PD with 13.6%. Other review studies evaluating PD at 6 weeks postpartum have found rates between 13.2% to 34% [7], [8].

Prior to the COVID-19 pandemic, a review of studies in Vietnam from 2010 to 2020 on postpartum depression,
HuongTTN et al (2021) found a rates of depression in postpartum women from 1 to 12 months ranging from 8.2% to 48.1% [1]. Similarly, in a study in Dong Nai from 2012 - 2017, Hoan MN et al found the rates of PD was 12.6% [2].

During the COVID-19 pandemic, the effects of quarantine and social distancing played a role in mental health problems among new mothers affected to a higher than normal rates. In particular, these include reduced physical activity during pregnancy, being bored and feeling isolated, loss of job or home, inadequate antenatal care due to lack of transport or closure of city. On the other hand, the fear of coming to hospital infected with COVID-19 during the pandemic, the changed birth plan, the worry that there will be no relatives to support during the birth, the family not being able to visit after the birth, etc. also increases the symptoms of depression and anxiety in postpartum women. Several studies related to PD during the pandemic have been published, and the first meta-analysis reported an overall rates of PD is higher than before pandemic [9].

However, during the COVID-19 pandemic, the rates of PD among women with COVID-19 infection during pregnancy and postpartum is higher than in women without infection [10]. This study also showed that women infected with COVID-19 had a higher rates of PD compared to uninfected women with a rates of postpartum depression.

Factors associated with postpartum depression during the COVID-19 pandemic

The relationship between postpartum depression and socio-demographic characteristics

In this study, the rates of PD in the age group from 20 to under 35 years old was lower than the age group under 20 years old. It may be because women under the age of 20 have not yet matured psychologically and physiologically, are not prepared for motherhood such as motherhood psychology, stable relationship with the child's father, economic ability, social relationships.

The study also showed that there was no relationship between the characteristics of being employed and unemployed, job stability or not. This result is different from the study of Stojanov J (2021) [11], the rates of PD in low-income women was higher than in better-income groups and similarly a study in the United States also reported high income, and having a job versus no job as a protective factor for PD in women during the COVID-19 pandemic [12].

This study showed that domestic violence from the child's father is the increased risk of PD nearly 2.5 times compared to a family without violence. Unlike Hoan MN's study, at the time before the pandemic, the characteristics of the state of violence were not statistically significantly associated with PD [2].

Relationship between postpartum depression and postpartum obstetric characteristics

In this study, the risk of PD in the planned pregnancy group was lower than in the unplanned group, and the risk of PD in the weak/dead child group was higher than the group with healthy children. Similarly, a study by Ceuleman M (2021) found that unwanted pregnancy is a risk factor for PD [13]. Research by Koyuncu K (2020) on conditions affecting PD during the COVID-19 pandemic found that mothers with infants in the NICU were found to be significantly associated with PD [14]. This study also found that PD was not related to the method of delivery, cesarean section did not increase the risk of depression compared with normal delivery. Study Özbaşaran F (2011) did not find this association [15].

Several studies reported a negative correlation between PD and lack of family support, especially from the husband [16], [17]. In this study, A family that has a good marital relationship after the birth of their child is a protective factor against depression (p < 0.001). In the context of social isolation by COVID-19, the family environment will greatly affect the psychology of family members. Therefore, if there is mutual understanding, sharing and helping each other in daily life, together overcome the especially difficult period of the family, the negative impacts of life minimal impact on family life.

This study performed a multivariate analysis to find out the true risk factors for PD in women with COVID-19. After controlling for potentially confounding variables, it was found the following three factors associated with PD: COVID-19, domestic violence from husbands, good relationship postpartum.

4.3. Rates of postpartum depression and risk factors for increased postpartum depression in women with COVID-19, during the COVID-19 pandemic

Rates of postpartum depression among women with COVID-19 during the pandemic

In this study, the rates of PD among women with COVID-19 during the pandemic was higher than the rates in the group without COVID-19 at the time of the study. The study explained that at the time of the pandemic, the government and the health sector faced a lot of difficulties in how to handle COVID-19 patients. The preventive measures included concentrated isolation in epidemic areas, isolation of patients at medical facilities, and infected areas in hospitals. The patients are not allowed to have contact with their husbands, children, family members and has limited contact with medical staff. This causes disruption of daily routines, but often loss of employment or reduced financial income. All of these problems has tremendously negative implications on the health of mothers and their children, affecting their mental health due to anxiety and fear for their own lives and the future of their children.
Risk factors for increased postpartum depression in women with COVID-19

Social-demographic factors in women with COVID-19 at increased risk of postpartum depression

Among the demographic factors in the group of women infected with COVID-19, this study found that education is associated with PD. This study suggests that people with high education have a high rate of employment, good income, lots of social interaction, and a full family life. Therefore, when the pandemic occurs, social distancing, companies, factories, agencies stop working or reduce working hours, causing a decrease in income, living is limited to staying at home. This issue has greatly affected the mood of this group of women. Koyuncu K's study (2020) also reported that higher educational attainment was associated with a greater risk of PD [14].

The economic stagnation has severely affected social life, and people face many difficulties to earn enough to live during the pandemic. This reason has affected the mood of low-income pregnant women infected with COVID-19 and lost their jobs due to COVID-19 isolation, certainly increasing the risk of postpartum depression. The study found that women with low incomes infected with COVID-19 were more likely to have PD than women with good incomes, Koyuncu K study (2020), Stojanov J (2021) also reported that low income increased the risk of postpartum depression [11],[14].

Obstetric factors in women with COVID-19 at increased risk of postpartum depression

In the group of women with COVID-19 who knew they were infected with COVID-19 during the pregnancy - labour - postpartum stages, as the later as the higher the risk of PD. It can be explained that anxiety increases with the timing of pregnancy, anxiety during labour is greater than during pregnancy because mothers need support from relatives (husband, mother, etc.) during this time because they are infected with COVID-19. After birth, there is a risk of infection with COVID-19 from the mother, the hospital environment and the risk of infection during breastfeeding due to concerns about the health of the children, which increases the rates of PD in women. Similarly, some studies have found an increased risk of PD when the mother "does not receive support during childbirth and/or worries that the family will not be able to visit her after delivery and/or childcare facilities are not available and/or postnatal care is lacking. All of these have contributed to increased symptoms of anxiety and depression among postpartum women" (Basu A 2021) [17].

5. CONCLUSIONS

From the results of the study, 414 women, 124 infected with COVID-19 and 290 not infected with COVID-19, gave birth at Dong Nai General Hospital between November 15, 2021, and February 15, 2022, and were assessed for depression at the time of birth from 4 to 12 weeks. We have the following conclusions:

- Rates of postpartum depression among women during the COVID-19 pandemic was 14.5%: with COVID-19 is 19.4% and without is 12.4%.
- Three factors associated with the increased rate of PD in women with COVID-19: education, income, and diagnosed of COVID-19.

REFERENCES

9. Yan H, Ding Y, Guo W. Mental Health of Pregnant and Postpartum Women During the Coronavirus Disease