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The psychosocial impact of nausea and vomiting during pregnancy as a predictor of postpartum depression

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Abstract

This study examined the extent to which psychosocial impact of nausea and vomiting during pregnancy predicts postpartum depression using a retrospective design. Data from a cross-sectional survey investigating women's experiences of nausea and vomiting during pregnancy were used ($N = 861$). Hierarchical logistic regression models revealed that the psychosocial impact of nausea and vomiting in pregnancy appears to be predictive of postpartum depression, independent of depression status before and during pregnancy. Our findings indicate that assessing the psychosocial impact of nausea and vomiting in pregnancy during antenatal care may identify women at risk of postpartum depression.

Keywords

depression, nausea and vomiting in pregnancy, NVP genetics consortium, postpartum depression, pregnancy, psychosocial

Depressive disorders are twice as common in women than in men (Weissman and Olfson, 1995; World Health Organization (WHO), 2017), and pregnancy and postpartum are two periods where women are at increased vulnerability to developing depression (Le Strat et al., 2011). Postpartum depression (PPD), encompassing non-psychotic depressive episodes following childbirth, has a prevalence rate of 13 to 19 per cent (O'Hara and McCabe, 2013). Mothers who experience PPD endure emotional suffering, poor psychosocial functioning, low quality of life (Feki et al., 2017; Lovejoy et al., 2000), severe anxiety and panic attacks (American Psychiatric Association (APA), 2013) and, in some cases, suicidal ideation (Kettunen et al., 2014). Furthermore, disturbed mother–infant interactions, and inadequate caregiving and safety practices associated with PPD (Field, 2010), may increase the risk for adverse infant social–emotional and cognitive developmental outcomes (O'Hara and McCabe, 2013).

Given the serious consequences of PPD, understanding the influence of risk factors and their interplay on PPD is important. The strongest risk factors for PPD, as identified in a 2004

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meta-analysis comprising nearly 24,000 participants, are anxiety or depression during pregnancy, previous depressive episodes, recently experienced stressful life events and perceived low levels of social support (Ozcan et al., 2017; Robertson et al., 2004; Silverman et al., 2017). Notably, hyperemesis gravidarum (HG), an extreme form of nausea and vomiting in pregnancy (NVP), has also been associated with an increased risk of PPD (Hizli et al., 2012; Meltzer-Brody et al., 2017; Senturk et al., 2016; Tian et al., 2017). However, there is limited data focusing on the extent to which psychosocial impacts of NVP predict PPD.

NVP affects 70 to 80 per cent of pregnant women (Einarson et al., 2013; Lacroix et al., 2000; Lee and Saha, 2011; Tan et al., 2018) and is associated with substantial physical, psychological and social impacts. Health burdens of NVP and HG include higher risk of pregnancy complications such as high blood pressure, preeclampsia, proteinuria and severe pelvic girdle pain (Chortatos et al., 2015). If left untreated, HG may lead to weight loss, malnutrition, dehydration, metabolic imbalance, renal and hepatic failures, and Wernicke encephalopathy (The American College of Obstetricians and Gynecologists (ACOG), 2015). Quality of life can be significantly reduced in women with NVP and HG (Heitmann et al., 2017; Munch et al., 2011), with adverse effects on partner and family relationships, lack of social support, poor job performance, resignation and missing days of work (Poursharif et al., 2008; Tan et al., 2018), as well as inability to manage household activities and less effective parenting (Heitmann et al., 2017; Smith et al., 2000). HG is further associated with fear of pregnancy (Iliadis et al., 2018; Poursharif et al., 2008) and in 16 per cent of cases, consideration of pregnancy termination (Dean et al., 2018; Mazzotta et al., 2000). It has been suggested that depression during pregnancy may be a direct consequence of the impacts of NVP (Koken et al., 2008) and HG (Magtira et al., 2015; Tan et al., 2010).

Perceived social support may affect the impact of severe NVP and HG on psychological outcomes. The stress-buffer hypothesis suggests that social support acts as a buffer against stressors by reducing or alleviating psychological outcomes (Cohen and Wills, 1985). Indeed, social support from partners, families and friends has been reported to moderate the impact of NVP through reducing stress levels in women with NVP (Chou et al., 2008). Notably, Schwab-Reese et al. (2016) and Reid and Taylor (2015) found that although social support is a protective factor for PPD, it does not mediate the relationship between stress and PPD.

Psychosocial factors such as depression during pregnancy, history of depression, low social support and experiencing NVP and HG are associated with the development of PPD; however, no studies have assessed the extent to which psychosocial impacts resulting from NVP and HG predict PPD when simultaneously examining PPD risk factors identified as relevant from previous research. Therefore, the aim of this study was to assess the extent to which psychosocial factors associated with NVP and HG predict PPD while incorporating well-established PPD risk factors in the model. It was hypothesised that severe physical characteristics of NVP and HG, previous history of depression, lower mental health well-being during pregnancy, lower NVP- and HG-specific social support and higher psychosocial impact of NVP and HG symptoms would be associated with an increased risk of developing PPD in women experiencing NVP and HG.

Materials and methods

Study design and study population

Data were derived from a large, retrospective, cross-sectional, self-report online survey conducted by the QIMR Berghofer Medical Research Institute (QIMR), as part of the NVP Genetics Consortium (Colodro-Conde et al., 2017). Starting in 2013, the NVP study was designed to collect comprehensive data to identify environmental and genetic risk factors for severe NVP and included information on

perinatal mental health (Colodro-Conde et al., 2017). For this study, we used data collected between 2013 and 2016. Participants were women above 18 years of age who had been pregnant at least once. Participants were recruited via social media posts and by word-of-mouth and invited to complete an online questionnaire. All participants confirmed written consent. This study was approved and conducted in accordance with the University of Queensland School of Psychology Ethics Review Committee (clearance no. 17-PSYCH-4-35-AH) and the QIMR Human Research Ethics Committee (P1515).

After data cleaning (entry errors, patterns of missing data and outliers), the final sample included 861 women who were well-characterised with regard to NVP (reporting extensive information on the severity, duration and impact of experiencing nausea and vomiting for each pregnancy) and who self-reported on depression before and post pregnancy and mental health status during pregnancy. The average age of women was 32.8 ($SD = 6.82$, range = 19–75) years. As described below, the main analysis was a hierarchical logistic regression to predict PPD in the pregnancy most affected by NVP. With 15.8 per cent PPD cases and 12 predictors, the cases-to-variable ratio of 11:1, suggesting the validity of the logistic model was not problematic (Peduzzi et al., 1996).

Variables

Demographic information. Information included age at survey, education level, employment, marital status, number of biological children and order of most affected pregnancy. Only age at survey time was included in the analyses.

PPD. A dichotomous variable was created for self-reported experience of PPD in relation to the pregnancy most affected by NVP. The experience of PPD correlated with the lifetime diagnosis or treatment of PPD collected in a different question ($r = 0.8$, $p < 0.001$). This was the outcome variable.

Physical characterisation of NVP and HG in relation to the pregnancy worst affected by NVP

Severity of NVP and HG. Participants were asked to rate their severity of NVP using qualifiers adapted from Zhang et al. (2011) in a 5-point scale that included qualifiers of interference with daily routine, consultation with medical professionals, medication prescription, weight loss and IV hydration or nutrition therapy and it could range from (1) I did not have any NVP or I had some NVP for less than 7 days, but I did not see a doctor about this and it did not disrupt my daily routine to (5) It really disrupted my daily routine. I lost weight. I was prescribed medication or was put on a drip or feeding tube. Higher scores indicated higher severity of NVP (range = 1–5).

Duration of NVP. Participants also reported the duration of their NVP (number of trimesters in which they experienced NVP, up to three trimesters).

Loss of weight. A dichotomous variable (yes/no) was created to indicate whether their pregnancy weight went below their starting (pre-pregnancy) weight due to NVP.

HG diagnosis. A dichotomous variable (yes/no) was created to indicate whether they had been diagnosed with HG.

Psychosocial variables in relation to the pregnancy worst affected by NVP

Psychosocial functioning. The Hyperemesis Impact of Symptoms Questionnaire (HIS) is a 10-point questionnaire designed to assess the physical and psychosocial impacts of HG (Power et al., 2010). Each question is scored from 0 to 3, with higher scores indicating higher impact. The validity and reliability of the HIS have been affirmed by Power et al. (2010) when comparing the HIS with the Pregnancy-Unique Quantification of Emesis (PUQE), the Hospital Anxiety and Depression Score (HADS) and the 12-Item Short Form Health Survey (SF-12). The HIS showed strong significant correlations with the PUQE

($r = 0.75$), HADS ($r = 0.76$) and SF-12 ($r = -0.65$) confirming good criterion validity, and the HIS also showed good internal consistency (Cronbach's alpha = 0.87). For this study, 6 of the 10 questions in the HIS were used as these questions were specifically related to the psychosocial impact of NVP/HG. The four questions that were not used were related to the physical impact of NVP/HG which we had sufficiently addressed in other data collected, therefore these further questions were redundant. In addition, three further questions were included to assess the ability to drive or use public transport, ability to parent their other children (coding impact for first-time mothers as 0) and whether their social life was affected. Responses to the nine questions were summed to form a variable ranging from 0 to 27, where higher scores indicated a higher impact of NVP and HG on psychosocial functioning. Internal consistency was measured using Cronbach's alpha statistic, and the resulting alpha value of 0.94 indicated good reliability of the scale.

Considering termination. A dichotomous variable (yes/no) was created to indicate whether nausea or vomiting was ever bad enough that the participants considered terminating the pregnancy on medical grounds.

NVP- and HG-specific social support. One of the questions in the HIS asks 'do you feel people understand how ill you are feeling?' This question was expanded to create six questions asking whether the participant felt her partner, family and friends (1) understood how ill she was feeling and (2) how much support they felt they received from them while they were feeling ill. The scores were summed, and a new variable ranging from 0 to 18 was created, where higher scores indicated that participants perceived more social support specific to NVP and HG was received. Internal consistency was measured using Cronbach's alpha statistic, and the resulting alpha value of 0.78 indicated acceptable reliability of the scale.

Depression before first pregnancy. Participants were asked whether a doctor, nurse, psychologist, counsellor or other medical/mental health professional has ever diagnosed them with or treated them for depression, and at what age. A dichotomous variable was created if participants had been diagnosed or treated for depression before their first pregnancy age.

Mental health rating during pregnancy. Participants were asked to rate their mental health, including stress, depression and problems with emotions, using a single-item measure. Responses ranged from 1 (*really good for most of the pregnancy*) to 5 (*really bad for most of the pregnancy*), where a higher score indicated a worse mental health.

Statistical analyses

First, descriptive and correlational analyses were conducted. The Shapiro–Wilk statistic ($p < 0.001$) and visual inspection of the histograms confirmed data were not normally distributed therefore zero-order correlations were performed using Spearman's rho. Hierarchical logistic regression was used to calculate odds ratio (OR) with 95% confidence interval (CI) and statistical significance determined at $p < 0.05$ for the predictors of PPD. Assumptions of logistic regression were all checked, and multicollinearity showed acceptable levels (variance inflation factor <10). In the first block, age was entered. The second block included the physical characterisation of NVP/HG variables (severity, duration, weight loss and HG diagnosis). The third block included psychosocial variables (psychosocial impact, termination, social support and the interaction of psychosocial impact with social support). The fourth block included mental well-being variables (mental health rating during pregnancy, depression before first pregnancy and the interaction of mental health rating with social support).

Chi-square and Hosmer–Lemeshow tests were used to assess the overall fit of the model. In addition, Nagelkerke's R^2 was used to estimate

the amount of variance in the outcome variable accounted for by the model. To determine whether each predictor was associated with the outcome variable, Wald's statistics were used, and if significant, the coefficient was evaluated followed by calculation of the OR. Statistical analyses were performed using IBM SPSS Statistics for Mac (Version 24).

Results

Sample characteristics are presented in Table 1.

The mean, standard deviation and intercorrelation for outcome and predictors are presented in Table 2.

The results of the regression model are presented in Table 3. For all blocks, Hosmer–Lemeshow tests confirmed the model was a good fit for the data. Except for block 1, all blocks were statistically significant. After including the physical variables in block 2, the model explained 2.9 per cent (Nagelkerke's R^2) of the variance in PPD, although no one predictor was a statistically significant unique contributor to PPD.

When adding block three (psychosocial variables), the model explained 8.9 per cent (Nagelkerke's R^2) of the variance in PPD, that is, an increase in 6 per cent of the variance explained in relation to the previous model. In this block, psychosocial impact was statistically significant, $b = 0.16$, $p = 0.001$, where the OR indicated that an increase in one unit of worse psychosocial functioning was associated with an increase in the odds of PPD by a factor of 1.17 (95% CI = 1.07, 1.29). In addition, the interaction term (psychosocial impact and social support variable) was marginally statistically significant, $b = -0.01$, $p = 0.049$, where the negative beta indicated that at low levels of perceived social support, worse psychosocial impact was associated with an additional increase in the odds of PPD. The direction of scoring for the interaction term meant the OR of 0.99 (95% CI = 0.99, 1.00) needed to be inverted to obtain an increased odds of PPD by a factor of 1.01. All remaining variables were not significant.

Block four included the mental health variables. The final model explained 18 per cent (Nagelkerke's R^2) of the variance in PPD (9.1% increase compared with the previous block) and correctly classified 84.2 per cent of cases. Having a worse psychosocial functioning during NVP remained statistically significant, $b = 0.12$, $p = 0.030$, where the OR indicated that an increase in one unit of the worse impact of NVP on psychosocial functioning was associated with an increase in the odds of PPD by a factor of 1.13 (95% CI = 1.01, 1.26). In addition, mental health was statistically significant, $b = 0.46$, $p = 0.048$, where the OR indicated that an increase in one unit of mental distress was associated with an increase in the odds of PPD by a factor of 1.59 (95% CI = 1.00, 2.52). Furthermore, depression before first pregnancy was statistically significant, $b = 0.79$, $p < 0.001$, where the OR indicated that an increase in one unit of depression before first pregnancy was associated with an increase in the odds of PPD by a factor of 2.19 (95% CI = 1.42, 3.39).

Discussion

This study assessed the extent to which psychosocial factors during the NVP experience predict PPD when simultaneously examining well-established PPD risk factors. As expected, a previous history of depression was the most significant predictor of PPD. This is consistent with previous research proposing a history of depression is a strong predictor of PPD (Lancaster et al., 2010; Robertson et al., 2004).

In addition, women experiencing higher mental distress during their worst NVP affected pregnancy were more at risk of developing PPD. This is consistent with previous research reporting that depression during pregnancy may predict PPD (Gaillard et al., 2014; Robertson et al., 2004). While research has primarily focused on the relationship between a psychiatric diagnosis and NVP or HG, this study examined a broad range of mood and behavioural

Table 1. Demographic characteristics ($N = 861$).

Characteristics	*M* (*SD*)	*N* (%)
Age, years (survey at completion)	32.82 (6.82)	
Marital status		
Married		677 (78.6)
Widowed		3 (0.3)
Divorced		13 (1.5)
Separated		11 (1.3)
Never married		14 (1.6)
Living with partner		138 (16.0)
I'd rather not say		5 (0.6)
Highest level of education		
High school (years 8–12)		26 (3.0)
Certificate or diploma at university, or TAFE		228 (26.5)
Undergraduate degree		288 (33.4)
Postgraduate diploma		79 (9.2)
Postgraduate masters or PhD		112 (13.0)
Employment status		
Full-time paid work		160 (18.6)
Part-time paid work		261(30.3)
Unpaid work (carer)		288 (33.4)
Student		32 (3.7)
Looking for work/unemployed		16 (1.9)
Number of biological children		
0		66 (7.7)
1		349 (40.5)
2		300 (34.8)
3		103 (12.0)
4		26 (3.0)
5		12 (1.4)
6		4 (0.5)
7		1 (0.1)
Order of most affected pregnancy by nausea and vomiting		
Equally bad in all pregnancies		155 (18)
1		301 (35)
2		204 (24)
3		108 (13)
4		47 (6)
5		28 (3)
6		8 (1)
7		5 (0.6)
8		4 (0.5)
9		1 (0.1)

TAFE: technical and further education.

Table 2. Summary of mean, standard deviation and intercorrelation for predictors and postpartum depression.

Measures	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	*M* (*SD*)	*n* (%)
1. Age	–	–	–	–	–	–	–	–	–	–		32.82 (6.82)	
2. Severity	–0.11**	–	–	–	–	–	–	–	–	–		4.07 (1.16)	
3. Duration	–0.07**	0.37**	–	–	–	–	–	–	–	–		2.07 (0.91)	
4. HG diagnosed	–0.14**	0.68**	0.35**	–	–	–	–	–	–				384 (44.6)
5. Weight loss	–0.14**	0.71**	0.25**	0.51**	–	–	–	–	–				537 (62.4)
6. Psychosocial impact	–0.11**	0.75**	0.35**	0.71**	0.56**	–	–	–	–			15.37 (6.45)	
7. Terminate	–0.06**	0.45**	0.19**	0.55**	0.37**	0.58**		–	–				377 (29.7)
8. NVP-/HG-specific social support	–0.01	–0.18*	–0.07*	0.71**	–0.16**	–0.26**	–0.15**	–	–			10.75 (3.90)	
9. Mental health during pregnancy	–0.09*	0.40**	0.22**	0.48**	0.29**	0.54**	0.44**	–0.24**	–			2.53 (1.35)	
10. Depression before pregnancy	–0.09**	0.07*	0.10**	0.08*	0.04	0.09*	0.09*	–0.07*	0.19**				174 (20.2)
11. Postpartum depression	–0.02	0.10**	0.11**	0.11**	0.09*	0.16**	0.08*	–0.16**	0.26**	0.19**			136 (15.8)

HG: hyperemesis gravidarum; NVP: nausea and vomiting in pregnancy.
*Correlation is significant at the 0.05 level (two-tailed); **Correlation is significant at the 0.01 level (two-tailed). HG diagnosed, weight loss, termination, depression before pregnancy and postpartum depression are categorical variables (coded 1 = *yes*, 0 = *no*); *n* represents the frequency of code 1.

states which included women's rating on stress, depression and problems with emotions in a single-item measure.

Of note, the physical characteristics of NVP (severity, duration, HG diagnosis and weight loss) predicted PPD although none of them uniquely contributed to the disease. This finding did not replicate studies reporting associations between severity of NVP and symptoms of depression during pregnancy (Heitmann et al., 2017; Koken et al., 2008; Kramer et al., 2013) and PPD (Kramer et al., 2013; Meltzer-Brody et al., 2017). An explanation may be the difference in measures to capture the severity of NVP. This study used an instrument that included multiple measures of the physical characteristics of NVP and HG symptoms across the pregnancy, including visits to the hospital and treatment received and was not limited to the frequency of nausea and vomiting at certain time periods in the pregnancy (Koken et al., 2008; Kramer et al., 2013) or within a 24-hour period (Heitmann et al., 2017).

In addition, this study assessed whether psychosocial impact of NVP, consideration of termination due to NVP and social support in relation to NVP predicted PPD. Contrary to studies by Reid and Taylor (2015) and Robertson et al. (2004), social support received in relation to the NVP experience does not appear to be protective of PPD. The interaction between psychosocial impact of NVP and social support related to NVP was marginally significant in the third block of the model, suggesting social support is a moderator of the effect of psychosocial impact on PPD. However, in the final model, which included the influence of mental health variables, the interaction was no longer significant. Therefore, although previous research suggests that social support buffers the impact of NVP (Chou et al., 2008), this study supports findings by Reid and Taylor (2015) that social support is not sufficient enough to mitigate the adverse effects of stressors, NVP in this study, on PPD. Of note, this study assessed NVP-/HG-specific social support only, and as both specific social support and general support provide different functions (Cohen and Wills,

Table 3. Predictor coefficients for the model predicting postpartum depression ($N = 861$).

Predictor variable	Nagelkerke's R^2	−2log likelihood	*b*	*SE*	Wald's *F*	*p*-value	Exp(*B*)	95% CI
Block 0								
Constant			−1.67	0.09	320.73	<0.001***	0.19	
Block 1	0.00	750.52				0.394		
Age			−0.01	0.01	0.704	0.402	0.99	0.96, 1.02
Constant			−1.28	0.48	7.19	0.007**	0.28	
Block 2	0.03	736.80				0.013*		
Age			−0.04	0.01	0.080	0.779	0.99	0.97, 1.03
Duration			0.21	0.19	3.17	0.075	0.98	1.00, 1.56
Severity			0.03	0.13	0.047	0.828	1.03	0.79, 1.34
HG diagnosis			0.30	0.26	1.40	0.236	1.35	0.82, 2.21
Weight loss			0.21	0.28	0.600	0.439	1.23	0.72, 2.12
Constant			−2.40	0.67	12.91	<0.001***	0.09	
Block 3	0.09	705.65				<0.001***		
Age			0.00	0.02	0.044	0.835	0.99	0.97, 1.03
Duration			0.22	0.12	3.43	0.064	1.25	0.99, 1.58
Severity			−0.19	0.15	1.58	0.208	0.82	0.61, 1.11
HG diagnosis			−0.46	0.28	0.02	0.874	0.96	0.54, 1.69
Weight loss			0.14	0.27	0.25	0.621	1.15	0.67, 1.98
Psychosocial impact			0.16	0.48	11.04	0.001***	1.17	1.07, 1.29
Termination			−0.21	0.26	0.69	0.407	0.81	0.49,1.34
NVP-/HG-specific social support			0.04	0.07	0.36	0.551	1.04	0.91,1.20
(Psychosocial impact × NVP-/HG-specific social support)			−0.01	0.00	3.88	0.049*	0.99	0.99,1.00
Constant			−3.07	1.12	7.51	0.006**	0.05	
Block 4	0.18	654.82				<0.001***		
Age			0.00	0.02	0.00	0.938	1.00	0.97, 1.03
Duration			0.19	0.12	2.34	0.126	1.21	0.95, 1.54
Severity			−0.17	0.16	1.10	0.294	0.85	0.62, 1.16
HG diagnosis			−0.32	0.31	1.08	0.299	0.73	0.40, 1.33
Weight loss			0.27	0.29	0.88	0.348	1.31	0.74, 2.31
Psychosocial impact			0.12	0.06	4.72	0.030*	1.13	1.01,1.26
Termination			−0.51	0.27	3.51	0.061	0.60	0.35,1.02
NVP-/HG-specific social support			0.05	0.08	0.38	0.540	1.05	0.90,1.23
(Psychosocial impact × NVP-/HG-specific social support)			−0.00	0.00	2.46	0.117	0.99	0.98,1.00
Mental health during pregnancy			0.46	0.24	3.91	0.048*	1.59	1.00,2.52
Depression before pregnancy			0.79	0.22	12.53	<0.001***	2.19	1.42,3.39
(Mental health during pregnancy × NVP-/HG-specific social support)			0.00	0.02	0.02	0.882	1.00	0.96,1.05
Constant			−4.24	1.25	11.43	<0.001***	0.01	

HG: hyperemesis gravidarum; NVP: nausea and vomiting in pregnancy.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

1985), these results might not apply to general social support received by the participants. Although termination consideration was not significantly associated with PPD, the frequency rate of considering termination in the current study was 29 per cent, indicating a substantial adverse impact of NVP and HG on physical and emotional well-being.

Finally, the psychosocial impact associated with the NVP experience appears to be predictive of PPD. The adverse effects of the impact of NVP and HG on family, social and occupational functioning are well documented (Heitmann et al., 2017; Mazzotta et al., 2000; Smith et al., 2000), and other studies have concluded that these adverse psychosocial impacts of NVP (Koken et al., 2008) and HG (Magtira et al., 2015; Tan et al., 2010) increase the risk of depression. However, this study suggests that higher psychosocial impact could have more predictive value on PPD than do separately the physical characterisations of NVP and HG (severity, duration, HG diagnosis and weight loss). Interestingly, the results revealed a significant relationship between psychosocial impact and PPD even after removing the variance due to mental health status before and during pregnancy, therefore highlighting the independent effect of the psychosocial impact of NVP and HG in predicting PPD.

Clinical implications of this study include increasing the knowledge of health professionals with respect to the psychosocial impact of NVP and its role as a potential risk factor for PPD independent of previous history of depression. Furthermore, standard antenatal care may benefit from including an assessment of the psychosocial impact of NVP for women. Notably, the validated HIS tool (Power et al., 2010), modified for this study, includes assessment of the psychosocial impact of NVP and HG and this may assist health professionals to plan and implement personalised care plans. These early preventive interventions may limit the problem of the majority of mothers not seeking help for their depressive symptoms (Liberto, 2012).

One of the strengths of this study was the availability of a history of depression data, with women reporting on depression prior and post pregnancy, together with mental health well-being data during pregnancy, and a broad assessment of the characterisation of NVP. Furthermore, Fejzo and MacGibbon (2012) commented that studies reporting increased incidence of pre-existing psychiatric disorders in women with HG can be explained by methodological issues, where studies are not limited to first HG pregnancies only, therefore psychological conditions resulting from a previous HG pregnancy may bias results. Therefore, a further strength of this study was utilising depression diagnosis before first pregnancy.

One major limitation of the study was the retrospective nature of data collection. Retrospective designs represent threats to internal and external validity (Tofthagen, 2012), and in self-reported data such as this study, recall basis represents a major bias to interval validity (Hassan, 2006). In this study, the time elapsed between the event and reporting ($M = 4$ years, $SD = 5.8$) may be considered a bias to the internal validity. As a sanity check, we included the time elapsed since the event and reporting into the logistic regression as a control variable. This variable was not perfect, since 18 per cent of participants reported their experience of NVP/HG was equally bad in all their pregnancies, and the average across pregnancies had to have an approximation of the time elapsed. The results were consistent with the final reported analysis, meaning recall bias is unlikely to be a problem for the present analyses. Due to the cross-sectional design, the causal relationship between NVP and PPD cannot be further investigated. Furthermore, as the sample was self-selected, and the study was advertised on forum groups for women experiencing HG, there were a larger proportion of HG cases than what is observed in a population-based sample. Although using a population-based sample with expected prevalence is more desirable, for this study, a larger proportion of HG cases may enrich the analyses. A further limitation was the use of a self-reported diagnosis of depression and PPD. Although the validity of a self-reported depression diagnosis has been confirmed (Sanchez-Villegas et al., 2008), and the validity of self-reported PPD diagnosis by the Edinburgh Postnatal Depression

Scale has been confirmed as moderately psychometrically sound (Boyd et al., 2005), this study did not utilise a validated clinical scale. However, at present, there is no gold standard measurement of PPD (Vliegen et al., 2014), and additional research is still needed to determine the best measure of PPD as there is lack of consensus regarding the psychometric properties of current valid measures in clinical and research settings (Boyd et al., 2005) Similarly, this study used a single-item measure of self-rated mental health which included stress, depression and emotions; therefore, it may be considered a low content validity. However a recent scoping review has proposed that general self-rated mental health may predict mental morbidity and has been shown to be moderately related with multi-item mental health measures (Ahmad et al., 2014). It may also be of interest for future research to explore the impact of NVP in other psychiatric disorders during and after pregnancy, for example, in anxiety, bipolar disorder, obsessive-compulsive disorder and post-traumatic stress disorder.

Conclusion

This study found that the psychosocial impacts of experiencing NVP were more predictive of PPD than the physical characteristics of NVP and HG and still remained significant even when controlling for depression before and during pregnancy. Furthermore, perceived NVP-specific social support was not found to be a protective factor against the psychosocial impact of NVP on PPD. Although all the predictors considered in this study explained only 18 per cent variance of PPD risk in the model, these findings identified and refined predictive factors for PPD and may be utilised by health professionals when considering care plans for women presenting with severe NVP and HG symptoms.

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