

# Risk Factors of Prolonged Nausea and Vomiting During Pregnancy

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**Background:** Determination of the risk factors associated with prolonged nausea and vomiting during pregnancy (NVP) helps to develop prevention strategies. However, there is a lack of studies regarding risk factors of prolonged NVP. Thus, the potential risk factors of prolonged moderate and severe NVP were examined.

**Methods:** This is a retrospective study among pregnant women in South of China. The Pregnancy-Unique Quantification of Emesis (PUQE) scale was used to evaluate NVP. Onset before 12 weeks and persistence after 20 weeks of gestation were defined as prolonged NVP. Data on NVP and other variables were collected by standard questionnaires and medical records.

**Results:** A finally sample of 1739 participants were analyzed. The incidence of prolonged moderate and severe NVP was 42.1% and 1.1%, respectively. Among those with NVP, the increased risk of prolonged moderate NVP was associated with lower gestational age (OR = 0.95 per SD increase, 95% CI=0.93–0.97), being a housewife (OR = 1.30, 95% CI=1.02–1.65), pre-pregnant longer sedentary time (OR = 2.02, 95% CI=1.16–1.83), pre-pregnant lower exercise frequency (OR = 1.84, 95% CI=1.20–2.82), and history of gastrointestinal (GI) diseases (OR = 2.21, 95% CI=1.61–3.03). Persons who were a housewife (OR = 6.39, 95% CI=1.90–21.47), with pre-pregnant high frequent (always) cold drinking (OR=11.12, 95% CI=1.24–100.73), and had a history of GI diseases (OR=10.10, 95% CI=2.63–38.86) were more likely to experience prolonged severe NVP.

**Conclusion:** The results of the present study suggested that pregnant women unemployed, with lower gestational age, pre-pregnant longer sedentary time, less exercise, high frequent (always) cold drinking and history of GI diseases had a higher risk of prolonged NVP and should be taken more care.

**Keywords:** prolonged nausea and vomiting during pregnancy, risk factors, pregnant women, retrospective analysis

## Introduction

Nausea and vomiting during pregnancy (NVP)<sup>1</sup> are common symptoms, with rates of prevalence from 50% to 90%.<sup>2</sup> The symptoms of NVP usually start at 5 to 6 gestational weeks, peak at 8 to 9 weeks, and alleviate after 16 to 20 weeks.<sup>3</sup> Although most women with NVP have symptoms limited to the first trimester, in 15% to 20% of women, the symptoms continue until late pregnancy, and in 5% of cases, they persist throughout the pregnancy.<sup>2</sup> Among women with severe symptoms, 76% reported that they considered never getting pregnant again; 84% reported that NVP had major adverse effects on their ability to care for their children; and 43% reported major effects on the relationship with their partner,

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reflecting substantial effects on the functioning of family life.<sup>4</sup> Moreover, women with prolonged nausea in pregnancy have an increased risk of depressive symptoms postpartum,<sup>5</sup> and those with severe NVP show a higher risk of lower birth weight.<sup>6</sup>

Most studies examine the various treatments for NVP and the relation between NVP and delivery outcomes,<sup>5,7–10</sup> and few focus on the risk factors associated with NVP. Among those that examine the risk factors, no clear consensus has emerged. For example, in some studies, NVP is associated with younger maternal age,<sup>11,12</sup> whereas in others, there is no association between maternal age and NVP.<sup>13–15</sup> The results concerning gravidity and parity are also inconclusive. Some studies show a statistical relation between gravidity, parity, and NVP,<sup>13,16</sup> whereas others do not.<sup>17,18</sup>

The duration and severity of NVP differ among women and among individual pregnancies in the same woman. Currently, the severity of NVP is defined by the Pregnancy-Unique Quantification of Emesis and Nausea (PUQE) scale,<sup>19</sup> but the duration of NVP has not been defined. Most cases of NVP alleviate and are self-limited after 20 weeks.<sup>2</sup> Therefore, the NVP cases that persist beyond 20 weeks (defined as prolonged NVP) and that score above mild NVP should receive more attention, because prolonged NVP is a significant risk factor for bad delivery outcomes.<sup>5,20</sup> However, there is a lack of studies regarding risk factors of prolonged NVP.

The aim of this study was to find out potential risk factors of prolonged NVP. In the analysis, the risk factors of NVP were categorized both by duration and severity. In addition, the prevalence of prolonged moderate and severe NVP was determined on the basis of the PUQE scale.

## Methods

### Participants and Procedures

A hospital-based retrospective study was conducted in the Department of Obstetrics, Foshan Women and Children Hospital (FWCH), Foshan, Guangdong, China. The participants were interviewed from March 1 to May 30, 2018. The criteria for inclusion in this study were the following: pregnant, more than 18 years old, more than 20 gestational weeks, and NVP onset before 12 gestational weeks. The criteria for exclusion were the following: preparing to terminate the pregnancy, less than 18 years old, less than 20 gestational weeks, diagnosed gastrointestinal (GI) diseases during pregnancy, serious mental illness (which were

reported related with hyperemesis gravidarum,<sup>10</sup> the most severe type of NVP), and without self-expression ability. Face-to-face interviews were used to conduct the survey. Written informed consent was obtained from all participants. The Human Subjects Committee of the Foshan Women and Children Hospital Affiliated to Southern Medical University approved the study (FSFY-MEC-2017-056), and all methods were performed in accordance with the relevant guidelines and regulations.

## Measurements

### Nausea and Vomiting During Pregnancy

The severity of NVP was measured by using the Chinese version of the Pregnancy-Unique Quantification of Emesis (PUQE) scale. In the Chinese version of the PUQE scale, the value of Cronbach's  $\alpha$  was 0.864, the value of the test-retest reliability was 0.889 after 24 h, and the content validity index value was 0.953 and its Pearson's correlation coefficient  $r$  was 0.892.<sup>21</sup> The PUQE is a self-reported questionnaire and consists of three questions about the physical symptoms of nausea, vomiting, and retching over the past 24 h. Each question has five options scored from 1 to 5 points. The scores of the three questions are summed to obtain the total PUQE score, which ranges from 3 to 15, with higher scores reflecting more severe NVP. In this study, the NVP was divided into mild NVP (3 to 6), moderate NVP (7 to 12), and severe NVP (13 to 15), according to the recommendation of the PUQE scale.<sup>2</sup> Thus, the NVP was divided into prolonged mild NVP, prolonged moderate NVP, and prolonged severe NVP. The onset time of NVP was according to self-reporting and the first obstetrical outpatient visit record.

### Demographic Variables and Treatments of Nausea and Vomiting During Pregnancy

Demographic variables and treatments were assessed using a standardized questionnaire. Self-reporting data were used to document age, gestational age, parity, employment, marriage, education, and treatment. Gestational age was calculated with the conformation of the sonogram and the last menstrual period. For employment, women were either a housewife or employed. The two marriage categories were married and unmarried. The education levels were primary school or below, middle school, and college or above.

The treatments of the participants were also surveyed by the question "what kinds of treatment were taken for

NVP?” The common treatments included vitamin B<sub>6</sub>, multivitamins, ginger, and prescription drugs.

### Health-Related Variables

Health-related variables of the participants were also examined and included sedentary time, exercise frequency, cold drinking, incidence of gestational diabetes mellitus (GDM), hypothyroidism, and hypertension, and history of gastrointestinal (GI) diseases and *Helicobacter pylori* test (carbon-14 respiration test),<sup>22</sup> gastroscopy, and colonoscopy. Sedentary time was collected by question “In generally, how long do you sit per day before pregnancy?” The categories of sedentary time were <4, 4 to 6, 7 to 9, and ≥10 h/d. Exercise was collected by question “In generally, how many times will you take exercise per week before pregnancy?” The categories of exercise frequency were 0, <1, 1 to 2, 3 to 5, and >6 d/week. The drinking of cold drinks was collected by question “In generally, how frequent will you have cold drinking (0–4°C cold drinks including water or other beverage) before pregnancy?” The frequency of cold drinking was categorized as never, sometimes, often, and always. The incidence of GDM, hypothyroidism, and hypertension and the history of diseases, *H. pylori* test, gastroscopy and colonoscopy were based on self-reported data and medical records. A history of GI diseases was defined as a clinical diagnosis of GI disease within one year before the pregnancy. The GI diseases in the current study included acute gastroenteritis, chronic gastritis, dyspepsia, chronic gastroenteritis, colitis, irritable bowel syndrome, gastroesophageal reflux, acute gastritis, and gastric ulcer. The carbon-14 respiration test, gastroscopy, and colonoscopy were also conducted within one year before the pregnancy.

### Statistical Analyses

In this study, all analyses are conducted using the statistical analysis program IBM SPSS 24.0. To describe the data, the mean and standard deviation (SD) are presented for continuous variables, and the frequency and percentage are presented for categorical variables. Bivariate analysis and multivariate logistic regression were used to analyze the risk factors of NVP. One-way ANOVA and  $\chi^2$  test were used to conduct bivariate analyses. One-way ANOVA was used to analyze the age and gestational age among different NVP groups, and the  $\chi^2$  test was used to explore the association between other categorical variables and NVP. Then, the variables significantly related to NVP were used in multivariate logistic regression. Odds ratios (ORs) and

95% confidence intervals (95% CI) were obtained to evaluate the increased risk of prolonged moderate and severe NVP. All statistical tests of hypotheses were two-sided, and a P-value less than 0.05 was considered statistically significant.

## Results

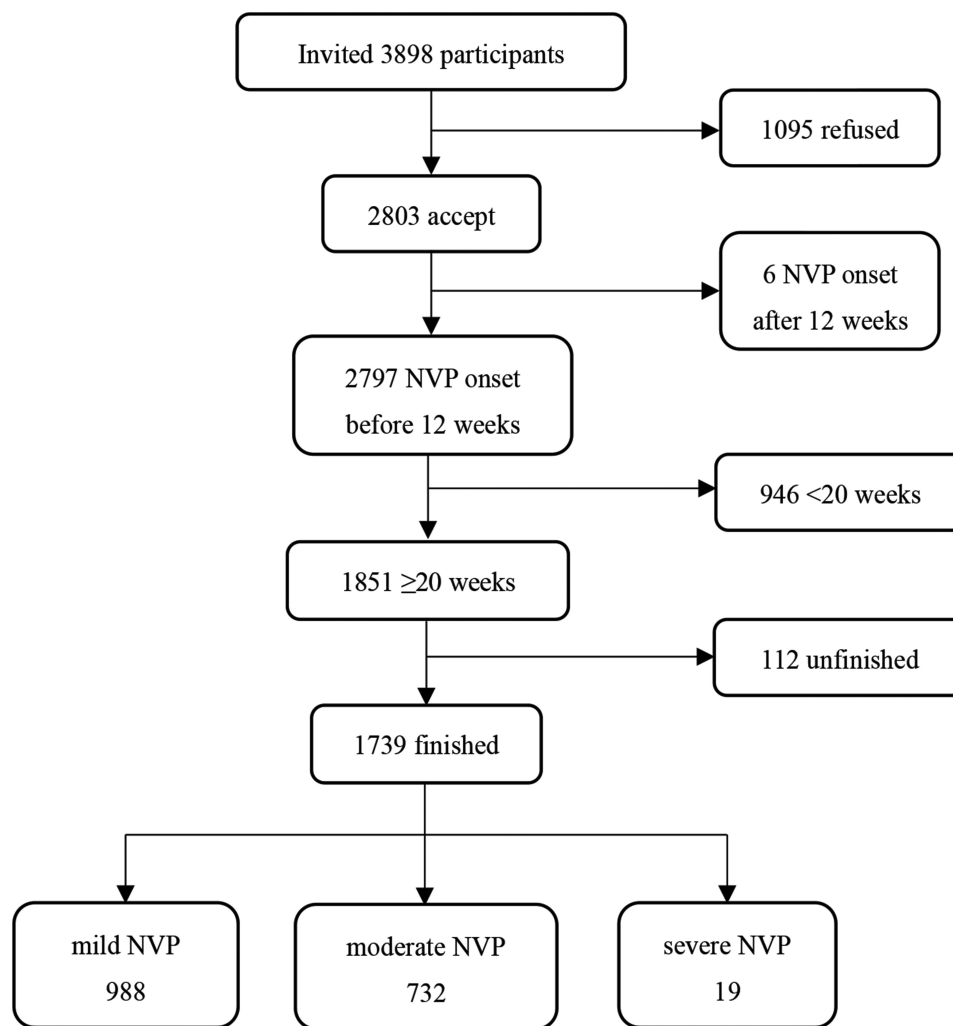
### Characteristics of Participants

Figure 1 was the patient selection flow chart. Of the 3898 pregnant women asked to participate, 2803 agreed and accepted an interview. The response rate was 71.91% (2803/3898). After those with less than 20 gestational weeks, NVP onset after 12 gestational weeks, and unfinished questionnaires were excluded, 1739 women were included in the final analysis.

Table 1 shows the NVP, demographic, treatment, and health-related characteristics of the study participants. The mean PUQE score was 6.25 (SD = 2.51), and 42.1% (732/1739) of pregnant women had prolonged moderate NVP (PUQE = 6 to 12) and 1.1% (19/1739) had prolonged severe NVP. The mean age of participants was 29.68 years (SD = 4.92). The mean gestational age was 29.72 weeks (SD = 5.51). Most of the pregnant women were primiparous (79.1%), employed (77.7%), married (95.3%), and educated to middle school or below (77.8%). Women used different treatments to ease their NVP, including vitamin B<sub>6</sub> (9.5%), multivitamins (30.2%), ginger (5.6%), and prescription drugs (1.7%). However, most participants did not use treatment to prevent their NVP. Of the health-related characteristics of the participants, most were sedentary 4 to 6 h per day (40.4%), exercised 1 to 2 times per week (37.0%), and drunk cold drinking sometimes (48.2%) before pregnancy. Some of the participants had pregnancy complications, such as GDM (13.1%), hypothyroidism (3.2%), and hypertension (0.7%). Nearly two hundred participants had a history of GI disease one year before pregnancy (11.2%), and some women had GI-related examinations before pregnancy, such as carbon-14 respiration test (4.6%), gastroscopy (3.1%), and colonoscopy (1.3%).

### Bivariate Analysis of Risk Factors of Prolonged Nausea and Vomiting During Pregnancy

Table 2 shows the bivariate analysis of the associations between general variables and NVP. The results indicated that women who were housewives with lower gestational



**Figure 1** The procedure of sampling. (NVP, nausea and vomiting during pregnancy).

age, longer pre-pregnant sedentary time, lower pre-pregnant exercise frequency, high frequent (always) pre-pregnant cold drinking and a history of GI disease or an abnormal gastroscopy result were more likely to have prolonged moderate and severe NVP.

## Multivariable Analysis of Risk Factors of Prolonged Nausea and Vomiting During Pregnancy

The variables significantly related to NVP in Table 2 were used in multivariate logistic regression. Persons with severe NVP were excluded from the analysis of the risk factors of prolonged moderate NVP. Table 3 shows the statistically significant factors included in the final regression of prolonged NVP. The risk of prolonged moderate NVP decreased when the gestational age increased (OR = 0.95 per SD increase; 95% CI = 0.93 to 0.97;  $P < 0.001$ ).

The housewives had a higher risk of prolonged moderate NVP than employed women (OR = 1.30; 95% CI = 1.02 to 1.65;  $P = 0.034$ ). Among the health-related factors, pre-pregnant sedentary time and exercise frequency, and history of GI diseases were significantly associated with prolonged moderate NVP. Women with longer sedentary time before pregnancy presented a higher risk of prolonged moderate NVP. Compared with women with <4 h sedentary time before pregnancy, the odds ratios were 1.45 (95% CI = 1.16 to 1.83;  $P = 0.001$ ) with 4 to 6 h, 1.67 (95% CI = 1.26 to 2.22;  $P < 0.001$ ) with 7 to 9 h, and 2.02 (95% CI = 1.16 to 3.53;  $P = 0.013$ ) with over 10 h sedentary time. Lower exercise frequency before pregnancy was associated with a higher risk of prolonged moderate NVP. Compared with women who exercised 6 to 7 days per week before pregnancy, the odds ratios were 1.84 (95% CI = 1.25 to 2.80;  $P = 0.005$ ) for those who did

**Table 1** Characteristics of Participants

Variables	Mean±SD or n and (%)	Variables	n and (%)
<b>Outcomes</b>		Exercise (days/week)	
PUQE	6.25±2.51	>6	237(13.6)
NVP		3 to 5	475(27.3)
Mild NVP	988(56.8)	1 to 2	644(37.0)
Moderate NVP	732(42.1)	<1	204(11.7)
Severe NVP	19(1.1)	0	179(10.3)
<b>Demographic characteristics</b>		Cold drinking	
Age (years)	29.68±4.92	Never	832(47.8)
Gestational age (weeks)	29.72±5.51	Sometimes	838(48.2)
Parity		Often	46(2.6)
Primiparous	1375(79.1)	Always	23(1.3)
Multiparous	364(20.9)	GDM	227(13.1)
Employment		Hypothyroidism	56(3.2)
Employed	1352(77.7)	Hypertension	13(0.7)
Housewife	387(22.3)	History of GI diseases	194(11.2)
Marriage		Acute gastroenteritis	80(4.6)
Married	1657(95.3)	Chronic gastritis	53(3)
Unmarried	82(4.7)	Dyspepsia	41(2.4)
Education		Chronic gastroenteritis	6(0.3)
Primary school or below	29(1.7)	Colitis	4(0.2)
Middle school	1323(76.1)	Irritable bowel syndrome	3(0.2)
College or above	387(22.3)	Gastroesophageal reflux	3(0.2)
<b>Treatments</b>		Acute gastritis	2(0.1)
Vitamin B <sub>6</sub>	165(9.5)	Gastric ulcer	2(0.1)
Multivitamins	525(30.2)	<i>Helicobacter pylori</i> test	
Ginger	97(5.6)	Negative	50(2.9)
Prescription drugs	30(1.7)	Positive	30(1.7)
<b>Health-related characteristics</b>		Gastroscopy	
Sedentary time (hours/day)		Normal	24(1.4)
<4	639(36.7)	Abnormal	29(1.7)
4 to 6	703(40.4)	Colonoscopy	
7 to 9	337(19.4)	Normal	15(0.9)
≥10	60(3.5)	Abnormal	7(0.4)

**Abbreviations:** GDM, gestational diabetes mellitus; GI, gastrointestinal; NVP, nausea and vomiting during pregnancy; n, number; PUQE, Pregnancy-Unique Quantification of Emesis and Nausea; SD, stand deviation.

not exercise, 1.87 (95% CI = 1.25 to 2.80;  $P = 0.002$ ) for those who exercised less than 1 day per week, 1.77 (95% CI = 1.25 to 2.47;  $P = 0.001$ ) for those who exercised 1 to 2 days per week, and 1.48 (95% CI = 1.05 to 2.09;  $P = 0.025$ ) for those who exercised 3 to 5 days per week. In addition, women with a history of GI diseases one year before pregnancy were more likely to experience prolonged moderate NVP (OR = 2.21; 95% CI = 1.61 to 3.03;  $P < 0.001$ ).

Persons with prolonged severe NVP were compared with those with mild NVP in the logistic regression. Compared with employed women, housewives had a higher risk of prolonged severe NVP (OR = 6.39; 95%

CI = 1.90 to 21.47;  $P = 0.003$ ). The risk of severe NVP among women who with high frequent (always) cold drinking was more than 11 times that of those who never drank cold drinks (OR = 11.12; 95% CI = 1.24 to 100.70;  $P = 0.032$ ). Similar to the women with moderate NVP, pregnant women with a history of GI diseases were more likely to experience prolonged severe NVP (OR = 10.10; 95% CI = 2.63 to 14.67;  $P = 0.001$ ).

## Discussion

In this study, the prevalence and risk factors of prolonged NVP among pregnant women in South China were investigated. The prevalence of prolonged moderate and severe

**Table 2** Bivariate Analysis of Risk Factors of Prolonged NVP

Variables	NVP (Mean±SD or n and (%))			P-value
	Mild	Moderate	Severe	
<b>Demographic characteristics</b>				
Age(years)	29.62±4.85	29.69±5	32.05±4.95	0.103
Gestational age (weeks)	30.46±5.42	28.76±5.48	28.26±5.06	<0.001
Parity				0.23
Primiparous	793(57.7)	569(41.4)	13(0.9)	
Multiparous	195(53.6)	163(44.8)	6(1.6)	
Employment				0.002
Employed	783(57.9)	560(41.4)	9(0.7)	
Housewife	205(53)	172(44.4)	10(2.6)	
Marriage				0.498
Married	938(56.6)	700(42.2)	19(1.1)	
Unmarried	50(61)	32(39)	0(0)	
Education				0.642
Primary school or below	20(69)	9(31)	0(0)	
Middle school	750(56.7)	557(42.1)	16(1.2)	
College or above	218(56.3)	166(42.9)	3(0.8)	
<b>Health-related characteristics</b>				
Sedentary time (hours/day)				<0.001
<4	412(64.5)	227(35.5)	0(0)	
4 to 6	381(54.2)	315(44.8)	7(1)	
7 to 9	168(49.9)	159(47.2)	10(3)	
≥10	27(45)	31(51.7)	2(3.3)	
Exercise frequency (days/week)				<0.001
>6	168(70.9)	69(29.1)	0(0)	
3 to 5	286(60.2)	189(39.8)	0(0)	
1 to 2	343(53.3)	294(45.7)	7(1.1)	
<1	106(52.0)	98(48.0)	0(0)	
0	85(47.5)	82(45.8)	12(6.7)	
Cold drinking				0.02
Never	465(55.9)	357(42.9)	10(1.2)	
Sometimes	483(57.6)	349(41.6)	6(0.7)	
Often	26(56.5)	19(41.3)	1(2.2)	
Always	14(60.9)	7(30.4)	2(8.7)	
GDM				0.504
No	851(56.3)	644(42.6)	17(1.1)	
Yes	137(60.4)	88(38.8)	2(0.9)	
Hypothyroidism				0.495
No	959(57)	705(41.9)	19(1.1)	
Yes	29(51.8)	27(48.2)	0(0)	
Hypertension				0.071
No	981(56.8)	727(42.1)	18(1)	
Yes	7(53.8)	5(38.5)	1(7.7)	

(Continued)



Table 2 (Continued).

Variables	NVP (Mean±SD or n and (%))			P-value
	Mild	Moderate	Severe	
History of GI diseases				<0.001
No	914(59.2)	618(40)	13(0.8)	
Yes	74(38.1)	114(58.8)	6(3.1)	
<i>Helicobacter pylori</i> test				0.169
Negative	20(40)	30(60)	0(0)	
Positive	10(33.3)	18(60)	2(6.7)	
Gastroscopy				0.014
Normal	10(41.7)	14(58.3)	0(0)	
Abnormal	3(10.3)	23(79.3)	3(10.3)	
Colonoscopy				0.313
Normal	5(33.3)	9(60)	1(6.7)	
Abnormal	1(14.3)	4(57.1)	2(28.6)	
<b>Treatments</b>				
Vitamin B <sub>6</sub>				0.735
No	891(90.2)	665(90.8)	18(94.7)	
Yes	97(9.8)	67(9.2)	1(5.3)	
Multivitamins				0.236
No	675(68.3)	524(71.6)	15(78.9)	
Yes	313(31.7)	208(28.4)	4(21.1)	
Ginger				0.415
No	936(94.7)	687(93.9)	19(100)	
Yes	52(5.3)	45(6.1)	0(0)	
Prescription drugs				0.759
No	972(98.4)	718(98.1)	19(100)	
Yes	16(1.6)	14(1.9)	0(0)	

**Notes:** One-way ANOVA was used to analyze the age and gestational age among different NVP groups, and the  $\chi^2$  test was used to explore the association between other categorical variables and NVP.

**Abbreviations:** GDM, gestational diabetes mellitus; GI, gastrointestinal; NVP, nausea and vomiting during pregnancy; n, number; SD, standard deviation.

NVP among pregnant women was 42.10% and 1.1%, respectively. Women that were housewives with lower gestational age, longer pre-pregnant sedentary time, less pre-pregnant exercise, and a history of GI diseases were more likely to experience prolonged moderate NVP. Housewife status and a history of GI disease were also the risk factors of prolonged severe NVP. In addition, women who with high frequent cold drinking had a higher risk of prolonged severe NVP than those that never drank cold drinks before pregnancy.

Women of greater gestational age were associated with a lower incidence of NVP in this study, which is consistent with previous information that gestational age affects NVP.<sup>2</sup> Compared with employed women, housewives

were also at increased risk of both prolonged moderate and severe NVP, which is consistent with several studies in which unemployment is identified as a risk factor of NVP.<sup>13,23</sup> However, whether employment status is a true risk factor for NVP remains unclear, because women may stop work because of their symptoms. In addition, they may remain in the home because of multiparity and the need to care for other children.

Pre-pregnant lifestyle factors were associated with prolonged NVP such as sedentary time, exercise and cold drinking. Sedentary behavior had been reported significantly associated with GDM,<sup>24</sup> larger newborn abdominal circumference and higher risk of fetal macrosomia,<sup>25</sup> but the relationship between pre-pregnant sedentary time and

**Table 3** Multivariate Analysis of Risk Factors of Prolonged NVP

Variables		Moderate NVP (n = 1720)			Severe NVP (n = 1007)		
		OR	95% CI	P	OR	95% CI	P
Gestational age (weeks)		0.95	0.93–0.97	<0.001			
Employment (housewife vs employed)		1.3	1.02–1.65	0.034	6.39	1.90–21.47	0.003
Sedentary time (hours/day)	<4	Ref	Ref	<0.001			
	4 to 6	1.45	1.16–1.83	0.001			
	7 to 9	1.67	1.26–2.22	<0.001			
	≥10	2.02	1.16–3.53	0.013			
Exercise frequency (days/week)	>6	Ref	Ref	0.007			
	3 to 5	1.48	1.05–2.09	0.025			
	1 to 2	1.77	1.27–2.47	0.001			
	<1	1.87	1.25–2.8	0.002			
	0	1.84	1.2–2.82	0.005			
Cold drinking	Never				Ref		0.046
	Sometimes				0.41	0.12–1.39	0.151
	Often				0.39	0.03–4.49	0.448
	Always				11.12	1.24–100.73	0.032
History of GI diseases (yes vs no)		2.21	1.61–3.03	<0.001	10.1	2.63–38.86	0.001

**Abbreviations:** CI, confidence interval; GI, gastrointestinal; NVP, nausea and vomiting during pregnancy; n, number; OR, odds ratio.

prolonged NVP had not been demonstrated. Exercise during pregnancy can bring a variety of health benefits.<sup>26</sup> Our results shown that women with shorter sedentary time and more frequent exercise before pregnancy had a lower risk of prolonged NVP. A previous study also demonstrated that lack of leisure-time physical activity before pregnancy was associated with an increased odds of hyperemesis gravidarum,<sup>27</sup> but there was no other published research supporting our results. High frequent cold drinking before pregnancy also appeared to be a risk factor of NVP in this study. Some literatures reported that cold water intake inhibits colonic motility.<sup>28</sup> Fone's Study implied that cold stress delayed the gastric emptying produced.<sup>29</sup> In addition, cold water was reported can induce esophageal reflexes in patients with achalasia.<sup>30</sup> Thus, we guess the frequency of cold drinking may had an effect on the gastrointestinal health and then stimulated different degrees of NVP during pregnancy. And the result of present study was in accordance with it.

A history of GI disease also increased the risk of both prolonged moderate and severe NVP in this study. However, a search of PubMed found no previous research that studied the relations between GI diseases before pregnancy and NVP, and therefore, there are no other data that can support this result. However, studies show that *H. pylori* infection most likely acquired before pregnancy is related to hyperemesis

gravidarum, the most serious form of NVP.<sup>31,32</sup> During the last decade, it has been well established that *H. pylori* infection is related to worsening GI health.<sup>33–36</sup> According to the above research, GI health before pregnancy is likely closely associated with NVP, which is consistent with the conclusion in the present study. Although NVP is generally considered as a common condition primarily caused by hormonal change, the women with a history of GI diseases were assumed to have worse GI health, which could have stimulated the NVP.

This study was large enough to provide stable estimates for many potential risk factors for prolonged NVP. Factors were included that can suggest interventions, such as pre-pregnant exercise frequency, sedentary behavior and cold drinking, and history of GI diseases, which were rarely studied in association with NVP. In addition, the PUQE was used to evaluate NVP instead of a simple question. However, the study had some limitations. As a retrospective study, pre-pregnant lifestyle variables and history of GI diseases were based on participant recall. To further validate the present results, prospective cohort study should be conducted.

## Conclusion

The results of present study suggested that pregnant women unemployed, with lower gestational age, pre-



pregnant longer sedentary time, less exercise and high frequent (always) cold drinking and history of GI diseases had a higher risk of prolonged NVP and should be taken more care.

## Data Sharing Statement

Available upon request to the first author.

## Ethical Approval

The study is approved by Human Subjects Committee of the Foshan Women and Children Hospital Affiliated to Southern Medical University (FSFY-MEC-2017-056) and all methods are performed in accordance with the relevant guidelines and regulations. The study was conducted in accordance with the Declaration of Helsinki.

## Consent to Participate

Informed consent was obtained from all individual participants included in the study.

## Acknowledgments

We are grateful to all of the women for participating in this study and all staff for helping collect data.

## Author Contributions

Huishan Zhang analyzed the data, drafted the paper and responsible for revisions.

Shuzhen Wu analyzed the data and interpreted the results.

Jingping Feng collected data and reviewed the paper.

Zhengping Liu designed the project and reviewed the paper.

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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