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## Original Contribution

# Increased Levels of Depressive Symptoms Among Pregnant Women in The Netherlands After the Crash of Flight MH17

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On July 17, 2014, Malaysia Airlines flight MH17 was shot down, a tragedy that shocked the Dutch population. As part of a large longitudinal survey on mental health in pregnant women that had a study inclusion period of 19 months, we were able to evaluate the possible association of that incident with mood changes using pre- and postdisaster data. We compared mean Edinburgh Depression Scale (EDS) scores from a group of women ( $n = 126$  cases) at 32 weeks' gestation during the first month after the crash with mean scores from a control group ( $n = 102$ ) with similar characteristics who completed the EDS at 32 weeks' gestation during the same summer period in 2013. The mean EDS scores of the 126 case women in the first month after the crash were significantly higher than the scores of 102 control women. There were no differences in mean EDS scores between the 2 groups at the first and second trimesters. The present study is among the first in which perinatal mental health before and after the occurrence of a disaster has been investigated, and the results suggest that national disasters might lead to emotional responses.

depression; disaster; Edinburgh Depression Scale; life event; mourning; perinatal mental health; pregnancy; psychological distress

Abbreviation: EDS, Edinburgh Depression Scale.

On July 17, 2014, Malaysia Airlines flight MH17 (hereafter referred to as MH17) was shot down near the border of Ukraine and Russia, killing all 298 passengers and crew members. This disaster was a tragedy that stunned the whole world; it was especially shocking to people from The Netherlands because most of the passengers were Dutch.

Scientific evidence of a possible association between national disasters and mental health at an individual level is scarce. In a review on mental health responses to community disasters, North and Pfefferbaum (1) concluded that the limitations of their review reflected the state of the literature on mental health responses to disasters, in which there is a limited evidence base and a lack of methodological rigor. Scientific investigation of disasters is difficult, particularly because the occurrences of such events are unexpected (1). With regard to disaster traumatization among pregnant women in particular, Harville et al. (2) concluded that there is some evidence that disasters might influence maternal mental health

and some perinatal health outcomes, particularly among highly exposed women, but they noted that studies with an adequate design have not yet been performed.

It has been recognized that the severity of the exposure to the disaster trauma is associated with the magnitude of the effect on mental health (1, 2), but it is not known to what extent an indirect exposure might be related to mental health. In an article about psychological responses to the terrorist attacks of September 11, 2001 (hereafter referred to as September 11), Silver et al. (3) stated that psychological changes resulting from a national disaster were not limited to persons who experienced it directly; they also occurred in persons who viewed the attacks and their aftermath on television, for example. Nonetheless, studies that include data on pre-disaster mental health assessments are lacking.

One could hypothesize that a disaster that affected an entire nation would be reflected in the mood of the Dutch citizens, with pregnant and postpartum women potentially being

especially vulnerable (2). Because the MH17 crash occurred during the 19-month inclusion period of our longitudinal research study of perinatal mental health, we were able to test this hypothesis in 2 subsamples within the larger ongoing Holistic Approach to Pregnancy and the First Postpartum Year (HAPPY) Study (4). We identified a group of women who completed mental health questionnaires before the crash (summer of 2013) and a comparable group of women who were assessed before and after the MH17 crash (summer of 2014), and we investigated whether women in the latter group reported more depressive symptoms than did women in the former group.

## METHODS

At 12, 22, and 32 weeks of gestation and 1 week postpartum, the women participating in the HAPPY Study (4) completed a set of questionnaires that included an assessment of depressive symptoms measured by the 10-item Edinburgh Depression Scale (EDS). The EDS has been validated in both pregnant and postpartum women. The reliability values of the EDS indicated by Cronbach's  $\alpha$ -coefficient are

0.82, 0.83, and 0.84, for the first, second, and third trimesters, respectively (5). Trimester-specific cutoff points to define a depressive episode have been reported to be 11 or higher for the first trimester and 10 or higher for the second and third trimesters (5). The 10 items were scored on a 4-point Likert scale from 0 to 3. The total score ranges from 0 to 30, with higher scores reflecting more depressive symptomatology.

In the present study, we defined 2 groups of women: 126 cases who were 32 weeks pregnant in the summer of 2014 (first month after the MH17 crash) and 102 controls who were 32 weeks pregnant in the corresponding summer period in 2013 (July 17–August 17). We compared scores at 32 weeks of gestation with previous scores at 12 and 22 weeks of gestation. In the case group, the questionnaire assessment at 12 and 22 weeks of gestation had taken place before the crash in July 2014, and these scores were compared with the scores from the assessment at 32 weeks, which were obtained in the first month after the crash. The scores at 12, 22, and 32 weeks of gestation in the 2013 group functioned as controls. Finally, we compared the EDS scores between the 2 groups at the end of the first postpartum week; in the case

**Table 1.** Characteristics and Obstetric Outcomes in July–August of 126 Pregnant Women in the Netherlands After the Malaysia Airlines Flight MH17 Crash (2014) and 102 Control Pregnant Women (2013)

Variable	Controls (n = 102)			Cases (n = 126)			P Value	
	No.	%	Mean (SE)	No.	%	Mean (SE)	t test	$\chi^2$
Baseline characteristics								
Age, years <sup>a</sup>			30.1 (3.9)			30.5 (3.7)	0.43	
High educational level <sup>b</sup>	62	60.8		81	64.3			0.55
Lived with a partner	102	100		126	100			1.00
Had a paid job	92	90.2		120	95.2			0.13
Current smoker	4	4.0		7	5.6			0.56
Obstetric features								
Nulliparous	46	45.1		54	42.9			0.72
Multiparous	56	54.9		72	57.1			0.72
Unplanned pregnancy	7	6.9		10	7.9			0.78
Previous abortion or miscarriage	29	28.4		34	27.0			0.77
Psychiatric history								
Episode of depression earlier in life	15	14.7		15	11.9			0.52
Mean EDS score								
At 12 weeks			3.74 (0.37)			4.25 (0.35)	0.32	
At 22 weeks			4.64 (0.39)			5.09 (0.41)	0.43	
At 32 weeks			4.11 (0.36)			5.21 (0.37)	0.03 <sup>c</sup>	
Postpartum			4.30 (0.46)			4.35 (0.45)	0.94	
Obstetric outcome parameters								
Length of gestation at delivery, weeks <sup>a</sup>			39.7 (1.1)			39.9 (1.0)	0.10	
Preterm birth	3	2.9		2	1.6			0.48
Birth weight, g <sup>a</sup>			3,506 (525)			3,520 (473)	0.85	

Abbreviations: EDS, Edinburgh Depression Scale; SE, standard error.

<sup>a</sup> Values are expressed as mean (standard deviation).

<sup>b</sup> High level of education means at least 16 years of education (college education/university).

<sup>c</sup> Significant at 0.05 level.

group, these scores were from an assessment that occurred approximately 2 months after the crash.

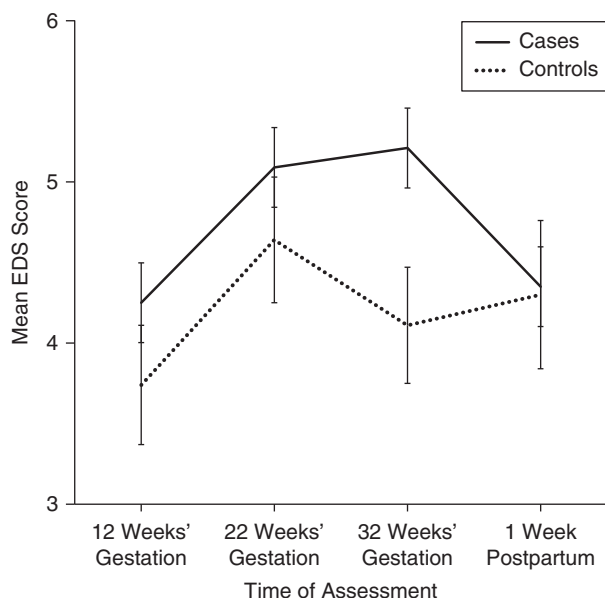
Data on demographic variables, obstetric features, and any episodes of depression earlier in life were collected at the baseline questionnaire assessment at 12 weeks of gestation. Only European women who were conversant in the Dutch language were included in the study (4). Data on birth outcome parameters (birth weight and gestational age at delivery) were collected after childbirth. The study was approved by the Medical Ethics Committee of the Máxima Medical Center (Veldhoven, The Netherlands).

To test for significant differences, we used  $\chi^2$  analyses, *t* tests, and analysis of covariance (SPSS, version 20; IBM, Chicago, Illinois). Statistical tests were 2-sided, and significance was set at  $P < 0.05$ .

## RESULTS

Statistical analyses showed that baseline characteristics and birth outcome parameters were similar among the 2 groups (Table 1). Cronbach's  $\alpha$  for reliability analyses on the EDS outcome measure was 0.80 in controls who were in their third trimesters and 0.81 in cases in their third trimesters. As shown in Figure 1, the mean EDS score at 32 weeks of gestation was significantly higher in the cases (first month after the crash; mean = 5.21; standard error, 0.37) than in the controls (mean = 4.11; standard error, 0.36) ( $t = 2.12$ ,  $P = 0.03$ ), with a Cohen's *d* of 0.3 representing a small to medium effect size (6).

The percentage of women with an EDS score indicating depression at 32 weeks (EDS score  $\geq 10$ ) did not differ significantly between the groups (8.8% for controls vs. 15.9% for



**Figure 1.** Mean Edinburgh Depression Scale (EDS) scores in 2014 among 126 Dutch women before and after the Malaysia Airlines flight MH17 crash (cases) and those in a control group ( $n = 102$ ) who completed the EDS at the same 4 time points in 2013.

**Table 2.** Analysis of Covariance With Adjusted Edinburgh Depression Scale Score at 32 Weeks of Gestation as Dependent Variable and Exposure to Malaysia Airlines Flight MH17 Crash as Independent Variable Among 228 Pregnant Women in The Netherlands, 2014

Covariate <sup>a</sup>	F	P Value
EDS score at 12 weeks gestation	23.2	<0.001 <sup>b</sup>
EDS score at 22 weeks gestation	27.9	<0.001 <sup>b</sup>
Parity	0.3	0.60
Age	3.5	0.06
Smoking	7.0	0.01 <sup>b</sup>
Pregnant at the time of the crash	5.6	0.02 <sup>b</sup>

Abbreviation: EDS, Edinburgh Depression Scale.

<sup>a</sup>  $R^2 = 0.40$ .

<sup>b</sup> Significant at 0.05 level.

cases;  $P = 0.11$ ). However, there were significantly fewer cases with EDS scores in the lower range of 0–4 (48% compared with 69% of controls;  $\chi^2 = 9.4$ ,  $P = 0.002$ ). The case participants also had significantly higher median EDS scores in the third trimester than did controls (for controls: median = 3, range, 0–17; for cases, median = 5, range, 0–16;  $P = 0.04$ ). This difference did not exist between the groups in the other 2 trimesters.

After adjustment for the EDS scores at 12 and 22 weeks of gestation, age, parity, and smoking status, the difference in EDS scores at 32 weeks between groups remained significant (using analysis of covariance (df = 6, 221),  $F = 5.6$ ,  $P = 0.02$ ; Table 2). There were no differences in the mean EDS scores of the 2 groups at 12 and 22 weeks of gestation (Figure 1). The mean 1-week postpartum EDS scores did not differ between the control and case subjects, with mean scores of 4.30 (standard error, 0.46) and 4.35 (standard error, 0.45), respectively.

## DISCUSSION

In the present study, we found significantly higher levels of depressive symptoms in a group of women who were in their third trimesters of pregnancy and completed the EDS during the first month after the MH17 crash in July 2014 than in a group of women with similar characteristics who completed the EDS during a comparable summer period in 2013. Interestingly, when EDS scores of case participants that were determined before the crash (at 12 and 22 weeks of gestation) were compared with those of controls at similar trimesters, no differences were found, which suggests a possible direct relation between the airplane crash and maternal mood. This emotional response is assumed to be temporary because the EDS scores did not differ between the groups at 1 week postpartum (which in the case group refers to a period of 2 months after the crash occurred).

The fact that the percentages of women with an EDS score above the cutoff for depression at 32 weeks did not differ significantly between the groups suggests that the higher mean EDS scores in the both case participants and control

participants were mainly due to elevated scores in the lower ranges. However, the limited statistical power resulting from there being only 9 controls (8.8%) and 20 cases (15.9%) with scores above the cutoff for depression could also explain why the number of women with clinically relevant depression did not differ significantly between the cohorts.

Two other factors that could explain possible differences in depression scores at a population level are seasonal influences and economic situation. In the present study, women in both groups completed the EDS at 32 weeks of gestation in the season (July–August) with a comparable number of hours of sunshine (7). In addition, the economic situation in The Netherlands was even more favorable situation in 2014 than in 2013 (8).

The present study indicates that disasters that affect a whole nation might lead to emotional responses among pregnant women at an individual level. Several aspects of this incident might explain the nationwide level of emotional shock: the high number of victims, the deaths of families and young children, and the fact that it took almost a week to get access to the area of the crash to collect the remains of the victims. Perhaps the most impressive scenes were the live broadcasts on national TV of the arrival of the deceased by military airplanes, followed by a transport to the morgue in long queues of hearses, with thousands of people standing along roads.

Our data are consistent with those on mental health outcomes after September 11, which indicated that substantial psychological distress was reported not only people with a direct experience (9) but also those with an indirect experience (witnessed the attack on television) (10, 11).

No unfavorable birth outcomes were described in pregnant women with an indirect experience after September 11, which is comparable to the results from our study (11, 12). Also, in a Dutch study, Smits et al. (10, 11) found no significant association of indirect exposure with pregnancy duration, but they did report a rather weak but significant association with lower birth weight in neonates of women in The Netherlands who were pregnant at the time of the September 11 attacks.

Although the results of our study showed no unfavorable influence of the MH17 crash on birth weight and pregnancy duration, it is yet unknown whether experiencing a national disaster during pregnancy might influence fetal neurobehavioral development. There is a growing body of literature that suggests that prenatal environmental exposure to stress that affects maternal psychological wellbeing can have sustained influence across the lifespan (“fetal programming”) (14–16). Therefore, future research on the possible association between disasters and pregnancy should also focus on neurobehavioral development of the child.

The key strength of the present study is the fact that during the 19-month inclusion period of a study of pregnant women, we were able to collect data before and after an airplane crash that shocked that nation, which made it possible to compare data from after the crash with baseline information and questionnaire assessments earlier in pregnancy and to compare women who were pregnant at the time of the crash with women who were pregnant a year earlier. However, the retrospective design did not enable us to prove a causal relationship. Other study limitations include the possibility of uncontrolled confounding and the lack of assessment of

cases’ “level of exposure” to the disaster (e.g., whether they had lost a friend or family member).

The results of this study are relevant. Adequate research on a possible indirect association between national disasters and mental health is scarce, yet up to 90% of the people are likely to experience trauma at least once in their lifetimes (1, 17). Using pre- and postdisaster data, we showed that there is an emotional response in people who were indirectly exposed to the disaster. Furthermore, the present study focused on mental health in a general, nonclinical population of pregnant women, which implies that the association that we found might be even stronger in women with mental health issues.

Although our study showed only a temporary increase of depressive symptoms, the results imply that it could be important to monitor pregnant women in general when they are faced with a national disaster. As mentioned above, the cases had an almost 2-fold higher prevalence of depression (scores above the cutoff), which was not statistically significant (likely because of the restricted sample size power). Because pregnant women are especially vulnerable with regard to adequate fetal development, it could be worthwhile to monitor them and to interfere when the symptoms do not decrease over time. Although the indirect influence of a nationwide disaster does not seem to be long lasting, in the context of fetal programming related to maternal stress, offering an immediate intervention (such as counseling) is an option. In conclusion, the present study is one of the first in which perinatal mental health before and after the occurrence of a national disaster has been investigated, and the results indicate that such a disaster might lead to emotional responses at an individual level.

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