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Maternal Anxiety about a Child's Diabetes Risk in The Environmental Determinant of Diabetes in the Young (TEDDY) Study: the Potential Role of Life Stress, Postpartum Depression and Risk Perception

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Abstract

Objective—To understand the association between life stress, postpartum depression, maternal perception of her child's risk for type 1 diabetes (T1D), and a mother's anxiety about her child's T1D risk in mothers of genetically at risk children in the TEDDY (The Environmental Determinants of Diabetes in the Young) study.

Methods—A short form of the state component (SAI) of the State Trait Anxiety Inventory, negative life events (LE), the Edinburgh Postnatal Depression Scale (EPDS), and one question about the child's risk of developing T1D (RP) were given to mothers at the 6 month TEDDY clinic visit. The relationship between the four measures was modeled using multiple regressions.

Results—Controlling for socio-demographic factors, significant country differences in SAI, LE, EPDS and RP emerged. LE – particularly interpersonal life events - had a strong association to maternal anxiety about the baby’s diabetes risk. Both evidence of postpartum depression and accurate risk perceptions about the child’s T1D risk were associated with increased maternal anxiety about the child’s T1D risk.

Conclusion—Heightened maternal anxiety in response to the news that a child is at increased risk for T1D is common. Mothers who have experienced recent negative life events, who suffer from postpartum depression and who accurately understand their child’s risk may be particularly vulnerable to high levels of anxiety. The findings reported here need to be confirmed in future prospective studies.

Keywords

anxiety about baby’s diabetes risk; negative life events; postpartum depression; risk perception; type 1 diabetes

Introduction

Type 1 diabetes (T1D) is one of the most common endocrine and metabolic conditions in childhood and the number of children developing this form of diabetes every year is increasing rapidly worldwide, especially among the youngest children (1–4). Genetic screening for T1D risk at birth is now possible but raises concerns about the burden of risk awareness in asymptomatic individuals, most of whom will never develop the disease (5–8). A number of studies used the State-Trait Anxiety Inventory (STAI) (9) to investigate the emotional impact of learning that an individual or their child is at risk for T1D. These studies suggest that anxiety tends to be high in response to the news of increased risk but declines over time (5, 10–15).

Prior studies identified a number of factors associated with heightened anxiety in response to risk notification: lower education, ethnic minority status, and a priori history of depression (10, 15, 19). These same factors were associated with increased depressive symptoms in response to risk notification as well (10, 19). Risk underestimation has been reported in TEDDY (13) and previously in parents of children at increased genetic risk for T1D and appears to increase over time (5, 19). Although anxiety and depression symptoms are frequently correlated, differential effects of maternal anxiety and depression symptoms in response to infant T1D risk were reported. Mothers who were more accurate in risk perception (RP) experienced more anxiety and fewer depressive symptoms (19). Likewise, underestimation of risk was associated with fewer anxiety and more depressive symptoms. Individuals with a history of depression may be particularly vulnerable to depressive symptoms (5, 19). Coping strategies like self-blame and avoidance in response to the news that their child is at risk for T1D can prevent accurate risk perception (5, 19).

Life Stress has long been considered a potential trigger for T1D (20) and autoimmunity (21–23). Life events (LE) are often used as an indicator of stress and have been previously associated with both depression (24–28) and anxiety (29, 30). The available literature indicates that there are differences in the report of LE depending on socio-demographic

factors such as ethnicity (31, 32), income, and education (32). Few studies have included different countries when measuring LE (33, 34). Further, LE in T1D are typically assessed in a single country (12, 20–22) and measured retrospectively for one or more past years, introducing recall bias. Experiences of negative LE at a similar time as learning of the baby's risk for T1D may increase stress with impact on anxiety, postpartum depression (PD) and RP.

About 10 – 15% of women experience postpartum depression (35, 36) although prevalence rates differ by race/ethnicity (37), social status (37–39), and country (39, 40). Studies have documented the link between life stress and PD; young mothers with a history of major LE are at greater risk for PD (38).

However; none of these studies examined the impact of LE, PD and RP on maternal anxiety about the child's risk for T1D in an international study. Greater consideration of these factors may help us better support families who are asked to participate in longitudinal natural history studies or diabetes prevention trials.

The TEDDY study offers the opportunity to examine factors associated with maternal anxiety about a child's T1D risk in an international cohort. We are in particular interested in how measures of recent LE (during the last three months), PD and RP are related to maternal anxiety about the child's risk for T1D. The current study focuses on the 6 month TEDDY visit. Families enter TEDDY when the child is approximately 3 months of age so at the 6 months TEDDY visit, mothers have been aware of their child's increased T1D risk for 3 months but are still relatively new to the TEDDY study and their children are still quite young (6 months). Consequently, we hypothesized that all three LE, PD and RP after delivery might be important determinants of the mother's anxiety about the child's T1D risk. We also expected that mothers of children with a first degree relative (FDR) with T1D would be more anxious than mothers from the general population (GP) who are unfamiliar with T1D. Further, we expected that mothers with accurate RP of their child's T1D risk would exhibit more anxiety than mothers who underestimated their child's T1D risk.

Methods

The TEDDY Study

The Environmental Determinants of Diabetes in the Young (TEDDY) is a prospective multinational (Finland, Sweden, Germany, United States) cohort study investigating the environmental determinants of T1D. GP- and FDR-children were screened for genetic predisposition for T1D (HLA-DR and -DQ genotypes) before 3 months of age and if eligible, invited to take part in the study. Characteristics of families who were enrolled or refused to be enrolled are described elsewhere (14, 18). Over eight thousand (8668) children were initially enrolled in the study between September 2004 and March 2010 and followed for environmental exposures potentially associated with autoimmunity and T1D. Data collected at each study visit including biological data (e.g. blood, nasal swabs), dietary records, demographic and health histories for the child, as well as psychological measurements, including reports of LE, PD, RP and anxiety about the baby's risk from the parents (41).

In all TEDDY countries the study was approved by the respective Institutional Review Board or Research Ethics Committee. Demographic variables as well as maternal lifestyle behaviors during pregnancy are collected as part of the TEDDY study; these factors were taken into consideration when examining the relationship between LE, PD, RP and maternal anxiety about the baby's T1D risk.

Study Population

The study population consisted of all families who completed a TEDDY study visit when the baby was 6 months of age (window 4.5 – 7.5 months of age) as of June 30th 2011 (N=8133); a small sample of mothers failed to complete the 6 month study questionnaires (N=521) and were excluded, leaving 7612 families for analysis. Of these, most came from the GP (N=6786) with no history of T1D but 826 of participating babies had a FDR with T1D.

Socio-Demographic and Maternal Life Style Measures

The socio-demographic measures included in the analyses were: TEDDY country of residence (US, Finland, Germany, Sweden); child's gender (male, female); child's ethnic minority status (US: the TEDDY child's mother's first language is not English or the mother was not born in the US or the child is a member of an ethnic minority group – yes/no; Europe: the child's mother's first language or country of birth is other than that of the TEDDY country in which the child resides - yes/no); child has a FDR with T1D (yes/no); child is an only child (yes/no); maternal age at child's birth; mother's education (1 - Basic primary education includes primary school through some trade school, 2 - Graduated trade school or some college/university, 3 - Higher education includes graduated university/college or higher); parent's marital status (married or living together versus single parent), and crowding (number of persons in the household divided by the number of rooms in the household). Because the crowding variable was skewed, it was rescored to normalize the distribution (0–0.49 = 1; 0.50–0.59 = 2; 0.60–0.75 = 3; 0.76–1.00 = 4; > 1.00 = 5).

We also included maternal lifestyle behaviors during pregnancy as control variables in our analysis: smoking (yes/no); working all three trimesters versus reducing work hours or not working at all; and complete abstinence from alcohol during the last trimester of the mother's pregnancy (yes/no).

Maternal Anxiety about the Child's T1D Risk

Maternal anxiety about the child's T1D risk was measured at 6 months by a six-item scale (State Anxiety Inventory - SAI) (5, 10, 12–14) adapted from the state component of the STAI (9). Mothers were asked to respond to the SAI while thinking specifically about their baby's risk for T1D and their 6 item scores were converted into total scores comparable to the 20 item scores obtained using the STAI. The alpha coefficient for the SAI at 6 months in the TEDDY sample is .901. Because of skewed SAI scores, they were rescored to normalize the distribution (<23 = 0, 23–29 = 1, 30–37 = 2, 38–45 = 3, 46 = 4).

Life Stress

At each TEDDY visit, mothers were given a list of LE that might have happened to them and a list of LE that might have happened to their child. The mother indicated whether she or her child had experienced any of the events and if so, she was asked to rate the event's impact as very bad, bad, good, or no impact. Mothers were asked if another event had occurred not on the lists and if so, they were asked to describe the event and rate its impact. Events on the parent list included: serious illness/injury; hospitalization; family member/close friend died; separation/divorce; marriage; victim of violence; quit/lost job; started new job; serious conflicts; legal conflicts; financial difficulties; moved; changed family composition. Events on the child list included: serious illness/injury; hospitalization; separation from parent; moved; new sibling; started daycare; changed daycare; new step-parent. Only events with very bad or bad impact were considered. Negative LE were further separated into two categories: loss/loss threatening LE (disease/injury, hospitalization, death in family and separation/divorce) and interpersonal LE (job related, financial difficulties, violence, serious conflicts, legal conflicts, moved, changed family composition). The total number of negative LE, the total number of loss/loss threatening LE, and the total number of interpersonal negative LE reported in the first six months of TEDDY was calculated. Because 67% of the sample reported no negative LE, this variable was treated as categorical variable in all data analyses.

Postpartum Depression

Maternal PD was assessed at the 6 months visit by the Edinburgh Postnatal Depression Scale (EPDS) (42, 43). The alpha coefficient for the EPDS in the TEDDY sample is .844. Because the EPDS scores were skewed they were rescored to normalize the distribution (0 = 0, 1–2 = 1, 3–5 = 2, 6–8 = 3, 9–12 = 3, 13–27 = 4). We considered both the EPDS normalized total score, and whether the score was equal or above the clinical cut-off (13) (38, 42, 43).

Risk Perception

RP was measured by the question: "Compared to other children, do you think your child's risk for developing diabetes is much lower, somewhat lower, about the same, somewhat higher, much higher". The mother's perception of the child's risk for developing diabetes was scored as accurate when she indicated the child's T1D risk was higher or much higher than other children's T1D risk, and was scored as inaccurate if she indicated the child's T1D risk was the same, somewhat lower or much lower than other children's.

Statistical Analyses

Chi-square was used to test for differences in proportions between categories and Wald tests using simple linear regression models were used to test for differences in means across countries. Multiple linear regressions were used to develop a model of the association between negative LE, EPDS, RP, and maternal SAI about the child's T1D risk, controlling for country and other socio-demographic and lifestyle variables. Data were available on at least 94.3% of all relevant variables and all multiple regression models retained at least

88.3% of the total cohort (N = 7612). Analyses were conducted using the Statistical Analysis System Software (Version 9.2, SAS Institute, Cary, NC).

Results

Socio-demographic and Maternal Life Style Measures by Country

The composition by demographic and lifestyle factors differed significantly between the countries (see Table 1); only gender of children was distributed proportionally. In the US, mothers were more likely to be unmarried or not living with the father, have multiple children and to work during pregnancy. The percentage of minority children is also highest. In Europe, mothers were likely to be living in more crowded households than in the US. In Germany the percentage of FDR children were highest, maternal age at birth was higher and more mothers reported smoking and drinking alcohol during pregnancy than in the other TEDDY countries. In US fewest mothers smoked and alcohol consumption was least likely in Swedish moms. In US and Finland about two third of mothers got a higher education, in Sweden and Germany the percentage was lower. In Germany a graduated trade school education and some college/university was more frequent (50 %), basic primary education was more likely in Swedish moms in comparison to other TEDDY sites.

Anxiety about the Child's T1D risk, Negative Life Events, Postpartum Depression and Risk Perception

Significant country differences emerged for all four variables (see Table 2). SAI scores were highest in German and US mothers and lowest in Finland.

Overall, 19.6 % of mothers reported a loss/loss threatening LE, 19.4 % reported an interpersonal negative LE, and in total 33 % of mothers reported negative LE in either category. Overall, more US mothers reported one or more negative LE compared to mothers in the European TEDDY countries. Types of negative LE reported by country also differed. The US had the highest rates of both, loss/loss threatening events as well as interpersonal events; Germany had lowest. The variation in the number of mothers reporting interpersonal negative LE is much greater than that for loss/loss threatening events. Job related and financial LE, moving and changed family composition was more frequently reported in the US than in the European TEDDY countries.

Overall, the prevalence of PD (EDPS scores ≥ 13) was 9% for the total sample. However, significant country differences arose. Germany showed the highest prevalence of PD (11.3%) and Sweden the lowest (7.3%). Considering the normalized scores mothers from Finland had the highest EPDS scores and Swedish mothers the lowest.

Although communication of the child's increased T1D risk was given to the child's parents orally and in writing, risk underestimation was high. In Finland and Germany about a third of mothers underestimated their child's risk in US and Sweden the percentages were even higher (40.1 % and 46.3 % respectively).

Predictors of Maternal Anxiety about the Child's T1D risk

We used a multiple regression approach to predict mother's anxiety. In order to control for mediating or confounding variables (44, 45) we built several models. The first model includes country and the socio-demographic factors; only significant predictors were retained. The second model added negative loss/loss threatening and interpersonal LE as predictor variables (see Table 3a). The third model added the EPDS clinical cut-off score and the fourth and final model added RP as a predictor variable (see Table 3b).

Country was a significant predictor in all four models; US and German moms had higher SAI scores than Finnish and Swedish mothers. Socio-demographic variables that were predictors of SAI scores in all four models included: child ethnic minority and FDR status, maternal age, education, and maternal alcohol consumption and smoking during pregnancy. Mothers of ethnic minority children, of FDR children, who were younger and less educated and who never drank alcohol but smoked during pregnancy, had higher SAI scores. Child's gender, only child status, household crowding, and mothers' work status during pregnancy were not associated with SAI scores. Marital status lost significance in the final model. Negative LE were significant predictors of SAI scores, but only interpersonal LE stayed significant when EPDS clinical cut-off score was introduced in the analysis (final model). When EPDS normalized score was used instead, smoking during pregnancy and interpersonal LE lost significance in the final model (data not shown). RP had an independent contribution to mother's anxiety.

Discussion

In the framework of type 1 diabetes research, LE have typically been collected retrospectively from one to several years before diabetes manifestation (20), one year or longer before the appearance of autoantibodies (12, 21–23). In TEDDY, parents are asked about LE at each TEDDY visit, using a recall window of the preceding three months in an effort to minimize the impact of recall bias inherent in prior studies (46).

There are few studies comparing life stress across different countries and those that do exist have focused on cardiovascular disease (33) or Post Traumatic Stress Disorder (PTSD) (34). To our knowledge, TEDDY is the first study to prospectively collect recent LE under comparable conditions in an international cohort of families with small children. In the TEDDY cohort as a whole, 33% of mothers reported one or more negative LE at the baby's 6 months TEDDY visit. However, prevalence rates varied from a high of 42 % in the US to a low of 18 % in Germany. Country differences were greatest for interpersonal negative LE; 29 % of US moms reported such events compared to only 8 % of German mothers. Moving or changing family composition, job-related and financial difficulties were particularly pronounced in the US.

The prevalence of postpartum depression worldwide is currently estimated at 10 – 15 % (36, 38, 40), with considerable differences between countries (39, 40) depending on the clinical cut-off scores (between 9 and 13) (39) and the time of measurement (39, 40). Consistent with other newborn screening studies (19, 47), EPDS scores in TEDDY were in the normal range, with an overall PD prevalence rate of 9 %, varying from 12 % in Germany to 7 % in

Sweden. Affonsoa et al. (40) reported similar results, with Sweden having the lowest rate of PD, followed by Finland and the US (Germany was not included in the Affonsoa study). Halbreich et al. (39) observed slightly higher percentages but nearly the same country order of PD measured by EPDS with lower clinical cut-off scores (from 10 to 11) from 17.7 % in Germany, 16.6 % in Finland, 15.4 % in the US and 12.3 % in Sweden.

Mothers' reactions to their child's T1D risk varied significantly by TEDDY country. Mothers in Germany and the US reported the highest anxiety scores and Finland the lowest. Germany had the highest percentage of FDR babies in the study; mothers of FDR babies often exhibit higher levels of anxiety (5, 10, 12, 19, 47). However, the higher anxiety rates seen in the US and Germany remained, even with FDR status in the model. Anxiety about the baby's risk to get T1D is comparable to anxiety of pregnant women and working women. Parents of ICA+ children and pregnant women undergoing amniocentesis show higher anxiety (10, 12). Although Finland has the highest incidence of T1D in the world (16) a number of studies documented low rates of anxiety in Finish people (5, 6, 13, 17). Because T1D is so common in Finland, families might view the disease as less anxiety provoking (5, 17). Consistent with prior literature, younger mothers who were less educated and who had an ethnic minority child reported greater anxiety about the child's T1D risk (5, 10, 14). Mothers who reported drinking alcohol during pregnancy reported lower anxiety scores. We suspect that alcohol use may be one way these mothers manage their anxiety; unfortunately we did not collect information on alcohol use after the birth of the baby. Smoking during pregnancy was related to higher anxiety; smoking is often used as a coping strategy in response to stress and anxiety (48).

In addition to these socio-demographic predictors of maternal anxiety about her child's T1D risk, LE, PD and maternal RP were all strongly related to mothers SAI scores at the 6 month TEDDY visit. These findings are important in a number of respects. First it was possible to collect LE in an international cohort, under very similar conditions, considering a window of three months, minimizing recall bias. Second, the opportunity to examine the relationship between LE, PD, RP and anxiety about a child's risk for disease in an international cohort is rare and informative. We were able to elucidate important country differences and identify other socio-demographic factors associated with maternal anxiety about the child's risk for T1D. More importantly, we were able to model the relationship between LE, PD, RP and anxiety, with the effects of country and other socio-demographic and lifestyle factors controlled. As expected, we found that life stress has a strong association with anxiety about the baby's diabetes risk. However, the association between loss/loss threatening LE and maternal anxiety about the child's T1D risk was reduced when PD was introduced in the analysis. The results indicate that the relationship between loss/loss threatening LE, to a lesser extent interpersonal LE and maternal anxiety about the baby's risk is mediated by PD; such as negative LE increase the risk of PD which in turn is associated with higher levels of maternal anxiety about the child's T1D risk. Accurate RP about the child's risk was an independent predictor of maternal anxiety. The differential effects of mother's anxiety and depression symptoms in response to RP as reported earlier (5, 10, 19) could not be observed in TEDDY.

If mothers scored ≥ 13 , the clinical EPDS cut-off score, TEDDY nurses recommended seeing a psychological counselor. Family adversities like distress in mothers in infancy predict children's depression and anxiety in adolescence; early interventions are suggested to reduce not only mother's distress but also long-term consequences for children (49). Mothers with accurate risk perceptions experiencing high anxiety about their child's risk were more likely to withdraw from the study. A tailored intervention has been introduced to prevent them from drop out (13).

Acknowledgments

We acknowledge that the TEDDY population is a highly motivated sample of educated mothers who have volunteered to participate in a longitudinal study with a demanding protocol. Consequently, our study findings may not replicate in other populations.

Another limitation is the cross-sectional nature of the study, with self-report measures collected at the same point in time (the TEDDY 6-month study visit). There is a risk of inflated associations between variables because of shared method variance and the causal direction of significant associations cannot be confirmed. For example, although we suspect that negative LE reported in the 3-month window prior to the study visit led to higher reports of maternal PD and anxiety about the child's T1D risk, one cannot rule out the possibility that mothers who are more anxious or depressed are more likely to recall a negative life event in the prior 3 months whereas mothers who are not depressed or anxious simply do not remember such events. We believe this is unlikely since all participants were prompted with a list of negative LE – most of which would be difficult to “forget” when prompted (e.g., serious illness, getting a divorce, losing a job). Nevertheless, prospective studies are needed to confirm the findings reported here. Since TEDDY is a longitudinal study in which LE data is collected at each TEDDY visit, it holds great promise for discerning the impact of negative LE on study outcomes – both psychological (e.g., anxiety and depression) and physical (child illness and autoantibody development). The findings reported here strongly suggest that future prospective studies are warranted.

Abbreviations

EDPS	Edinburgh Postnatal Depression Scale
FDR	First Degree Relative
GP	General Population
LE	Life Event
PD	Postpartum Depression
RP	Risk Perception
SAI	State component of STAI
STAI	State-Trait-Anxiety Inventory
T1D	Type 1 Diabetes

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Table 1

Socio-demographic and maternal lifestyle factors by country

Socio-demographic variables	US		Finland		Germany		Sweden		All	
	N (%)	or M (SD)	N (%)	or M (SD)	N (%)	or M (SD)	N (%)	or M (SD)	N (%)	or M (SD)
Gender of child										
Boy	1583	(50.9)	829	(51.0)	265	(50.8)	1194	(50.8)	3871	(50.9)
Girl	1527	(49.1)	798	(49.0)	257	(49.2)	1159	(49.2)	3741	(49.1)
Child ethnic minority										
No	2034	(69.9)	1502	(97.0)	429	(87.6)	2105	(92.9)	6070	(84.2)
Yes	874	(30.1)	47	(3.0)	61	(12.4)	160	(7.1)	1142	(15.8)
Child has FDR with T1D										
No	2782	(89.5)	1479	(90.9)	323	(61.9)	2202	(93.6)	6786	(89.1)
Yes	328	(10.5)	148	(9.1)	199	(38.1)	151	(6.4)	826	(10.9)
Child is an only child										
No	1810	(62.7)	875	(55.7)	257	(52.4)	1243	(54.8)	4185	(58.0)
Yes	1075	(37.3)	696	(44.3)	233	(47.6)	1024	(45.2)	3028	(42.0)
Maternal age at child's birth (years)	30.5	(5.7)	30.0	(5.0)	31.6	(4.9)	30.8	(4.7)	30.6	(5.2)
Maternal education										
Basic primary	441	(15.3)	154	(9.8)	65	(13.3)	767	(33.8)	1427	(19.9)
Graduated trade school	720	(25.0)	447	(28.6)	246	(50.3)	389	(17.2)	1802	(25.0)
Higher education	1723	(59.7)	964	(61.6)	178	(36.4)	1111	(49.0)	3976	(55.2)
Married or living status										
Married or living together	2711	(93.8)	1518	(96.7)	473	(96.5)	2213	(97.7)	6914	(95.8)
Single parent	178	(6.2)	52	(3.3)	17	(3.5)	53	(2.3)	300	(4.2)
Maternal lifestyle variables during pregnancy										
Working status										
Did not work or reduced work hours	1368	(46.1)	883	(56.7)	302	(58.3)	1245	(54.7)	3798	(51.9)
Worked all three trimesters	1599	(53.9)	673	(43.3)	216	(41.7)	1030	(45.3)	3518	(48.1)
Smoking during pregnancy										
No	2748	(90.5)	1393	(87.2)	425	(82.7)	2038	(87.7)	6604	(88.4)
Yes	287	(9.5)	204	(12.8)	89	(17.3)	287	(12.3)	867	(11.6)

Socio-demographic variables	US	Finland	Germany	Sweden	All
	N (%) or M (SD)	N (%) or M (SD)	N (%) or M (SD)	N (%) or M (SD)	N (%) or M (SD)
Alcohol during pregnancy					
No	2345 (76.6)	1331 (82.5)	381 (73.1)	2131 (90.8)	6188 (82.0)
Yes	715 (23.4)	283 (17.5)	140 (26.9)	217 (9.2)	1355 (18.0)
Household crowding *	1.6 (1.3)	2.5 (0.9)	2.4 (1.1)	2.1 (1.1)	2.0 (1.2)

Note: except for child's gender (p=0.99), all variables significantly differed across countries (p<0.0001).

* normalized scores

Table 2

Maternal SAI scores, number of negative LE and types of LE reported at 6 months by country, EPDS scores and Risk perception

	TEDDY country					All
	US	Finland	Germany	Sweden		
	M (SD) or N (%)	M (SD) or N (%)	M (SD) or N (%)	M (SD) or N (%)	M (SD) or N (%)	
Maternal Anxiety (SAI)	N = 3072	N = 1626	N = 519	N = 2338	N = 7555	
Mean (SD) SAI score	37.6 (10.6)	32.0 (8.3)	39.4 (10.9)	35.6 (9.0)	35.9 (10.0)	
Mean (SD) normalized SAI score	2.16 (1.3)	1.52 (1.0)	2.39 (1.2)	1.96 (1.1)	1.98 (1.2)	
Life Events (LE)	N=3006	N = 1610	N = 494	N = 2325	N=7434	
1 LE with negative impact: N (%)	1268 (42.2)	394 (24.5)	90 (18.2)	702 (30.2)	2454 (33.0)	
	LE yes N (%)	LE yes N (%)	LE yes N (%)	LE yes N (%)	LE yes N (%)	
Loss or loss threatening event						
Disease, injury, hospitalization (A)	453 (15.1)	144 (8.9)	36 (7.3)	321 (13.8)	954 (12.8)	
Death and significant loss (B)	150 (5.0)	46 (2.9)	12 (2.4)	106 (4.6)	314 (4.2)	
Separation and divorce (C)	148 (4.9)	95 (5.9)	16 (3.2)	78 (3.4)	337 (4.5)	
Overall (Categories A, B or C)	690 (23.0)	260 (16.1)	59 (11.9)	448 (19.3)	1457 (19.6)	
Interpersonal event						
Job related (D)	256 (8.5)	29 (1.8)	6 (1.2)	76 (3.3)	367 (4.9)	
Financial Difficulties (E)	322 (10.7)	51 (3.2)	0 (0.0)	48 (2.0)	421 (5.7)	
Violence, Serious conflict, Legal conflict (F)	229 (7.6)	66 (4.1)	11 (2.2)	145 (6.2)	451 (6.1)	
Moved, changed family composition (G)	375 (12.5)	68 (4.2)	24 (4.9)	127 (5.5)	594 (8.0)	
Overall (Categories D, E, F or G)	885 (29.4)	188 (11.7)	39 (7.9)	341 (14.7)	1453 (19.5)	
Postpartum Depression (EDPS)	N = 3105	N = 1627	N = 522	N = 2352	N = 7606	
Mean (SD) EPDS score	6.33 (4.4)	6.53 (4.4)	6.11 (4.7)	5.72 (4.2)	6.17 (4.4)	
Mean (SD) normalized EPDS score	2.62 (1.4)	2.70 (1.3)	2.52 (1.4)	2.43 (1.3)	2.57 (1.4)	
Clinical Cut-off Score 13: N (%)	296 (9.5)	151 (9.3)	62 (11.9)	172 (7.3)	681 (9.0)	
Risk Perception (RP)	N = 3095	N = 1625	N = 521	N = 2343	N = 7584	
Underestimation	1242 (40.1)	461 (28.4)	153 (29.4)	1084 (46.3)	2940 (38.8)	
Accurate	1853 (59.9)	1164 (71.6)	368 (70.6)	1259 (53.7)	4644 (61.2)	

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Note: SAI – State Anxiety Inventory; LE – Life events; EPDS – Edinburgh Postnatal Depression Scale; RP – Risk Perception; SAI scores, number (%) of mothers reporting negative LE and EPDS scores differed significantly across the countries (p 's <0.0001)

The frequency of mothers reporting loss or loss threatening events or interpersonal events differed significantly across the countries (p 's <0.0001).

Table 3a
Multiple linear regression results predicting maternal SAI about the child's T1DM risk

Factors	Total or mean		Socio-demographic factors as predictors of SAI scores			Socio-demographic factors and negative LE as predictors of SAI scores		
	N	or mean (SD)	β	95%CI	p-value	β	95%CI	p-value
Country of residence								
US	2624		0.00	ref		0.00	ref	
Finland	1499		-4.67	-5.29 – -4.05		-4.34	-5.97 – -3.72	
Germany	457		1.56	0.59 – 2.53		1.99	1.01 – 2.97	
Sweden	2182		-1.46	-2.02 – -0.89	<0.001	-1.19	-1.77 – -0.62	<0.001
Child ethnic minority								
Yes	989		0.00	Ref		0.00	Ref	
No	5773		-3.79	-4.46 – -3.12	<0.001	-3.76	-4.43 – -3.09	<0.001
Child has FDR with T1DM								
No	6029		0.00	Ref		0.00	Ref	
Yes	733		2.91	2.17 – 3.65	<0.001	2.89	2.15 – 3.63	<0.001
Maternal age at child's birth	30.7 (5.1)		-0.07	-0.11 – -0.02	0.006	-0.07	-0.11 – -0.02	0.006
Maternal education								
Basic primary	1328		0.00	Ref		0.00	Ref	
Graduated trade school/college	1669		-1.39	-2.10 – -0.69		-1.39	-2.10 – -0.69	
Higher education	3765		-1.79	-2.44 – -1.13	<0.001	-1.73	-2.38 – -1.08	<0.001
Married or living together								
No	268		1.32	0.15 – 2.50		1.10	-0.07 – 2.72	
Yes	6494		0.00	Ref	0.027	0.00	Ref	0.066
Smoking during pregnancy								
No	6022		0.00	Ref		0.00	Ref	
Yes	740		0.64	-0.11 – 1.38	0.092	0.76	0.01 – 1.50	0.048
Alcohol during pregnancy								
No	4438		0.00	Ref		0.00	Ref	
Yes	2324		-0.61	-1.10 – -0.13	0.012	-0.65	-1.13 – -0.17	0.008
Loss or loss threatening neg								
No	5472		-	-	-	0.00	ref	

Factors	Total or mean		Socio-demographic factors as predictors of SAI scores				Socio-demographic factors and negative LE as predictors of SAI scores			
	N	or mean (SD)	β	95%CI	p-value		β	95%CI	p-value	
Interpersonal neg LE	1290		-	-	-		0.77	0.20 – 1.34	0.008	
	5486		-	-	-		0.00	ref		
	1276		-	-	-		1.65	1.06 – 2.23	<0.001	
EPDS score 13										
No	6188		-	-	-		-	-	-	
Yes	574		-	-	-		-	-	-	
Risk perception										
Underestimation	2572		-	-	-		-	-	-	
Accurate	4190		-	-	-		-	-	-	

SAI - State Anxiety Inventory; LE - Life event(s); EPDS - Edinburgh Postnatal Depression Scale; RP - Risk perception

Table 3b
Multiple linear regression results predicting maternal SAI about the child's T1DM risk

Socio-demographic factors	Total or mean		Socio-demographic factors, negative LE and EPDS as predictors of SAI scores			Socio-demographic factors, negative LE, EPDS and RP as predictors of SAI scores		
	N	or mean (SD)	β	95%CI	p-value	β	95%CI	p-value
Country of residence								
US	2624		0.00	ref		0.00	ref	
Finland	1499		-4.50	-5.12 – -3.88		-4.77	-5.39 – -4.16	
Germany	457		1.76	0.79 – 2.73		1.59	0.64 – 2.55	
Sweden	2182		-1.20	-1.76 – -0.63	<0.001	-1.09	-1.65 – -0.53	<0.001
Child ethnic minority								
Yes	989		0.00	Ref		0.00	Ref	
No	5773		-3.58	-4.25 – -2.92	<0.001	-3.87	-4.53 – -3.21	<0.001
Child has FDR with T1DM								
No	6029		0.00	Ref		0.00	Ref	
Yes	733		2.83	2.10 – 3.56	<0.001	2.11	1.37 – 2.84	<0.001
Maternal age at child's birth	30.7 (5.1)		-0.07	-0.11 – -0.02	0.005	-0.07	-0.12 – -0.03	0.002
Maternal education								
Basic primary	1328		0.00	Ref		0.00	Ref	
Graduated trade school/college	1669		-1.27	-1.97 – -0.58		-1.49	-2.18 – -0.80	
Higher education	3765		-1.51	-2.16 – -0.86	<0.001	-2.07	-2.72 – -1.43	<0.001
Married or living together								
No	268		0.79	-0.37 – 1.95		0.81	0.34 – 1.96	
Yes	6494		0.00	Ref	0.183	0.00	Ref	0.168
Smoking during pregnancy								
No	6022		0.00	Ref		0.00	Ref	
Yes	740		0.73	-0.01 – 1.47	0.054	0.78	-0.05 – 1.52	0.036
Alcohol during pregnancy								
No	4438		0.00	Ref		0.00	Ref	
Yes	2324		-0.73	-1.21 – -0.26	0.002	-0.81	-1.28 – -0.34	0.001
Loss or loss threatening neg LE								

Socio-demographic factors	Total or mean	Socio-demographic factors, negative LE and EPDS as predictors of SAI scores			Socio-demographic factors, negative LE, EPDS and RP as predictors of SAI scores		
		N or mean (SD)	β	95%CI	p-value	β	p-value
No	5472	0.00	ref	0.073	0.00	ref	0.125
Yes	1290	0.52	-0.05 – 1.08	0.073	0.44	-0.12 – 1.00	
Interpersonal neg LE							
No	5486	0.00	ref	<0.001	0.00	ref	<0.001
Yes	1276	1.17	0.59 – 1.76	<0.001	1.09	0.52 – 1.67	
EPDS score 13							
No	6188	0.00	Ref	<0.001	0.00	Ref	<0.001
Yes	574	5.10	4.30 – 5.90	<0.001	5.02	4.23 – 5.82	
Risk perception							
Underestimation	2572	-	-	-	0.00	Ref	<0.001
Accurate	4190	-	-	-	2.80	2.34 – 3.27	<0.001

Note: SAI - State Anxiety Inventory; LE - Life event(s); EPDS - Edinburgh Postnatal Depression Scale; RP - Risk perception

Child's gender, only child status, household crowding, and mothers' work status during pregnancy were not associated with SAI scores. When EPDS normalized scores were used smoking during pregnancy and interpersonal LE lost significance