

Risk of postpartum depression and very early child mistreatment among mothers reporting higher autistic traits: Evidence from the Japan Environment and Children's Study

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Abbreviations: PPD: postpartum depression, JECS: the Japanese Environment and Children's Study, AQ-J10: Autism-Spectrum Quotient Japanese version, aRR: adjusted relative risk

Highlights

- Mothers with higher autistic traits in the general population had double risk of PPD
- They were also at risk of child mistreatment (hit/shake) at one-month postpartum
- Social support during pregnancy mediated 26–31% of the above associations
- Social support during pregnancy could be a target of prevention for these mothers

Abstract

Background: Little is known about how mothers who report higher autistic traits face new parenthood. This study examined the association between antenatal non-clinical autistic traits and the risks of both postpartum depression (PPD) and child mistreatment at one-month postpartum and if these associations were mediated by preexisting social support.

Methods: Participants included 73,532 singleton mothers without histories of psychiatric conditions from the Japan Environment and Children's Study, a nationwide birth cohort. Autistic traits were measured during the second/third trimesters using the short-version of the Autism Quotient-Japanese version. Participants were classified into three groups (i.e., typical-range, moderate-range, and high-range). PPD was measured using the Japanese version of the Edinburgh Postnatal Depression Scale, while participants self-reported experiences of child mistreatment (i.e., hit or shake the child); both assessments were conducted at one-month postpartum. Individual social support was reported during pregnancy. Data analyses were conducted through Poisson regressions.

Results: A total of 7,147 (9.7%) participants reported PPD, while 12,994 (17.7%) reported child mistreatment at one-month postpartum. Autistic traits were associated with increased PPD risk (adjusted-relative risk [aRR] = 1.74, 95%CI=1.64–1.84 for moderate-range; aRR=2.33, 2.13–2.55 for high-range) and child mistreatment (aRR=1.19, 1.13–1.24 for moderate-range; aRR=1.39, 1.28–1.50 for high-range) independently of confounders. Social support mediated 26–31% of these associations for moderate/high-range groups (both risks).

Limitations: Self-reported measurements were used.

Conclusions: Mothers who reported moderate-to-high autistic traits in the general population were vulnerable to PPD and newborn mistreatment at one-month postpartum, which was partially explained by the lack of social support during pregnancy.

Keywords: postpartum depression, child mistreatment, social support, autistic traits

Introduction

Postpartum depression (PPD) and child mistreatment are the most serious social problems during the perinatal period. Notably, PPD affects approximately 10–20% of all pregnant women worldwide (Hahn-Holbrook et al., 2017), leaving long-lasting negative effects on both the mothers and the children (Hoffman et al., 2017; Verbeek et al., 2012). The onset of PPD is reported to be greatest during the very early postpartum period (i.e., within one-month of postpartum; Munk-Olsen et al., 2006). Child mistreatment can also occur as early as at one-month postpartum (Reijneveld et al., 2004), though evidence for this very early postnatal period is limited. Therefore, gaining a better understanding of the antenatal risk factors that influence both conditions could be the first step to improve strategies designed to support vulnerable women and promote future wellbeing of at-risk children.

The lack of social resources including limited social contact or social support is thought to be one of the most substantial risk factors for both PPD and child mistreatment (Kotch et al., 1999; Milgrom et al., 2008). Individuals who self-report “difficulties with social communication skills” such as those who report higher autistic traits, may have limited access to social resources which in turn may increase their vulnerability to PPD and/or child mistreatment. While previous studies have reported significant associations between maternal autistic traits and both PPD (Asano et al., 2014) and child mistreatment (Fujiwara et al., 2014; Tachibana et al., 2017), their sampling approaches (e.g., samples from single institutions and relatively small regional-cohorts) and minimal adjustment for potential confounders limit the generalizability of their findings. Moreover, the mechanisms underlying the associations between autistic traits and PPD or child mistreatment, including the role of social resources have not been explored. As previously noted, lack of social resources such as social support may be a modifiable mediator on the pathway between maternal autistic traits and PPD and child mistreatment.

This study used data from the Japanese Environment and Children's Study (JECS), a nationwide birth cohort in Japan to examine (1) whether higher preexisting reported autistic traits among mothers were associated with PPD and/or child mistreatment at one-month postpartum and (2) the extent to which social support during pregnancy mediated these associations.

Methods

Study population

Data were taken from the JECS, which explored the effects of environmental factors on child health and development (Dataset jecs-ag-20160424). Detailed information about this cohort, including the sampling method, is described elsewhere (Kawamoto et al., 2014; Michikawa et al., 2015). JECS participants included 103,099 pregnancies that were recruited throughout Japan between January 2011 and March 2014 (Michikawa et al., 2018). Of all eligible women with singleton live births ($N = 92,796$), women with missing information about age ($n = 5$) and those with histories of psychiatric conditions (e.g., depression, anxiety, schizophrenia, and/or autism spectrum disorder [ASD]) or who did not answer the JECS question related to this issue were excluded from analysis ($n = 6,048$). After excluding those with missing exposure, outcomes and covariates ($n = 13,211$), the final case sample included 73,532 participants (Figure 1). This study was conducted according to all guidelines contained in the Declaration of Helsinki; the Japan Ministry of the Environment's Institutional Review Board on Epidemiological Studies (No.100406001) and the Ethics Committees of all participating institutions approved all procedures involving participants. Written informed consent was obtained from all participants.

Explanatory variable: Antenatal maternal autistic traits

Antenatal maternal autistic traits were measured during the second or third trimesters using the short form of the Autism-Spectrum Quotient Japanese version (AQ-J10); all items were rated on a scale of 0–10, with higher scores indicating more severe difficulties (Kurita et al., 2005). The AQ-J10 is a self-reported questionnaire that is designed to measure autistic traits distributed among the general population and nine of the 10 total items refer to social communication difficulties. However, because social communication difficulties are not specific to ASD (Beauchamp and Anderson, 2010), it has been reported that higher scores on AQ-J10 may capture social communication difficulties in other psychiatric conditions (Kurita and Koyama, 2006), leading to low diagnostic specificity for this measure (Kurita et al., 2005). Therefore, we acknowledge that autistic traits measured in our study could be indicative of social communication difficulties in a broader context. To capture those with severe and extreme difficulties, participants were placed into three groups according to their AQ-J10 scores, as follows: High-range (those scoring in the top 2.5% of the JECS population; ≥ 7), moderate-range (those scoring between the top 2.5% and 10%; $5 \leq$ to < 7), and typical-range (0–4).

Explanatory variable: Individual social support score

Participants were also asked to identify the availability of individual social support they experienced during their second or third trimesters based on the four following questions: (1) “Is there someone available to you who shows you love and affection?”, (2) “Is there someone whom you can count on to provide you with emotional support (talking over problems or helping you make difficult decisions)?”, (3) “How often do you have as much contact as you would like with someone you feel close to: someone in whom you can trust and confide?”, and (4) “Number of friends/neighbors to whom you can talk casually about your concern”. The first three questions were adapted from the ENRICHED social support

instrument (ESSI), which is a validated measure to assess social support (Vaglio et al., 2004) and the other question assessing the participants' involvement in social relationship was included to capture individual social support. The first three questions were answered on a five-point scale ranging from "1: none of the time" to "5: all of the time," while the final question was answered according to a range of "1: none" to "3: three or more." Preliminary analyses showed high item correlations, thus supporting our decision to use all questions to capture individual levels of social support. Given the positively skewed distribution on all items, we dichotomized each by establishing a median cut off. Item scores were then totaled to generate an individual social support score ranging from 0–4, with higher scores indicating higher levels of individual social support.

Outcome: Postpartum depression

Postpartum depression was measured using the Japanese version of the Edinburgh Postnatal Depression Scale (EPDS), which was administered at one-month postpartum. The EPDS is a widely used self-reported questionnaire for assessing postpartum depression. It contains 10 items, the scores of which are totaled to result in a final score ranging from 0 to 30 (Cox et al., 1987). The Japanese version of the EPDS has been thoroughly validated by a previous study (Okano et al., 1996). Following the same research, this study used a cut-off score of nine or greater to identify PPD.

Outcome: Child mistreatment

Participants were asked to report the frequencies of shaking their babies when he/she cries and frequencies of hitting their babies at one-month postpartum (questions were rated as either "always," "sometimes," "seldom," or "never"). Those who provided any answers other than "never" were defined as having experienced a child-mistreatment episode. We also

defined “frequent child mistreatment” as those entailing reports of greater frequency (i.e., those who answered “always” or “sometimes” to either of the child mistreatment questions).

Covariates

We included the following variables as potential confounders in our model, such as maternal age at birth, the highest level of education achieved (university degree or above, two-year or vocational college degree, high-school graduate, or below), total household income (above 8 million yen, 4–7.9 million yen, 2–3.9 million yen, and below 2 million yen), marital status (married or unmarried), first birth or not. We also explored whether the association would be attenuated by the presence of depressive symptoms during pregnancy as defined by scoring 13 or more on the Kessler-6 scale (Furukawa et al., 2008; Kessler et al., 2003). Except for maternal age at childbirth, all information was obtained during pregnancy.

Statistical analyses

We first conducted a descriptive analysis to examine the association between our exposure and the study variables. We also conducted a sample bias analysis to explore whether mothers included in our study were different from those excluded out of our study variables. Thereafter we conducted multivariable Poisson regression analyses to assess the relative risks (RR) of PPD and child mistreatment according to the level of existing maternal autistic traits. Model 1 was considered crude, while Model 2 was adjusted for the previously mentioned potential confounders. To test the degree of attenuation by depressive symptoms during pregnancy, we adjusted for this factor further in Model 3. Possible mediation by social support in the association between autistic traits and outcomes was estimated based on Model 2. We used the SAS procedure CAUSALMED for this analysis. In this model, social support was treated as a continuous variable, whereas exposures and outcomes were treated as

categorical. We also examined possible effect modification from social support by including interaction terms with the exposures in the models. However, no evidence of significant interaction effects was derived from social support. As such, the interaction terms were not included. All analyses were performed using the SAS version 9.4 software (SAS Institute Inc., Cary, NC).

Missing data and sensitivity analyses

The proportion of missing data was considerably small (i.e., <5%, except for 7.4% on income). Our sensitivity analyses using missing data indicators for categorical variables, and mean imputation by exposure groups for continuous variables showed similar results (Table S2), therefore, the results for complete case analyses ($N = 73,532$) are presented here. Furthermore, to examine if the observed association would be different by specific cut-offs for our exposure, we repeated our analyses using alternative cut-offs for autistic traits (i.e., highest 5% and 25%, Table S3). We also conducted our analyses by including women who were excluded due to having or missing a valid answer for a history of psychiatric conditions.

Results

Participant characteristics

Of the 73,532 total participants included in our study, 8,688 (11.8%) were placed into the moderate-range group, while 1,843 (2.5%) were placed into the high-range group, and 63,001 (85.7%) were placed into the typical-range group. Participant demographic characteristics related to the level of antenatal autistic traits are shown in Table 1. In general, mothers with high autistic traits were from relatively disadvantaged socioeconomic status and experienced greater levels of depression during pregnancy than those in the typical-range group. Greater percentages of those in the high/moderate-range groups indicated lower levels

of individual social support during pregnancy. Our sample bias analyses revealed that women with higher autistic traits, unmarried, from disadvantaged backgrounds, with depressive symptoms during pregnancy and with lower individual support score were more likely to be excluded from our study (Table S1).

The occurrence of postpartum depression and child mistreatment

The occurrences of postpartum depression and child mistreatment at one-month postpartum are presented in Figure 2. As shown, these issues increased positively as the levels of maternal autistic traits increased (P for linear trend $< .001$, for both). Results from the multivariable Poisson regression analyses confirmed a positive relationship between the levels of maternal autistic traits and outcomes (Table 2). After adjusting for confounders in Model 2, the risk of PPD remained to increase with higher maternal autistic traits; the adjusted relative risk [aRR] for the moderate-range group was 1.74 (95% confidence interval [CI] 1.64–1.84), while that for the high-range group was 2.32 (2.13–2.55). A similar association was found for child mistreatment; the aRR for the moderate-range group was 1.19 (1.13–1.24), while that for the high-range group was 1.39 (1.28–1.50, Model 2). Further adjustment for depressive symptoms during pregnancy in Model 3 partially attenuated above the association for both PPD and child mistreatment, however, did not fully explain this association. Sensitivity analysis by repeating our analyses using alternative cut-offs for maternal autistic traits confirmed that the association between autistic traits and the outcomes were monotonic (Table S3). Analyses including women who had or did not have a valid answer for a previous history of psychiatric conditions showed similar results (Table S4). Finally, repeating our analysis for frequent child mistreatment (i.e., those who answered “always” or “sometimes” to either of the child mistreatment questions) yield similar and even stronger association (Table S5).

When we examined the mediating effects of individual social support for PPD, the association between maternal autistic traits and PPD was mediated by 27.5% (95%CI 24.4–30.5%) for women in the moderate-range group and 28.9% (25.3–32.5%) for women in the high-range group. Social support also mediated the association between autistic traits and child mistreatment by 31.4% (22.5–40.3%) for women in the moderate-range group and 25.8% (18.8–32.8%) for those in the high-range (Table S6). However, for frequent child mistreatment, the mediating effect of social support was relatively small (13.7%, 95%CI 8.3–19.2% for moderate-range and 15.9%, 95%CI 8.8–22.9% for high-range group).

Discussion

By analyzing nationwide longitudinal data from Japan, this study found a monotonic association between autistic traits reported during pregnancy in the general population and the risk of both PPD and child mistreatment at one-month postpartum. Compared to participants with typical-range autistic traits, those reporting moderate-range autistic traits were 1.7 times at risk for PPD and 1.2 times at risk for child mistreatment whereas those reporting high-range autistic traits were 2.3 times at risk for PPD and 1.4 times at risk for child mistreatment after adjusting for confounders (e.g., socioeconomic conditions and pregnancy-related factors). These increased risks for PPD and child mistreatment were not explained by depressive symptoms during pregnancy. Individual social support during pregnancy mediated this association by 26–31% between both groups for both PPD and child mistreatment.

Our finding from a nationwide birth cohort adjusting for various confounders, that self-reported autistic traits prior to childbirth were associated with increased risks of both PPD and child mistreatment, offers additional validated support to the findings from previous studies (Asano et al., 2014; Fujiwara et al., 2014; Hirokawa et al., 2019; Tachibana et al.,

2017). Our sensitivity analysis exploring the risks of the outcomes using alternative cut-offs for autistic traits confirmed that the association was monotonic, with those at the extreme (i.e., moderate-to-high traits) showing heightened risks. Given that AQ-J10 may measure social communication difficulties within and out of autism context, the result could be interpreted that women reporting moderate-to-high social communication difficulties are at heightened risks for PPD and child mistreatment. We also noted an increased risk for child mistreatment among these mothers as early as one-month postpartum. Despite policy emphasis to promote the prevention of child mistreatment during pregnancy (Ministry of Health, Labor and Welfare, 2015), very few studies have studied the incidence of child mistreatment within one-month postpartum. In Japan, home visits to all families with newborns to assess the wellbeing of the mother and child, which are conducted mainly by public nurses, are arranged by law. However, currently, only a quarter of the targeted children are visited within one-month postpartum (Ministry of Health, Labor, and Welfare, 2017). Our results suggest that, for women who self-report moderate-to-high autistic traits, preventive approach before one-month postpartum and possibly during pregnancy may help reduce these consequences.

Our study showed the importance of social support during pregnancy concerning PPD and child mistreatment, mediating approximately 26–31% of the risks of both PPD and child mistreatment for those who reported moderate-to-high autistic traits. Although professional interventions are effective in preventing both PPD and child mistreatment (Stephens et al., 2016; van der Put et al., 2018), many mothers have difficulty seeking such help, and providing professional interventions may even be counterproductive without mutually shared awareness of the need (U. S. Preventive Services Task Force et al., 2018; Scope et al., 2017). In this regard, providing social support (e.g., offering community-based support) from during pregnancy to mothers reporting moderate-to-high autistic traits could be effective in

preventing PPD and child mistreatment.

In our subsample analyses limiting those who reported engaging in frequent child mistreatment, the mediating effect of individual social support on the association between autistic traits and child mistreatment was relatively small (14–16%). It is possible that other factors, for example, maternal emotional dysregulation, which is closely linked with their own experiences of interpersonal trauma (Dittrich et al., 2018) play a role in this context (Tachibana et al., 2017; Van IJzendoorn et al., 2020). Exploring the role of emotional dysregulation among mothers with higher autistic traits was beyond the scope of our study; however, it could help identify additional pathways to frequent child mistreatment from mothers' reporting autistic traits, which we found in our study.

Strengths and Limitations

The strengths of this study include the large sample size drawn from a nationwide birth cohort, the rich sociodemographic information collected in JECS, which allowed us to select necessary confounders, the longitudinal design of the study enabling us to examine the temporal associations between the study model and the use of validated measures for self-reported autistic traits and PPD.

This study also had several limitations. An observational study design prevents us from establishing causal relationships and we relied on information obtained from mothers' self-reports including our outcomes (i.e., PPD and child mistreatment). This could have led to biased estimates particularly for child mistreatment as individuals with higher autistic traits have been reported to demonstrate lower social desirability (Skylark and Baron-Cohen, 2017), which may influence the respondents' answer. Having supplement information about child mistreatment from official records would have been useful; however, this information was not available to us because all participants' records were anonymized under a data-usage

agreement. Nevertheless, the use of official records is likely to underestimate the results since authorities identified only a small number of cases (Radford et al., 2013). Additionally, information about the mother's own experience of child mistreatment was not available in the JECS. This factor is strongly associated with self-reported autistic traits (Roberts et al., 2015) and PPD (Hutchens et al., 2017) and/or child mistreatment (Madigan et al., 2019) which could have elaborated the observed association in our study. Moreover, we were only able to include individual social support that reflected emotional support in our study. However, other types of support (e.g., practical support) may meet the mothers' needs more and thus effectively reduce PPD and child mistreatment at one-month postpartum, when the physical demands of childcare are very high (Negron et al., 2013). Further, some studies report that the association between social support and women's mental health differed by the provider such as kinship and friends (Cable et al., 2013; Honjo et al., 2018). Although the information regarding the provider was not available for social support measured during pregnancy in the JECS, clarifying the different roles of social support by type and providers (partners, other families, and friends/ neighbors) may provide further evidence for use in designing effective interventions to prevent both PPD and child mistreatment. Finally, future research replicating our results in settings outside of Japan would be important to explore the generalizability of our findings in other cultural contexts.

Clinical implications and conclusion

Our results warrant clinicians and healthcare providers to raise awareness of the psychological vulnerabilities experienced by mothers who report moderate-to-high autistic traits in the general population, even without a history of previous psychiatric conditions. It should also be acknowledged that the risk for child mistreatment was already apparent at one-month postpartum, suggesting the need for preventive approach among these mothers from

during their pregnancy. Individual social support offered during pregnancy could reduce potential risks of PPD and child maltreatment, especially for women reporting moderate-to-high autistic traits.

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Table 1 Maternal characteristics by levels of autistic traits in the Japan Environment and Children's Study (N = 73,532)

| | Levels of maternal autistic traits ^a | | | | | | <i>P</i> ^b | |
|--|---|------|---|------|------------------------------------|------|-----------------------|--|
| | Typical-range (n = 63,001, 85.7%) | | Moderate- range (n = 8,688, 11.8%) | | High-range (n = 1,843, 2.5%) | | | |
| | N | % | n | % | n | % | | |
| Mean autistic traits, (SD) | 2.3 | 1.1 | 5.3 | 0.5 | 7.4 | 0.6 | < .001 | |
| Mean maternal age, (SD) | 31.5 | 4.9 | 31.0 | 5.0 | 30.8 | 5.1 | < .001 | |
| Marital status, unmarried | 2,245 | 3.6 | 444 | 5.1 | 102 | 5.5 | < .001 | |
| Maternal education level | | | | | | | < .001 | |
| High school or below | 20,898 | 33.2 | 3,479 | 40.0 | 764 | 41.5 | | |
| College, vocational college | 27,417 | 43.5 | 3,469 | 39.9 | 690 | 37.4 | | |
| University, postgraduate | 14,686 | 23.3 | 1,740 | 20.0 | 389 | 21.1 | | |
| Household income, JPY | | | | | | | < .001 | |
| < 2 million | 3,078 | 4.9 | 629 | 7.2 | 146 | 7.9 | | |
| 2–3.9 million | 20,953 | 33.3 | 3,286 | 37.8 | 670 | 36.4 | | |
| 4–7.9 million | 31,746 | 50.4 | 3,985 | 45.9 | 841 | 45.6 | | |
| 8 million < | 7,224 | 11.5 | 788 | 9.1 | 186 | 10.1 | | |
| First birth | 26,248 | 41.6 | 3,977 | 45.6 | 892 | 48.2 | < .001 | |
| Had depressive symptoms during pregnancy | 2,458 | 3.9 | 694 | 8.0 | 223 | 12.1 | < .001 | |
| Individual social support score | | | | | | | < .001 | |
| 0 | 10,688 | 17.0 | 2,402 | 27.7 | 611 | 33.0 | | |
| 1 | 13,471 | 21.4 | 2,059 | 23.7 | 446 | 24.2 | | |
| 2 | 10,590 | 16.8 | 1,431 | 16.5 | 273 | 14.8 | | |
| 3 | 16,181 | 25.7 | 1,758 | 20.2 | 330 | 17.9 | | |
| 4 | 12,071 | 19.2 | 1,038 | 12.0 | 183 | 9.9 | | |
| Mean individual social support score, (SD) | 2.1 | 1.4 | 1.7 | 1.4 | 1.5 | 1.4 | < .001 | |

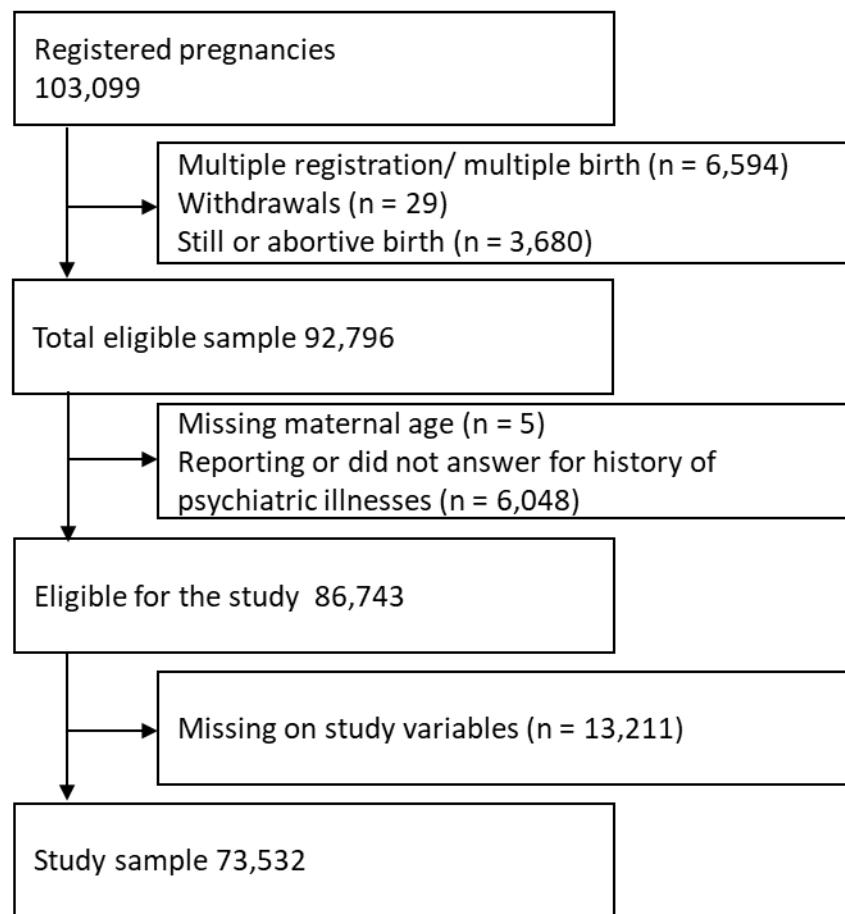
Numbers and percentages are shown unless otherwise mentioned. All measured during

pregnancy.^aMeasured by the short form of Autism-Spectrum Quotient Japanese version (AQ-J10).^bObtained using chi-square test for categorical variables and analysis of variance test for continuous variables. Significant difference was defined as difference at 5 % levels.

Table 2 Relative risk of maternal postpartum depression and child mistreatment at one-month postpartum by the level of maternal autistic traits

| Maternal autistic traits | Observed, n | Model 1: Unadjusted | | Model 2: Adjusted for confounders ^a | | Model 3: Further adjusted for depression during pregnancy | |
|----------------------------------|----------------|------------------------|---------------|--|---------------|--|---------------|
| | | Case / Total | RR | 95% CI | RR | 95% CI | RR |
| Postpartum depression | | | | | | | |
| Typical-range | 5,387/ 63,001 | 1(ref) | - | 1(ref) | - | 1(ref) | - |
| Moderate- range | 1,367/ 8,688 | 1.84 | 1.74– 1.94 | 1.74 | 1.64– 1.84 | 1.57 | 1.48– 1.65 |
| High-range | 393/ 2,038 | 2.49 | 2.26– 2.73 | 2.33 | 2.13– 2.55 | 1.90 | 1.74– 2.08 |
| Child mistreatment | | | | | | | |
| Typical-range | 10,691/ 63,001 | 1(ref) | - | 1(ref) | - | 1(ref) | - |
| Moderate- range | 1,840/ 8,688 | 1.24 | 1.19– 1.30 | 1.19 | 1.13– 1.24 | 1.18 | 1.13– 1.23 |
| High-range | 463/ 2,038 | 1.48 | 1.37– 1.60 | 1.39 | 1.28– 1.50 | 1.36 | 1.25– 1.47 |

RR: relative risk; CI: confidence interval ^aAdjusted for maternal age, maternal education, household income, marital status and previous deliveries.

Figure 1**Figure1 Legend**

Flow diagram of the recruitment and exclusion process for this study.

Figure 2A

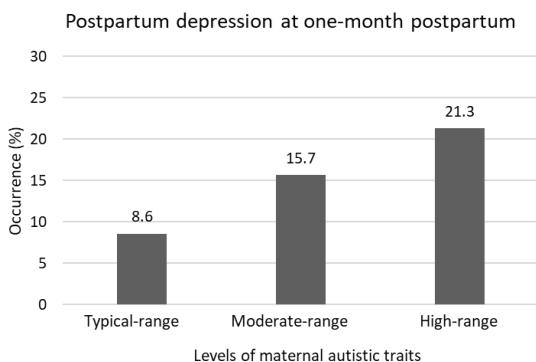


Figure 2B

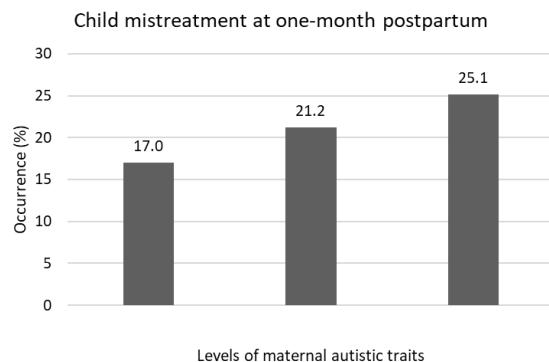


Figure 2 Legend

Occurrence of postpartum depression (Figure 2A) and child mistreatment (Figure 2B) by levels of maternal autistic traits among the Japan Environment and Children's Study sample (P for linear trend $< .001$, for both). Numbers in the graph show percentages.