

A Preliminary Investigation of Prenatal Stress and Risk Factors of Autism Spectrum Disorder

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Abstract: This study was a retrospective survey investigating the association between prenatal stress and risk factors of Autism Spectrum Disorders (ASD) in a Chinese population. Twenty-eight mothers of children diagnosed with ASD, and thirty-eight mothers of children with no diagnoses of neurodevelopmental diseases were interviewed. The survey analyzed the incidence and intensity of prenatal stress, birth conditions and developmental problems of children, maternal health conditions, and the participants' coping strategies towards prenatal stress. Higher overall prenatal stress intensity and incidence were found to be experienced by mothers of ASD children. Mothers with ASD children also showed higher incidence of premature deliveries, birth complications, health problems, maternal illnesses, advanced maternal age, and other developmental problems with their children.

Keywords: prenatal stress, risk factors, Autism Spectrum Disorders

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Autism Spectrum Disorder (ASD) refers to a spectrum of neuropsychological conditions characterized by widespread abnormalities in reciprocal social interaction, verbal and nonverbal communication, and restricted, repetitive and stereotyped behavior.¹ It has led to significant life-long impairments in social and language functioning for the affected individuals and significant distress for their caregivers. The prevalence of ASD was 1 in 88 children in the United States in 2012,² 58.7 per 10000 in the United Kingdom in 2005,³ and 39.2 per 10000 in Australia in 2004.⁴ No nationwide epidemiological study of the prevalence of ASD has been conducted in China, but the prevalence of ASD in Hong Kong was the subject of a ten years study by Wong and Hui⁵ from 1985 to 2005 and was found to be 16.1 per 10000. All these findings also suggested the changing epidemiology of ASD with increasing prevalence rate compared with data from the last century.²⁻⁵ Although ASD is a devastating disorder with high prevalence in different countries all over the world, its etiology is only understood in a small percentage of cases, and little is known about the incidence and development of ASD.

The causality cause of ASD has been a controversial topic since the 1970s. The concordance rates in monozygotic twin pairs have been found to be much higher than those for dizygotic twin pairs;^{6,8} Ritvo, Freeman, Mason-Brothers et al.,^{7,8} also found a higher incidence of ASD in siblings and family members of affected children. He suggested that ASD was often associated with a few particular genetic disorders. All these studies suggest that genetic factors play an important role in the etiology of ASD, which has also been supported by several genetic association studies.⁹⁻¹²

However, the concordance rates in monozygotic twin pairs in all these studies were less than 100%;^{6,7} This indicated that the genetic factors were not the only factor contributing to the development of ASD. In addition to genetic factors, the high similarity of prenatal and postnatal environment may contribute to the high concordance rate of ASD in monozygotic twins. The higher risk of ASD in siblings of affected children may also be the result of exposure to a similar environment. Moreover, Smalley, Asarnow, and Spence¹³ suggested that ASD was a non-Mendelian disorder, a complex genetic disease in which the expressivity of carriers of many susceptibility genes

in combination with environmental risk factors is the cause of the disease. These findings raised the possibility of environmental risk factors contributing to the cause of ASD. Therefore, identifying potential environmental risk factors relating to development of ASD is an important research issue as it may help locate avoidable environmental factors and suggest ways of prevention of ASD.

Psychological stress during pregnancy has been considered as one of the environmental risk factors that plays a role in the development of autism. Such maternal stress as a risk factor for ASD has been supported by many research studies.¹⁴⁻¹⁷

Ward¹⁷ (1990) conducted a retrospective study to compare the presence of family problems during pregnancy between mothers of children with ASD and mothers of normal children. Mothers of autistic children were found to have encountered significantly more family discord and psychiatric problems than those of normal children. However, this study only considered family problems as the sources of prenatal stress, and other possible sources such as change of place of residence, unhappiness related to work, financial strain, and sleeping problems during pregnancy were not addressed.

A similar study using a complementary survey design by Beversdorf, et al.¹⁴ further suggested a significantly higher incidence of prenatal stress in mothers of autistic children compared with mothers of normal children and children with Down syndrome. It also found a highest incidence of prenatal stress during the 21–32 weeks of gestation. This study made use of the Social Readjustment Rating Scale (SRRS) developed by Holmes and Rahe¹⁸ as an objective measure of the stress level by different sources of stress. Nevertheless, the same kind of source may result in different intensities of psychological stress for different people as affected by self-perception of the stress. Therefore, subjective rating on the stress level according to the participant's impression may be considered as a possible modification of such studies.

Apart from survey studies, a natural experiment by Kinney, et al.¹⁵ considered hurricanes and tropical storms in Louisiana of America as stressful events experienced by pregnant mother during gestation. The prevalence rate of ASD was found to increase with the severity of prenatal storm exposure. The incidence of ASD was also found to be higher for



storm exposure near the middle or end of gestation compared with other time periods of gestation. The above three studies all found significant association between prenatal stress and increased risk of ASD. They also provided evidence for specific periods of gestation that are most associated with such risk.

In addition, prenatal stress has been found to result in the development of various behaviors which are common characteristics of ASD as reported by Kinney, et al.¹⁵ A specific brain area called the orbitofrontal cortex (OFC), which is responsible for self-regulation of social emotional behaviors, was found to be sensitive to effects of prenatal stress.¹⁹ Furthermore, in a study on prenatal exposure to a stressful event, which considered an ice storm as the source of prenatal stress, children with higher prenatal storm exposure were found to demonstrate more stereotypical playing behaviors than those with less storm exposure.²⁰ These studies indicated that prenatal stress was likely to result in the development of ASD key features such as impaired social interaction, emotion problems and stereotyped behaviors.

Although the above studies all supported the hypothesis of association between prenatal stress and risk of ASD, there have also been research reports with different conclusions, such as the population-based cohort study conducted in Denmark by Li, et al.²¹ Maternal bereavement was considered as the source of prenatal stress, and all the Singletons (more than 1.4 million single birth babies) born in the period from 1978 to 2003 in Denmark were included in this study. Those with mothers who lost a close relative during pregnancy or up to one year before pregnancy were in the exposed group, while the others were in the control group. The rate of onset of autism was compared between these two groups, and a strong association was not found between prenatal stress from maternal bereavement and the risk of autism. However, this study only considered maternal bereavement as the source of prenatal stress, and other sources such as conflicts with family members, unhappiness at work, and financial strain were not included in the investigation. Moreover, all the studies mentioned above were conducted in American or European populations. No related research on prenatal stress and risk of ASD has been carried out among a Chinese population. Therefore, further studies on the relationship between prenatal stress and ASD are required.

The aim of this study was to investigate whether there was a positive relationship between the incidence of ASD and the intensity of prenatal stress among Chinese mothers. The incidences of various sources of prenatal stress during pregnancy were compared between the mothers of autistic children and the mothers of children with no neurodevelopmental diagnoses. The mothers were interviewed by a survey on the incidence of different stressful events during the gestation period and the perceived intensity of stress.

Method

Participants

Twenty-eight mothers of children diagnosed with ASD aged between three to seven years and 38 mothers of children with no diagnoses of neurodevelopmental diseases aged between three to seven years participated in the survey study. Subjects were recruited by phone calls and flyers. For data collection on the ADS group, questionnaires (Appendix A) were distributed to parents of children diagnosed with ASD through several special child care centers (SCCC), early education and training centers (EETC), and The Society for the Welfare of the Autistic Persons. For data on the control group, questionnaires were distributed directly to parents through Sun Island Kindergarten Metro Harbor Branch. Children selected have no history of diagnosis of neurodevelopmental diseases, developmental problems including language disorders, Attention Deficit and Hyperactivity Disorder (ADHD), dyslexia and physical handicap. All participants' participation in the study was voluntary with no compensation. Written consent form was signed by the participants before the data gathering. The researchers were careful not to give any indication of the focus of this study as ASD through the survey so that the interviewees of the ASD group would not relate the questions to the diagnosis of ASD when rating their stress level. This study was approved by the IRB board at University of Hong Kong.

Procedures

The survey questions were designed based on the sources of stress in the Social Readjustment Rating Scale (SRRS)¹⁸ and in the homeopathic survey developed by De. Schepper.²² The questionnaire was composed of questions on: (a) background information



of the participant's child; (b) peri-natal and postnatal health conditions; (c) medical complications and developmental problems of the child after birth; (d) maternal age and maternal health conditions; (e) incidence and intensity of psychological stress during pregnancy; (f) coping strategies towards prenatal stress; and (g) the demographic information of the participant.

The level of prenatal stress experienced by the participants was estimated by asking them to recall the stressful events that had occurred during their pregnancies and rate their corresponding stress levels. The participants were then asked to rate the level of stress caused by different sources, including (a) self-attitude towards pregnancy; (b) spouse's attitude towards pregnancy; (c) change in place of residence; (d) estrangement or separation from spouse; (e) changes in family dynamics; (f) conflicts with family members or friends; (g) death of family members or friends; (h) illness suffered by family members or friends; (i) overwork; (j) working unhappiness; (k) changes in working conditions; (l) financial strain; and (m) sleeping problems.

The participants were required to rate their stress levels by putting a short vertical line onto any point of a "0–100" number line that best represented the level of stress from that corresponding source. The number line was 10 cm long with landmarks of "0", "25", "50", "75" or "100" on each 2.5 cm interval. A short vertical line towards the left (0) side meant that there was no stress caused by that factor; while a short vertical line towards the right (100) side meant maximum level of stress caused by that factor. The ratings were quantified according to the position of the vertical line in ratio to the landmarks of "0", "25", "50", "75" and "100" on the "0–100" number line. For example, a marking on the 6.4 cm position relative to the 10 cm number line would be considered as an approximate stress level of 64.

Statistical procedures

Results from the survey questionnaire were converted to an SPSS file²³ for analysis. Twenty-eight surveys from the ASD group and thirty-eight surveys from the control group were analyzed. Descriptive statistics was used for comparison between groups in which the data could not be quantified, such as the incidence of medical complications, developmental

problems, maternal age, and maternal health condition in each group. Inferential statistical comparison was carried out between the intensity of prenatal stress of two groups, including both the total stress level, stress level of each individual source of stress and total weighted stress level. Such comparison was also carried out involving the ages of participants' children, and the maternal age of the participants in each group. Non-parametric statistical measures of the Mann-Whitney test was used for all the inferential statistical comparisons in this study.

Results

Incidence and intensity of prenatal stress

The thirteen sources of stress rated by the participants were calculated and recorded. Of the thirteen sources of stress the sources of self-attitude on pregnancy and spouse's desire on pregnancy were present and rated by all the participants. The incidence of other sources of stress was calculated and is shown in Figure 1.

The incidences of all the sources of stress were significantly higher in the ASD group than in the control group ($U = 22$, $P = 0.01$).

Total stress level experienced by each participant was calculated by summing up the stress level of all the sources of stress based on the participant's rating. The mean of the total stress level experienced by the control group was 165.2 (SD = 131.4); while the mean of the total stress experienced by the ASD group was 238.0 (SD = 124.0). The total stress level experienced by individual participants was found to be significantly higher in the ASD group ($U = 318.5$, $P = 0.006$) than in the control group.

Some sources of stress were mentioned in the Social Readjustment Rating Scale (SRRS)¹⁸ used by the previous retrospective survey study by Beversdorf, et al.,¹⁴ and these were: change of place of residence; conflicts with family members or friends; death of family members or friends; illness suffered by family members or friends; overworking; working unhappiness; change of working conditions; financial problems; and sleeping problems. A weighted total stress level experienced by each participant was calculated by summing up the stress level of the above stressors based on the estimated stress level mentioned in the SRRS. The mean of the weighted total stress level experienced by the control group was 14.62

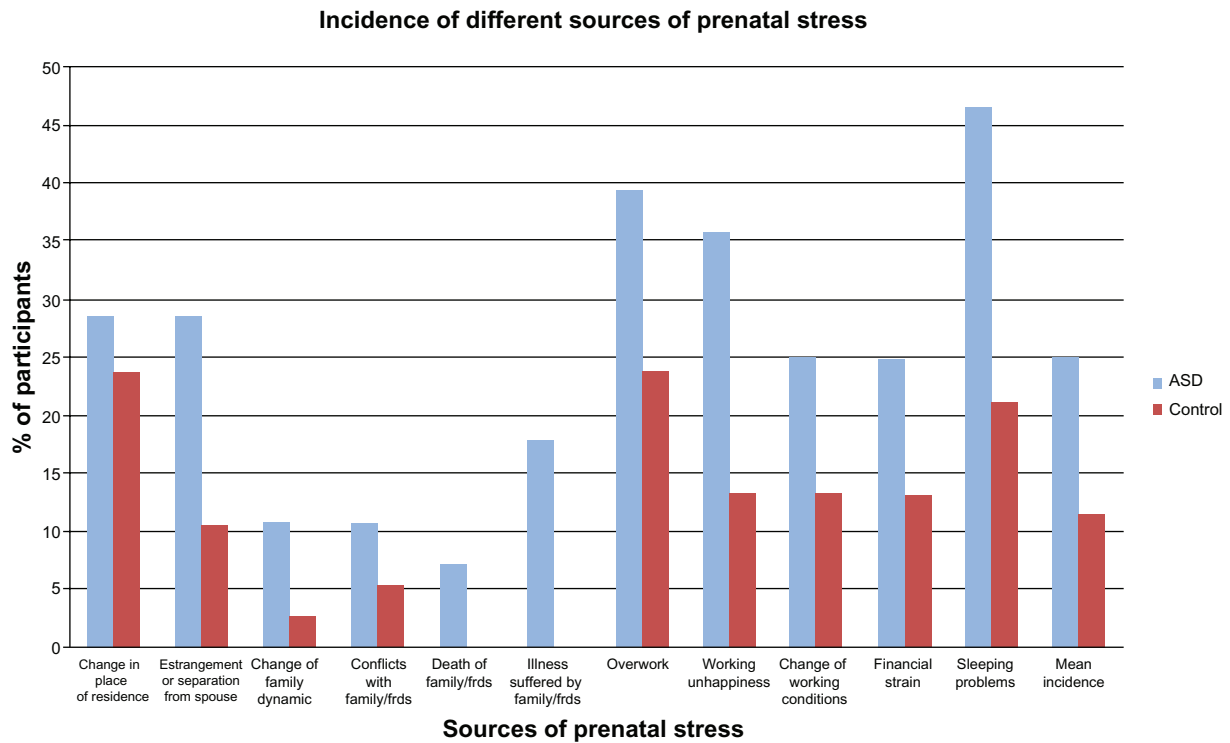


Figure 1. The incidence of different sources of stress.

(SD = 22.13), while the mean of the weighted total stress experienced by the ASD group was 40.52 (SD = 32.70). The weighted total stress level was found to be significantly higher ($U = 261, P < 0.000$) for the ASD group than for the control group.

The stress level of each source of stress was also compared between the two groups. Those participants reporting having no exposure to a particular source of stress were excluded in the comparison of that source. The number of participants was too small for statistical analysis for certain sources of stress that

were absent in most participants' gestation period and these were: change of family dynamic; death of family members or friends; and illness suffered by family members or friends. The results of the comparison of other sources of stress are summarized in Table 1.

The stress level of self-attitude towards pregnancy, and estrangement or separation from spouse was significantly higher for the control group than for the ASD group. No statistical significant difference was found for the stress level of other sources between two groups.

Table 1. Comparison of stress level of different sources of stress between two groups.

Source of stress	Control Mean stress level (±) SD	ASD Mean stress level (±) SD	Significant value of Mann-Whitney U (P)
Self-attitude towards pregnancy	48.55 ± 30.21	29.11 ± 25.45	0.008
Spouse's attitude towards pregnancy	45.18 ± 34.18	35.11 ± 28.61	0.209
Change in place of residence	43.56 ± 26.97	47.50 ± 21.04	0.807
Estrangement/separation from spouse	80.75 ± 11.30	52.00 ± 21.76	0.048
Conflicts with family members/friends	60.5 ± 7.78	78.67 ± 4.04	0.200
Overwork	60.33 ± 19.27	68.82 ± 12.26	0.456
Working unhappiness	54.4 ± 34.52	76.00 ± 12.20	0.254
Change in working conditions	45.40 ± 28.34	72.86 ± 10.75	0.149
Financial strain	69.80 ± 36.75	71.43 ± 17.25	0.639
Sleeping problems	51.00 ± 22.82	57.15 ± 22.33	0.422



Characteristics of the studied population

No significant difference was found in age of child between the ASD group and the control group ($U = 484.5, P = 0.52$). Other characteristics of the two groups were listed in Table 2.

The ASD group comprised of a higher percentage of males. Children born before the 37th week of gestation were considered as preterm, while those with birth weight less than 2.5 kilograms or 5.5 pounds were considered as having low birth weight.²⁴ The control group showed a higher percentage of preterm than the ASD group, while the ASD group showed a higher percentage of participant's children having low birth weight.

In addition, the children of ASD group showed a higher incidence of all kinds of birth complications including jaundice, umbilical cord entanglement, forceps delivery and anoxia than the control group. Health problems such as head injury, epilepsy, otitis media and spasm, were absent in the control group, while 53.57% of the participants in the ASD group reported a medical history of at least one of the above health problems.

Table 2. Characteristics of the studied population.

Characteristics	Control	ASD
Age of child/year (mean \pm SD)	4.75 \pm 1.40	4.56 \pm 1.54
Male gender (%)	39.47	82.14
Preterm (%)	5.26	3.57
Low birth weight (%)	5.26	18.86
Birth complications (%)		
Jaundice	5.26	9.29
Cord entanglement	2.63	3.57
Forceps delivery	10.53	17.86
Anoxia	0.00	7.14
Mean	4.61	9.47
Health problems (%)		
Head injury	0.00	10.71
Epilepsy	0.00	21.43
Otitis media	0.00	32.14
Spasm	0.00	3.57
Mean	0.00	16.96
Developmental problems (%)		
Physical handicap	0.00	7.14
Behavioral problems	2.63	39.29
ADHD	0.00	32.14
Language disorders	0.00	85.71
Dyslexia	0.00	14.29
Mean	0.53	35.71

Only 1 participant in the control reported a history of behavioral problems of the child. For the ASD group, 85.71% of the participants reported a diagnosis of language disorder, and about one third of the participants reported a diagnosis of ADHD and behavioral problems.

Maternal health and maternal health condition

The distribution of maternal age of the participants in each group is shown in Figure 2.

The mean maternal age of participants in the control group was 30.11, while the mean maternal age of the participants in the ASD group was 34.61. The maternal age of the participants was found to be significantly higher for the ASD group than for the control group ($U = 300, P = 0.002$).

For the health condition of the participants during pregnancy, the incidences of different factors that were associated with the participant's health in gestation period are listed in Table 3.

The participants in the ASD group showed higher incidences of illness, medication, injection and smoking during pregnancy, while the control group showed a slightly higher incidence of X-ray check-up during the gestation period. However, drinking/alcohol consumption was absent in both groups. Among the 28.57% of the participants in the ASD group who reported having diseases during the gestation period, 10.7% had colds, and participants in the ASD group still showed a higher incidence of the maternal hypertension and its related medication.

Coping strategies to relieve prenatal stress by the participants

The frequency of self-coping strategies applied by each participant to relieve stress during pregnancy, and the frequency of application of such coping strategies by their spouses are summarized in Figures 3 and 4 respectively.

Over 80% of the participants in both groups (86.84% in control group, 89.39% in ASD group) reported never, seldom or sometimes perform coping strategies to relieve prenatal stress; while over 80% of participants in both groups (86.74% in control group, 82.14% in ASD group) reported their spouse

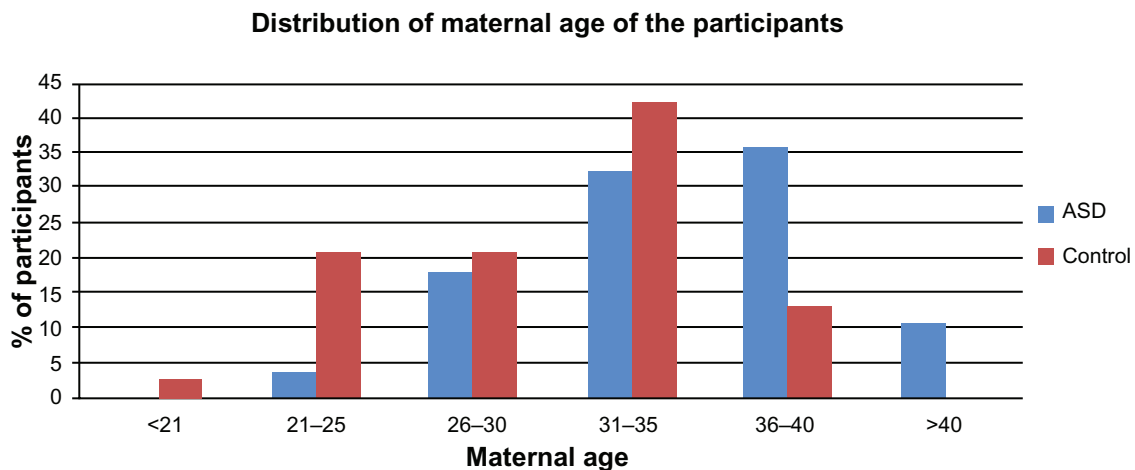


Figure 2. Distribution of maternal age of participants.

only never or seldom demonstrated coping strategies to relieve their stress during pregnancy.

Discussion

Association between prenatal stress and incidence of ASD

The incidences of all the sources of prenatal stress experienced by the participants in ASD group were significantly higher than the control group. This contributed to the significantly higher total stress level in the ASD group than in the control group. Moreover, the weighted total stress level of the ASD group was also significantly higher than the control group. This was consistent with the findings of the retrospective survey study by Beversdorf, et al.¹⁴ and further supported the findings of higher overall stress level experienced by mothers of ASD children resulting from their higher chances of exposure to different sources of stress compared with the control group. Therefore, prenatal stress was likely to be a possible risk factor for the incidence of ASD.

Table 3. Incidence of different factors associated with maternal health condition.

Factor	% of participants in control group	% of participants in ASD group
Illness	10.53	28.57
Medication	18.42	35.71
Injection	5.26	7.14
X-ray check-up	7.89	3.57
Smoking	2.63	3.57
Drinking	0.00	0.00

However, the intensities of most individual sources of stress were found not to be significantly different between two groups. For certain sources, including self-attitude towards pregnancy, and estrangement or separation from spouse, the corresponding stress levels were significantly higher for the control group than for the ASD group. These indicated that the ASD group only had a higher incidence of exposure to different sources of prenatal stress, but not a higher intensity of each source of stress. The level of stress by each source might be similar in the two groups. Hence, the overall higher intensity of stress in the ASD group might be mainly the result of the higher frequency of exposure to different sources of prenatal stress rather than the higher intensity of stress by each individual source.

Clinical implications

As prenatal stress is likely to be a risk factor of ASD, avoiding or reducing prenatal stress may be considered as a possible way to prevent the incidence of ASD. However, in our study most participants in both the ASD group and the control group reported limited or no use of self-coping strategies to relieve their stress during pregnancy. At the same time, most participants also reported limited or no attempt by their spouses to relieve their prenatal stress. This indicated a general tendency towards a lack of coping strategies for prenatal stress by both the pregnant women themselves and their spouses, regardless of whether their children had developed ASD. Clearly, development of some sort of stress

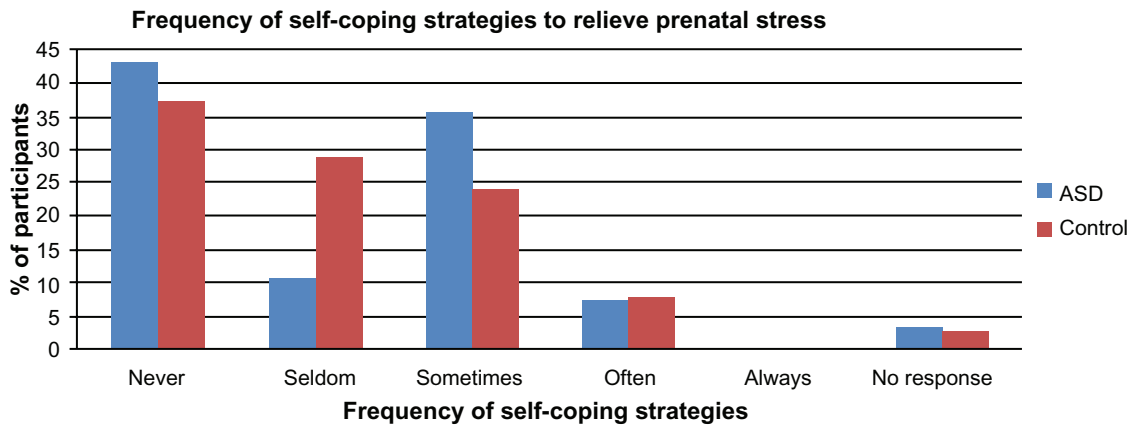


Figure 3. Frequency of self-coping strategies to relieve prenatal stress.

management training, social resources and other support for pregnant women to prevent and reduce the effect of prenatal stress would be important as prevention measurement of ASD.

Other possible factors that may contribute to the incidence of ASD

Apart from prenatal stress, there were several other factors that may have contributed to the findings. The ASD group showed a higher percentage of participants’ children having low birth weight than the control group. Risks of neurological, developmental and neurosensory morbidities have been found to be correlated with low birth weight (Ward and McCune²⁵). Thus, such higher incidence of prematurity in the ASD group might be a possible risk factor that contributed to the incidence of ASD.

In addition, the ASD group showed a higher percentage of birth complications including jaundice,

umbilical cord entanglement, forceps delivery and anoxia than the control group. Among these birth complications, almost 40% of participants in the ASD group reported a history of jaundice in their children. Jaundice has been found to be correlated with sensori-neural impairments,²⁵ and such impairments are common for ASD children. Association between ASD and birth complication such as birth trauma has also been reported.²⁶

Moreover, a higher percentage of participants in the ASD group reported a history of health problems including head injury, epilepsy, otitis media and spasm, which were all absent in the control group. Head injury may result in impairments which are commonly shown by ASD children, while epilepsy has been found to occur in about 25%–30% of autistic children.^{26–28} Hence, such a higher incidence of health problems reported by the ASD group may have contributed to the risk of ASD.

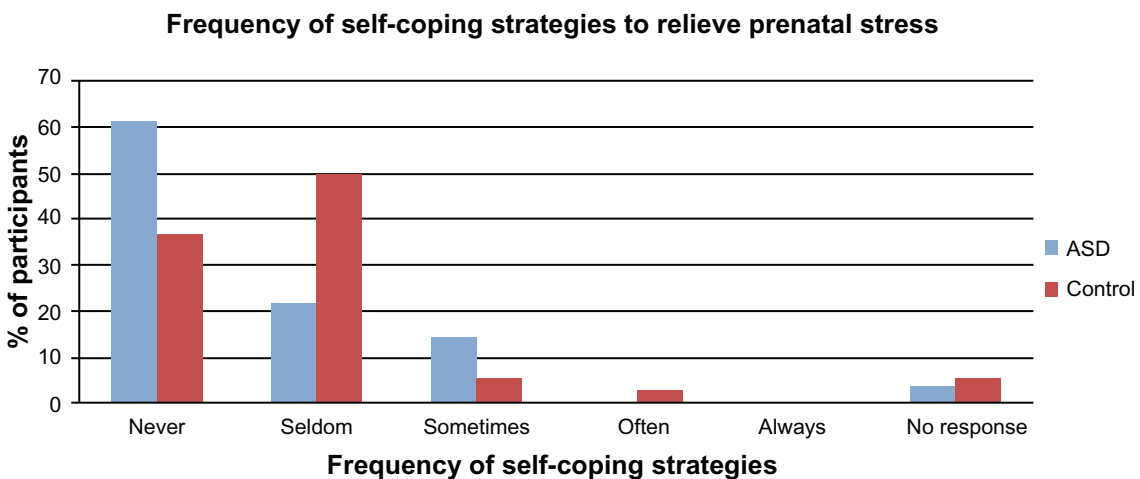


Figure 4. Frequency of coping strategies to relieve prenatal stress by the participant’s spouse.



The higher incidence of maternal illnesses and medications may also play a role in risk of ASD. The participants in the ASD group were found to have a higher percentage of occurrence of maternal illnesses and medications usage compared with the control group. The ASD participants showed a higher incidence of maternal illness hypertension and its related medication. Such illness may exert some prenatal stress on the participant. It may also increase the risk of prematurity and placental abruption and result in birth complication.²⁹ Therefore, the higher incidence of maternal illness in the ASD group may have been a contributing factor to the risk of ASD.

Furthermore, the difference in maternal age between the two groups may have contributed to the incidence of the above factors: prematurity, health problems, birth complications, and maternal illnesses. The maternal age was significantly higher in the ASD group than in the control group. Advanced maternal age is considered a risk factor of prematurity.²⁴ It has also been found to be associated with higher risk of maternal illnesses and birth complications. Therefore, it may be another risk factor contributing to the incidence of ASD.

In conclusion, the higher incidence of prenatal stress in the ASD group may not be the only factor contributing to the risk of ASD. The higher incidence of prematurity, birth complications, health problems, maternal illnesses, and advanced maternal age in the ASD group may also have been co-factors correlating with the incidence of ASD. Such factors may hinder the effect of prenatal stress on the risk of ASD, or they may reinforce each other, resulting in the manifestation of ASD.

Other possible developmental problems that may correlate with prenatal stress

The ASD group showed a high incidence of developmental problems, including ADHD, language disorders, dyslexia, behavioral problems and physical handicap compared with the control group. Language disorders, ADHD and behavioral problems are all common developmental problems associated with ASD.²⁶ However, such developmental problems may hinder the effect of prenatal stress on the risk of ASD as prenatal stress may also be a risk factor for language disorders, ADHD or other developmental problems instead of only being associated with ASD. Hence,

prenatal stress can only be considered as a possible risk factor for the incidence of ASD and developmental problems commonly showed by ASD children.

Conclusion

There were several limitations of this study concerning the number of participants, the research design, and the characteristics of the studied group. Firstly, the number of subjects in both groups was quite limited, and normal distribution for parametric statistical analysis was not possible. Moreover, the number of subjects was different for the two groups, which may have made the two groups less comparable. Secondly, risks of inaccurate recall and response bias by the participants may exist concerning the retrospective nature of the survey study. The higher incidence of advanced maternal age in the ASD group might have resulted in response bias since younger participants may be better at recalling details of the prenatal period compared to older participants. Moreover, differences in educational levels and other social backgrounds may also have led to variation in response bias. Thirdly, there may be a number of factors correlating with the incidence of ASD which may hinder the role of prenatal stress in the risk of ASD. As mentioned before, prematurity, birth complications, health problems, maternal hypertension, and advanced maternal age may also be risk factors for ASD. This study failed to delineate whether prenatal stress alone resulted in the incidence of ASD; or whether the incidence of ASD is the result of the other risk factors without a significant effect by prenatal stress; or whether the manifestation of ASD would only be the result of the co-occurrence of all these possible risk factors.

In summary, higher overall stress level resulting from a higher incidence of exposure to different sources of prenatal stress was found to be experienced by mothers of ASD children. The ASD group also showed a higher incidence of prematurity, birth complications, health problems, maternal illnesses, and advanced maternal age compared with the normal population. Moreover, a stronger association with developmental problems was also indicated for the ASD group than for the control group. Therefore, prenatal stress, prematurity, birth complications, health problems, maternal illnesses and advanced maternal age are all possible risk factors for ASD and the developmental problems commonly shown by ASD children.



Author Contributions

Conceived and designed the experiments: GJH, SAX, LdeS. Analysed the data: GJH, JCYK. Wrote the first draft of the manuscript: JCYK, SAX. Contributed to the writing of the manuscript: GJH, SAX, JCYK. Agree with manuscript results and conclusions: GJH, SAX, JCYK, LdeS. Jointly developed the structure and arguments for the paper: GJH, SAX, JCYK, LdeS. Made critical revisions and approved final version: GJH. All authors reviewed and approved of the final manuscript.

Disclosures and Ethics

As a requirement of publication author(s) have provided to the publisher signed confirmation of compliance with legal and ethical obligations including but not limited to the following: authorship and contributorship, conflicts of interest, privacy and confidentiality and (where applicable) protection of human and animal research subjects. The authors have read and confirmed their agreement with the ICMJE authorship and conflict of interest criteria. The authors have also confirmed that this article is unique and not under consideration or published in any other publication, and that they have permission from rights holders to reproduce any copyrighted material. Any disclosures are made in this section. The external blind peer reviewers report no conflicts of interest.

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Appendix A

[A survey study on prenatal stress and postnatal child health development]

Part 1—Child Information

1. Gender of your child: male/female
2. Age of your child: _____
3. Was your child born through natural labor? Natural labor/Operation
4. What was the time difference between the date of birth of your child and the expected birthday?
_____ days
5. Was your child born prematurely? Yes/No
6. What was the birth weight of your child? _____ kg
7. Were there any birth complications? Yes/No
If yes, please specify:

Cord entanglement <input type="checkbox"/>	Anoxia <input type="checkbox"/>	Forceps delivery <input type="checkbox"/>
Jaundice <input type="checkbox"/>	Others: _____	

8. Did your child experience any severe postnatal impairment soon after birth? Yes/No
If yes, please specify: _____
9. Did your child stay in hospital for observation for a period of time during the postnatal period? Yes/No
If yes, please specify: _____
10. Does your child have the following health problems?

Encephalitis <input type="checkbox"/>	Head injury <input type="checkbox"/>	Spasm <input type="checkbox"/>
Epilepsy <input type="checkbox"/>	Cerebral palsy <input type="checkbox"/>	Otitis media <input type="checkbox"/>
Others: _____		

11. Does your child have the following development problems?

Hearing impairment <input type="checkbox"/>	Visual impairment <input type="checkbox"/>	Physical handicap <input type="checkbox"/>
Mental retardation <input type="checkbox"/>	Emotional or behavioral problems <input type="checkbox"/>	Attention-deficit and hyperactivity disorder (ADHD) <input type="checkbox"/>
Autism Spectrum Disorder (ASD) <input type="checkbox"/>	Language delay/disorder <input type="checkbox"/>	Dyslexia <input type="checkbox"/>
Others: _____		



Part 2—Maternal Health Conditions

1. How old were you when you became pregnant?

<21 <input type="checkbox"/>	21–25 <input type="checkbox"/>	26–30 <input type="checkbox"/>
31–35 <input type="checkbox"/>	36–40 <input type="checkbox"/>	>40 <input type="checkbox"/>

2. How old was your spouse when you became pregnant?

<21 <input type="checkbox"/>	21–25 <input type="checkbox"/>	26–30 <input type="checkbox"/>
31–35 <input type="checkbox"/>	36–40 <input type="checkbox"/>	>40 <input type="checkbox"/>

3. Was the pregnancy naturally developed? Yes/No

4. Did you have any health problems or diseases during pregnancy? Yes/No

If yes, please specify the nature of the disease, time and duration of incidence:

5. Did you take any medication during pregnancy? Yes/No

If yes, please specify the nature of the medicines, time and duration of consumption:

6. Did you receive any injection during pregnancy? Yes/No

If yes, please specify the nature of the injection, time and duration of injection:

7. Did you receive any X-ray check up during pregnancy? Yes/No

If yes, please specify the reason and time of X-ray check up:

8. Did you have smoking habit during pregnancy? Yes/No

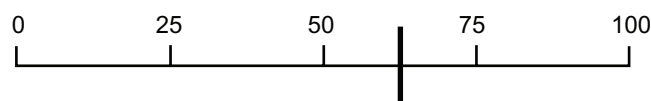
9. Did you have alcohol drinking habit during pregnancy? Yes/No

Part 3—Prenatal Psychological Conditions

This part requires your rating on the level of stress arising from different factors during your gestation period. Please answer the following questions, and put a short vertical line onto any point of the number line that best represents the stress level.

A short vertical line towards the left (0) side means there was no stress caused by that factor; while a short vertical line towards the right (100) side means maximum level of stress was caused by that factor.

Demonstration



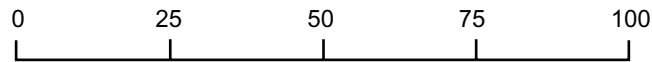


1. Was the pregnancy planned? Yes/No

Please describe your feeling when you were informed about becoming pregnant:

Happy/Reluctant/Confused/Others: _____

What do you think was the level of stress arising from your attitude towards pregnancy?



2. Was the pregnancy desired by your spouse and/or family? Yes/No

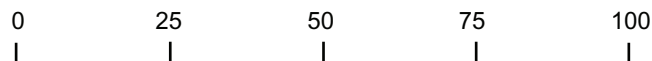
*What was the level of stress you think arising from the desire towards your pregnancy by your spouse and/or family?



3. Did you experience any changes in place of residence during pregnancy? (eg, changing residence, trip, or staying in hospital, etc.)? Yes/No

If yes, please specify the condition, time and duration of incidence:

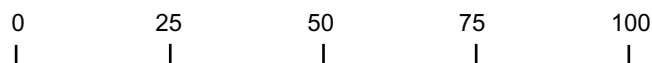
*What was the level of stress you think arising from the change in place of residence during pregnancy?



4. Did you experience any estrangement or separation from your spouse during pregnancy? (eg, you partner was working all the time or traveling for his work, etc.)? Yes/No

If yes, please specify the condition, time and duration of separation:

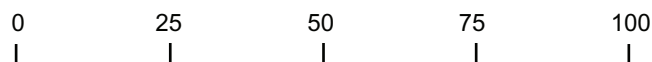
*What was the level of stress you think arising from the estrangement or separation from your spouse?



5. Did you experience any change in family dynamic during pregnancy? (eg, increasing number of family members, divorce, etc.)? Yes/No

If yes, please specify the condition, time and duration of incidence:

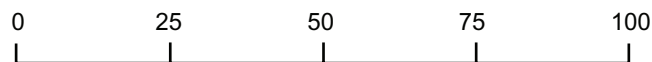
*What was the level of stress you think arising from the change in family dynamic during pregnancy?



6. Did you experience any conflicts with your family, friends or working partners during pregnancy? Yes/No

If yes, please specify the condition, time and duration of incidence:

*What was the level of stress you think arising from the conflicts with your family or friends during pregnancy?



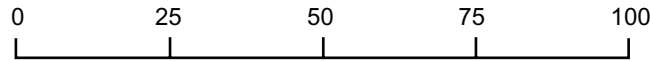


7. Did you experience any bad news about death or accident in your family or friends during pregnancy?

Yes/No

If yes, please specify the condition, time and duration of incidence:

*What was the level of stress you think arising from the bad news about death or accident of your family or friends during pregnancy?

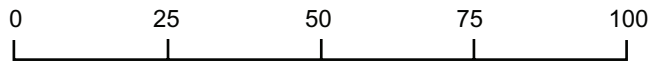


8. Did you experience any illness or did your family or friends experience any illness during your pregnancy?

Yes/No

If yes, please specify the condition, time and duration of incidence:

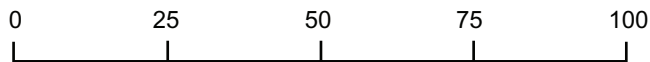
*What was the level of stress you think arising from the illness you experienced or experienced by you family or friends during pregnancy?



9. Did you experience physical and/or mental overwork during pregnancy? Yes/No

If yes, please specify the condition, time and duration of incidence:

*What was the level of stress you think arising from the physical and/or mental overwork during pregnancy?

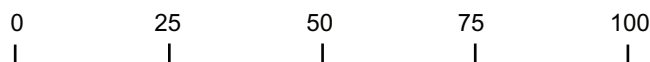


10. Did you experience any unhappiness related to work during pregnancy?

Yes/No

If yes, please specify the condition, time and duration of incidence:

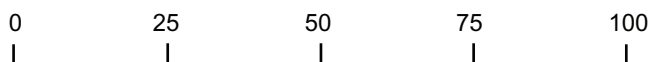
*What was the level of stress you think arising from the unhappiness related to work during pregnancy?



11. Did you experience any changes in working conditions (eg, changes in working position, changes in working partners, being fired, etc.) during pregnancy? Yes/No

If yes, please specify the condition, time and duration of incidence:

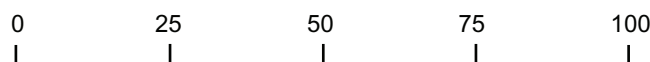
*What was the level of stress you think arising from the changes in working conditions during pregnancy?



12. Did you experience any financial strain during pregnancy? Yes/No

If yes, please specify the condition, time and duration of incidence:

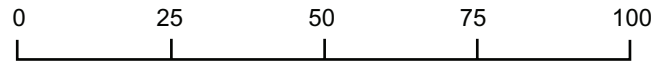
*What was the level of stress you think arising from the financial strain during pregnancy?





13. Did you experience any sleeping problems during pregnancy? Yes/No
If yes, please specify the condition, time and duration of incidence:

*What was the level of stress you think arising from the sleeping problems during pregnancy?



Part 4—Coping Strategies for Prenatal Stress

1. Have you tried any strategies to relieve the prenatal stress you faced?

Never/Seldom/Sometimes/Often/Always

If yes, what were your strategies: _____

Were the strategies effective?

Very ineffective/ineffective/generally effective/quite effective/very effective

Please describe how these strategies affected your psychological condition:

2. Have your spouse or other family members tried any strategies to relieve the prenatal stress you faced?

Never/Seldom/Sometimes/Often/Always

If yes, what were your strategies: _____

Were the strategies effective?

Very ineffective/ineffective/generally effective/quite effective/very effective

Please describe how these strategies affected your psychological condition:

Part 5—Basic Information

Please answer the following questions about your basic information.

1. Age

<21 <input type="checkbox"/>	21–25 <input type="checkbox"/>	26–30 <input type="checkbox"/>
31–35 <input type="checkbox"/>	36–40 <input type="checkbox"/>	41–45 <input type="checkbox"/>
46–50 <input type="checkbox"/>	50–55 <input type="checkbox"/>	>55 <input type="checkbox"/>

2. Occupation

Banking <input type="checkbox"/>	Accounting <input type="checkbox"/>	Computer related <input type="checkbox"/>
Catering <input type="checkbox"/>	Clerk <input type="checkbox"/>	Fashion related <input type="checkbox"/>
Education <input type="checkbox"/>	Hotel related <input type="checkbox"/>	Social worker <input type="checkbox"/>
Housewife <input type="checkbox"/>	Engineering <input type="checkbox"/>	Others: _____

3. Educational level

Primary school or below <input type="checkbox"/>	Secondary school <input type="checkbox"/>
Diploma/High Diploma/ Associate Degree <input type="checkbox"/>	Bachelor Degree or above <input type="checkbox"/>



4. Family income per month

<\$5,000 <input type="checkbox"/>	\$5,000–\$9,999 <input type="checkbox"/>	\$10,000–\$14,999 <input type="checkbox"/>
\$15,000–\$19,999 <input type="checkbox"/>	\$20,000–\$24,999 <input type="checkbox"/>	\$25,000–\$29,999 <input type="checkbox"/>
\$30,000–\$34,999 <input type="checkbox"/>	\$35,000–\$49,999 <input type="checkbox"/>	>50,000 <input type="checkbox"/>

~ Thank you for your participation~