

Associations between autism spectrum disorder and eating disorders with and without self-induced vomiting: an empirical study

Noriko Numata (✉ n_numata@chiba-u.jp)

Research center for child mental development, Chiba University <https://orcid.org/0000-0003-0117-7740>

Akiko Nakagawa

Chiba Daigaku

Kazuko Yoshioka

Fukuoka Kenritsu Daigaku

Kayoko Isomura

Karolinska Institutet

Daisuke Matsuzawa

Chiba Daigaku

Rikukage Setsu

Koutokukai Sato Hospital

Michiko Nakazato

Kokusai Iryo Fukushi Daigaku

Eiji Shimizu

Chiba Daigaku

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Abstract

Background: Although approximately 23% of anorexia nervosa (AN) patients have concomitant autism spectrum disorder (ASD), it is clinically difficult to determine ASD coexistence in patients with eating disorders. Restrictive AN is more common in younger patients, and self-induced vomiting usually appears during adolescence/young adulthood with the collapse of control. Some patients state that they “would never want to vomit” and are tolerant of weight gain even if they start overeating. We aimed to understand the essential difference between who vomit and who do not vomit and believed that this difference might be related to the ASD tendency. In this study, we hypothesised that the absence of self-induced vomiting may be associated with the presence of ASD and aimed to assess the presence of autism spectrum disorder tendencies in each eating disorder. Clarifying this association helps to consider the coexistence of ASD in the clinical setting and can lead to the next detailed ASD evaluation, and as a result, helps to determine the appropriate treatment and support individually.

Methods: We retrospectively evaluated 43 females aged 15–45 years who attended Chiba University Hospital between 2012 and 2016 using the Eating Disorder Examination Questionnaire and Autism Spectrum Quotient to quantify the severity of the eating disorder and to identify whether ASD tendency were present.

Results: There was no difference in the AQ between AN-BP and AN-R. The significant difference in the AQ score between BN and BED was clear. Of the four ED subtypes, BED had the highest ASD tendency. In the four groups, AN-BP had the longest duration of illness and was significantly longer than AN-R.

Conclusions: There was a difference in the AQ score by the presence or absence of self-induced vomiting. The present results help us understand why only those with binge eating disorder (BED) do not vomit even if they gain weight and why BED is admmissive even if there is weight gain. Further Therefore, evaluating patients for the presence of self-induced vomiting when assessing them for EDs may help us understand the association with ASD tendencies.

Plain English Summary

Although about 23% of anorexia nervosa (AN) patients have concomitant autism spectrum disorder (ASD), it is clinically difficult to determine ASD coexistence in patients with eating disorders (EDs). Restrictive AN is more common in younger patients, and self-induced vomiting usually appears during adolescence with the collapse of control. Some patients, however, state that they “would never want to vomit” and are tolerant of weight gain even if they start overeating.

We aimed to assess the presence of ASD tendency in each subtype of ED and explore whether an association exists between ASD tendency and EDs with or without self-induced vomiting.

We retrospectively evaluated 43 females aged 15–45 years using the Eating Disorder Examination Questionnaire and Autism Spectrum Quotient (AQ) to quantify the severity of the eating disorder and to

identify whether ASD tendency was present.

AQ tended to be higher in the group without, than in the group with, self-induced vomiting. Patients with binge eating disorder (BED) had the highest AQ score. The present results throw some light on why only those with BED do not vomit and are admmissive even if there is weight gain. If the presence of ASD is relevant, it may also need to change the treatment course. Further verification is required in the future.

Background

According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), eating disorders (EDs) can be classified into anorexia nervosa (AN), bulimia nervosa (BN) and binge eating disorder (BED) [1,2]. AN can then be further divided into a restricting (AN-R) type and a binge eating with self-induced vomiting (AN-BP) type. Patients frequently transition from one ED type to another, typically from the AN-R type to the AN-BP type [3]; this may be attributed to the fact that strict dietary restrictions cannot be maintained for a long time. However, this is less common in people with AN-BP to prevent self-induced vomiting [3]. All subtypes share certain features, such as distorted body image, excessive dieting (leading to severe weight loss), and a pathological fear of becoming fat [4].

It is interesting that many of the common features of EDs are similar to the cognitive rigidity in the presence of changing environmental demands that is often seen in autism spectrum disorder (ASD) [5]. This may indicate a pathological link between the two disorders, with some studies indicating that 18%–23% of patients with AN have comorbid ASD [6-8]. Given that the prevalence of ASD is 1% in the general population, the numbers with a comorbid ED must be quite high [6]. Other research has shown that scores on the Eating Disorder Examination Questionnaire (EDE-Q) were significantly and positively correlated with those on the Autism Spectrum Quotient (AQ), 10-item version, but not with the body mass index (BMI) [9]. This correlation has also been observed in studies conducted on adults and adolescents with AN [10,11]. Studies have shown that prognosis may be worse when EDs and ASD are comorbid [6,5,12].

It is necessary to assess the tendency of ASD when deciding the treatment policy for patients with EDs. However, clinically, it is difficult to determine the ASD tendency of patients with EDs. Restrictive AN is more common in younger patients, and self-induced vomiting usually appears during adolescence/young adulthood with the collapse of control. However, some patients say that they "would never want to vomit" and are tolerant of weight gain even if overeating began. We aimed to determine the difference between who vomit and who do not vomit and thought that this difference might be related to the ASD tendency. Therefore, we decided to investigate whether the presence or absence of vomiting was associated with the ASD tendency.

To date, many studies have discussed links between ASD and AN restricting type [8]. However, compare to that, studies that have examined the association between ASD and other eating disorder subtypes, such as bulimia nervosa, AN binge-purging type and BED were less. Given that many patients transit between ED subtypes, it is logical that research should be more expanded. In this study, we hypothesised that the absence of self-induced vomiting may be associated with the presence of ASD and aimed to

assess the presence of autism spectrum disorder tendencies in each eating disorder. Clarifying this association helps to consider the coexistence of ASD in the clinical setting and can lead to the next detailed ASD evaluation, and as a result, helps to determine the appropriate treatment and support individually.

Methods

Procedure

We retrospectively sampled outpatients from clinical record who attended Chiba University Hospital between 2012 and 2016. Subjects had been diagnosed by a psychiatrist with experience in EDs, using the DSM-IV revised criteria [13] and the DSM-5[2].

AN, BN and BED were included if the criteria was fully met, however, one atypical ED who was chewing type was excluded from this study. Self-report questionnaires used were that completed by subjects at that time visited the hospital. The Institutional Ethics Committee of Chiba University Graduate School of Medicine approved this study (no. 3431), and all subjects have provided written informed consent.

Subjects

The collected sample size was 43, all were female. Among them, 42 subjects were finally analysed because the chewing type was excluded. Among those 42 subjects, 23 of BN, 8 of AN-BP, 6 of AN-R and 5 of BED were included. The subjects with self-induced vomiting (BN and AN-BP) were 31, and without self-induce vomiting (AN-R and BED) were 11 at the time of assessment. The mean age of the 42 subjects was 26.2 (\pm 7.8). Vomiting was assessed by both a psychiatrist and self-reported questionnaire (EDE-Q).

Measures

Relevant demographic data were collected, including age, duration of illness and BMI. ED severity was assessed using the global EDE-Q score [14], whereas autistic tendencies were assessed using the AQ [15].

Eating Disorder Examination Questionnaire (EDE-Q)

The EDE-Q is a standardised and well-validated 36-item self-report questionnaire that measures the severity of ED symptoms and behaviours in the 28 days leading up to the survey [14]. In the questionnaire, patients are asked to rate how often they have engaged in specific ED behaviours or held

ED concerns during the previous 28 days. The questionnaire generates scores for four subscales –“dietary restraint,” “weight concern,” “shape concern” and “eating concern”—together with a global score that reflects overall illness severity. The maximum global score is 6, with higher scores indicating greater severity. The optimal cut-off score is 2.5 for discriminating between those with the disorder and healthy controls [16]. Cronbach’s α ranged from .78 (Eating concern at Time 1) to .92 (Shape Concern at Time 2) for women [17]. In Japanese version, the Cronbach’s α coefficient was global scale 0.94, restricting 0.81, eating 0.86, shape 0.88, weight 0.79. It showed a significant correlation with EAT26 and EDI91[18]. Considering the findings of the previous studies [19,14], the EDE-Q appears to be a psychometrically sound self-report measure for the screening of eating disorders.

The Autism Spectrum Quotient (AQ)

The 50-item AQ was developed to provide a brief self-report measure of autistic traits in adults but was not designed to be used as a diagnostic tool despite its widespread use. The AQ consists of five domains associated with ASDs: social skills, attention switching, attention to detail, communication and imagination. Each question allows the subject to indicate “definitely agree,” “slightly agree,” “slightly disagree,” or “definitely disagree.” Approximately half the questions are worded to elicit an “agree” response and half to elicit a “disagree” response in neurotypical individuals. The cut-off score for ASD is 33. The internal consistency of items in each of the five domains was also calculated, and Cronbach’s α coefficients were moderate-to-high (Communication = .65; Social = .77; Imagination = .65; Local Details = .63; and Attention Switching = .67) [20,15]. In Japanese version, the global scale was $\alpha = 0.81$, and the α coefficient for each scale was as follows: social skills 0.78, attention switching 0.63, attention to detail 0.57, communication 0.64, and imagination 0.51[20].

Statistical analysis

All data were reported as means and standard deviations or numbers (number of people) and percentages as appropriate. Demographic data were analysed by Kruskal–Wallis analysis and multiple comparisons were performed by the Steel–Dwass method. In addition, AQ scores and EDE-Q scores of patients with and without self-induced vomiting and EDE-Q scores were compared using the Mann–Whitney test, because we had assumed that the variables would not be normally distributed owing to the relatively small sample size. Illness duration can be a confounding factor; therefore, Fisher’s exact test was conducted to confirm this. (Correlation analysis could not be performed owing to the relatively small sample size). Furthermore, assuming that BMI is a confounding factor, Mann-Whitney test was performed between anorexic group and bulimic group. Finally, the ratio of the subtypes and the number of patients who exceeded the cut-off value of the AQ score was determined, and the difference in the ratio of the

number of patients was examined by Fisher's exact test. We also calculated the effect size using Cramer's V. A Cramer's V > 0.10 was used as the criterion for a small effect, a value >0.30 as a medium effect, and >0.50 as a large effect (http://jspt.japanpt.or.jp/ebpt_glossary/effect-size.html). There was no missing value. There were some outlier values; however, all the numbers were clinically possible and were not excluded.

Statistical analyses were performed using the STAT statistical package and js-STAR version 9.7.8j.

Results

Demographic analysis and clinical characteristics in subtypes of ED.

In total, 43 female outpatients aged 12–41 years (mean 26.4 ± 7.8 years) were enrolled with illness durations of 0.5–20 years (mean 6.4 ± 5.8). The sample comprised the following diagnoses: 23 with BN (53.5%), 8 with AN-BP (18.6%), 6 with AN-R (14.0%), 5 with BED (11.6%) and 1 with an atypical ED (2.3%). Among these patients, only 11 did not have self-induced vomiting (i.e., had AN-R and BED) at the time of visiting the hospital. The clinical and demographic characteristics are summarised in Table 1.

As shown in Table 1, the groups were not significantly different in their age. However, the AN groups (AN-BP and AN-R) had a significantly lower BMI compared with the other groups (BN and BED) (AN-R: 15.6 ± 1.5 , AN-BP: 17.0 ± 0.7 ; BN: 20.4 ± 2.4 , BED: 24.3 ± 7.0) ($H = 26.3$, $p < 0.01$). There were also statistically significant differences between the AN groups and BN in terms of the EDE-Q global scores for clinical severity (AN-R: 15.2 ± 11.5 ; BN: 74.5 ± 40.8 and AN-BP: 78.8 ± 39.4). AN-BP tended to be higher than the other subtypes in terms of restricting, eating, and weight, that were the sub-items of EDE-Q, and there was a significant difference in the comparison with AN-R (Restricting: AN-BP 5.2 ± 1.0 , AN-R 2.4 ± 1.5 ; Eating: AN-BP 4.9 ± 0.6 , AN-R 2.0 ± 1.4 , Weight: AN-BP 5.4 ± 0.6 , AN-R 2.6 ± 1.9).

Table 1 also shows that the average of AQ total score was highest for patients with BED (32.4 ± 6.2), followed by those with AN-R (26.0 ± 7.5), AN-BP (25.3 ± 4.8) and BN (22.1 ± 6.4). The difference between BN and BED was significant for the attention to detail score (BN: 3.2 ± 2.0 , BED: 7.6 ± 2.5) ($H = 9.4$, $p < 0.05$).

Clinics characteristics, EDE-Q and AQ score by the presence or absence of self-induced vomiting

As observed in Table 2, 31 patients self-induced vomiting and 11 did not self-induce vomiting. However, although there were no significant differences in age or BMI, there was a significant difference in illness duration between AN-BP and AN-R (AN-BP: 10.0 ± 6.7 , AN-R: 1.9 ± 1.7).

There were no significant differences in the EDE-Q, except for the “diagnosis” category, which is expected to be affected by the frequency of self-induced vomiting. The AQ total scores of those who did not self-induce vomiting were significantly higher than for those who self-induced vomiting. In particular, the scores for social and communication skills—which are subscales of the AQ—were significantly higher in the group that did not have self-induce vomiting.

There were also statistically significant differences between the purging and non-purging groups in the EDE-Q global scores for clinical severity. Two bulimic purging subtypes (BN and AN-BP) scored higher than non-purging subtypes ($U = 67.5, p < 0.01, r = 0.46$).

Illness duration could be a confounding factor for the score of EDE-Q and AQ; therefore, Fisher’s exact test was conducted to confirm this. Fisher’s exact test was performed for 1) Illness duration is 10 years or more and below, and 2) Average 6.2 years, so more and less.

There were 8 (≥ 10 years) patients and 23 (≤ 9 years) patients in the vomiting group and 1 (≥ 10 years) patient and 10 (≤ 9 years) patients in the non-vomiting group. There were 13 (≥ 6.2 years) and 18 (≤ 6.1 years) subjects in the vomiting group and 2 and 9 in the non-vomiting group. There was no difference in the illness duration between the groups; p value were .403 ($n=8$ (≥ 10 years) and $n=23$ (≤ 9 years)) and .273 ($n= 1$ (≥ 10 years) and $n=10$ (≤ 9 years)). Therefore, it was not possible to say that patients in the vomiting group had a longer illness duration than those in the non-vomiting group.

In addition, BMI may also be a confounder of EDE-Q and AQ scores; therefore, only AN-BP to AN-R and BN to BED were analysed (Table 3).

Despite the significant differences in illness duration, BMI, and age between AN-BP and AN-R, there were no differences in any of the AQ sub-items. In contrast, there was no significant difference in the illness duration, BMI, and age between BN and BED. However, there was a significant difference in the social skill, detail, and communication in the AQ score.

AQ score cut-off value by ED subtype

The ratio of the subtypes and the number of patients who exceeded the cut-off value of the AQ score were examined, and the difference in the ratio of the number of patients was examined using Fisher’s exact test.

Three patients of eight had an AQ score above 33, which well exceeded expected value in 60% of patients with BED. By contrast, one patient with BN had an $AQ \geq 33$ (4.3%), and this amount was below the expected value. The difference between the BN and BED groups was significant ($p = 0.02$) (Table.4).

Discussion

The aim of the current study was to examine the relationship between each subtype of EDs and ASD tendency regarding the presence or absence of self-induced vomiting. We first compared the illness duration, BMI, EDE-Q scores, and AQ scores in the four groups (BN, AN-BP, AN-R, and BED) that were diagnosed by a psychiatrist as per the DSM-IV and the DSM-5 (Table 1). Next, the four subtypes were divided as per the presence or absence of self-induced vomiting; the illness duration, BMI, age, EDE-Q, scores and AQ scores were compared (table2). Illness duration could be a confounding factor; therefore, we performed additional analysis to confirm it. Furthermore, assuming that BMI is a confounding factor, we compared EDEQ and AQ scores between anorexic group (AN-BP and AN-R) and bulimic group (BN and BED). (Table 3) Finally, we examined the ratio of the subtypes and the number of patients who exceeded the cut-off value of the AQ score (Table 4). Here, BMI could be confounding factor, and additional analyses were performed to confirm this.

We had hypothesised that patients without self-induced vomiting had a higher tendency for ASD; however, there was no difference in the AQ between AN-BP and AN-R. The significant difference in the AQ score between BN and BED was clear. Of the four ED subtypes, BED had the highest ASD tendency. In the four groups, AN-BP had the longest duration of illness and was significantly longer than AN-R.

The significantly short illness duration in AN-R indicates that rigid food restrictions cannot continue for a long time, with most patients ultimately switching to other ED subtypes. Previous studies have shown that most patients switch to BN [3] because the patient's ability to control or restrict food lessens after a period of severe food restriction (i.e., as a normal physiological response to starvation). In turn, this leads to increased food consumption accompanied by self-induced vomiting in a belief that this will prevent weight gain while still being able to eat. However, the reasons why some AN-R patients maintain strict food restrictions and do not transition to other ED subtypes are less well understood. Considering the characteristics of ASD, it is possible that some patients do not transit from AN-R because they follow strict dietary rules, such as only eating certain items at all times, due to preservation of sameness. (or Considering the characteristics of ASD, it is possible that people who follow strict dietary rules, such as only eating certain items at all times, due to preservation of sameness are included in AN-R.)

On the other hand, some patients say that they 'would never want to vomit' and are tolerant of weight gain even if they start overeating. In these BED patients, the absence of self-induced vomiting means that they tend to be obese [19], and it is unclear why they do not vomit in the face of weight gain [21]. If considering the characteristics of ASD, it may be possible that some patients with BED do not vomit because another obsessive compulsion arising from ASD is stronger than the core psychopathology of the ED, i.e. fear of being fat and the failure of severe restriction leads to acceptance of weight gain. This is seen clinically in our practice with comments from patients such as "I am scared to vomit," "My life is over when I am vomiting," or "Looking at vomit disgusts me." In such instances, the fear or aversion to vomiting might be stronger than the desire not to gain weight. In addition, patients who were absorbed in dietary restrictions were able to postpone the desire to lose weight due to the disgust of vomiting along with the failure of restrictions, and to endure the weight gain somehow could not be explained by the psychopathology of EDs. In some cases, from the experience of vomiting once in the past, people have a

strong sense to visceral sensations and/or disgust of vomiting; they are unable to forget the trauma and find it difficult to eat food because they do not want to vomit again. People with hyperesthesia within the autism spectrum are reluctant to self-induce vomiting. In addition, some patients cannot eat because they are afraid of vomiting. Therefore, detailed assessment of vomiting in each patient should be needed.

If there is an ASD tendency, it is easy to fall into maladaptation to environment because of lack of flexibility, and the behaviour is likely to become a routine. Social skill and communication skills scores of AQ in patients without self-induced vomiting were higher than those in patients with self-induced vomiting in this study. In a further analysis, patients with BED had by far the highest AQ score among patients without self-induced vomiting, and there was no difference in the AQ scores between AN-BP and AN-R.

The maladaptation to environment may lead to sameness behaviors, such as routine dietary patterns of patients, and environmental adjustment is first necessary. Therefore, evaluating patients for the presence of self-induced vomiting when assessing them for EDs may help us understand the association with ASD tendencies.

To the best of our knowledge, this is the first study to compare the predisposition for ASD by ED subtype and the presence or absence of self-induced vomiting.

For patients with ED coexisting ASD, long-term treatment may be needed. If they are maladaptive to environment, adjustment of environment is needed. For ED patients it may be necessary to prioritize the identification of characteristics over diagnosis. When assessing ED patients who never vomit, it is important to clarify the reason for that, i.e. what they are afraid of as a consequence of vomiting.

This study had some limitations. Of note, the sample size was small, there were differences in the number of participants in each subtype, and we only assessed the tendency for ASD using the AQ. There were no data for healthy subjects to compare patient data with standard values. Besides the above, there was a large age spread. In general, it is known that AN-R is much more common in the younger ages, and self-induced vomiting usually appear later on in adolescence/young adulthood. The differences of subjects' age, BMI and illness duration may always be a confounder and should be controlled it with bigger sample size.

Symptoms of depression and anxiety disorders, irritability, emotional lability, and obsessional features are frequent accompaniments in ED. Typically, these features worsen with weight loss and improve with weight regain [3]. Interest in the outside world also declines as patients become underweight, with the result that most patients become socially withdrawn and isolated. Since we did not measure anxiety or depression in this study, it is unclear how these were associated with ED and AQ scores. Since ED has a high incidence of anxiety and depression, it should be added to the evaluation index in the future study.

This study used AQ for evaluation of ASD. We should have used AQ-10 because a few adolescent patients were included in our subjects. However, AQ is a self-completed scale and not the assessment

measure to diagnose ASD. Using Autism Diagnostic Observation Schedule(ADOS) or Autism Diagnostic Interview (ADI) for ASD evaluation and excluding patients with extremely low body weights and including control subjects in a larger overall sample are needed in the future research [9,21].

Conclusions

The prevalence of higher ASD traits in adults with EDs may contribute to the high treatment resistance to conventional therapies [22]. It is a very important viewpoint for therapists to identify ASD for a disease with a high coexistence rate of EDs. Moreover, finding and understanding the association between ASD and symptoms of ED is very helpful in treatment course of patients.

There are still problems to be examined in the future regarding coexistence of autism tendency and measurement of individual differences. The only scale that we used was the AQ used for ASD screening. This is a good tool for getting a hint of the presence or absence of ASD traits in a busy clinical setting.

A future issue is to determine the clinical usefulness of using the ASD evaluation tool, which is called the gold standard such as ADOS and ADI, for ED patients whose ASD characteristics are considered to be a factor for maintaining the symptoms.

Abbreviations

DSM-5: the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition

EDs: eating disorders

AN: anorexia nervosa

BN: bulimia nervosa

BED: binge eating disorder

AN-R: restricting type of AN

AN-BP: binge eating with self-induced vomiting type

ASD: autism spectrum disorder

BMI: Body Mass Index

EDE-Q: Eating Disorder Examination Questionnaire

AQ: Autism Spectrum Quotient

Declarations

Ethical approval and consent to participate

All procedures in the current study were in accordance with the ethical standards of the institutional research committee (Chiba University Graduate School of Medicine approved the study (no. 3431) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study. In case that the patient was a minor under the age of 18, an informed consent was obtained from their patient/caregiver. In addition, the patients (adults) with 'ASD' were able to give informed consent on their own (because of the severity of the disease)

Consent for publication

Availability of data and materials

Competing interests

The authors do not have any competing interests to report.

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Authors' contributions

Author NN designed the study and collected data. Authors RS and MN provided summaries of previous research studies. Authors KI, KY and DM conducted the statistical analysis. ES and AN supervised the study. All authors contributed to and have approved the final manuscript.

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Tables

Due to technical limitations, the tables are provided in the Supplementary Files section.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Tables.docx](#)