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Associations between autism, gender dysphoria and gender incongruence: insights from the Swedish Gender Dysphoria Study (SKDS)

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ABSTRACT

Background: A higher prevalence of autism spectrum disorder (ASD) and autistic traits among transgender and gender diverse individuals compared to the general population has been reported. However, inconsistent findings and methodological limitations have been noted in the literature. This study aims to investigate the prevalence of ASD diagnoses and autistic traits among individuals with gender dysphoria compared to a cisgender group and to explore associations between autism and self-reported levels of gender incongruence in individuals with gender dysphoria.

Methods: This study is part of the Swedish Gender Dysphoria Study. ASD diagnoses were retrieved from the national patient registers. Autistic traits were assessed using the Ritvo Autism and Asperger Diagnostic Scale-14 (RAADS-14) and Autism Spectrum Quotient (AQ). Gender incongruence was evaluated with the Transgender Congruence Scale. Associations with gender incongruence were examined with linear regression analysis.

Results: Participants with gender dysphoria, regardless of birth-assigned sex, had a higher prevalence of ASD compared with cisgender participants (RR = 7.8; 95 % CI = 3.9, 15.3). The gender dysphoria group also scored higher on both the RAADS-14 (MD = 8.0; 95 % CI = 6.6, 9.6) and AQ (MD = 5.3; 95 % CI = 4.0, 6.6). When stratified by birth-assigned sex, the prevalence of ASD did not differ among participants with gender dysphoria. No association was found between ASD and gender incongruence among individuals with gender dysphoria.

Conclusions: Our findings confirm the high co-occurrence of ASD and gender dysphoria and suggest no difference in gender incongruence between autistic and non-autistic people with gender dysphoria.

1. Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental condition characterized by impaired social communication and interaction as well as restricted, repetitive patterns of behavior, interests, or activities (APA, 2013). Features of ASD are often present early in childhood, and ASD has heterogeneous manifestations in terms of symptoms and their severity. A systematic review of studies conducted between 2012 and 2021 from various countries reported a median ASD prevalence of 100 per 10,000 with a median male-to-female ratio of 4.2 (Zeidan et al., 2022). A significant increase in ASD prevalence in the last decades has been reported (Grosvenor et al., 2024). In line with global trends, a sixfold increase in ASD prevalence was observed in Sweden between 2010 and 2023, with the most notable rise among girls aged 10 to 17 years (Socialstyrelsen, 2024). As of 2023, the prevalence of ASD in the Swedish population is estimated at approximately 2 % (Socialstyrelsen, 2024).

The number of transgender and gender diverse (TGD) people who seek medical care has also increased over recent years (Kaltiala et al., 2020; Wiepjes et al., 2018). Along with increases in the numbers of TGD and autistic people (we use both identity-first and person-first languages in this article, following the different preferences within the autism community as noted by Taboas et al., 2023), a high co-occurrence of TGD identities and ASD has been reported (Kallitsounaki and Williams, 2023; Rea et al., 2024). In 2010, de Vries and colleagues, using a diagnostic tool for ASD, reported an ASD prevalence of 7.8 % among children and adolescents referred to a gender identity clinic in the Netherlands. Since then,

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the number of studies focusing on the intersection of TGD identities and ASD has been increasing (Rea et al., 2024). High levels of autistic traits have been reported among TGD people across age groups, using a variety of ASD screening tools (Huisman et al., 2024; Kung, 2020; Lehmann et al., 2020; van der Miesen et al., 2018a; Vermaat et al., 2018; Warrier et al., 2020). Studies using self-reported diagnoses and information from health records and registers have also demonstrated increased rates of ASD among TGD people in comparison to general or cisgender populations (David et al., 2025; Heylens et al., 2018; Mahfouda et al., 2019; Strauss et al., 2021). A recent meta-analysis showed that the pooled prevalence of ASD among people with gender dysphoria or gender incongruence is 11 % (Kallitsounaki and Williams, 2023). Even though the majority of studies have indicated high rates of ASD among TGD people, inconsistent findings have been reported, particularly concerning birth-assigned sex (Bouzy et al., 2023).

However, considerable methodological concerns remain. Studies reporting a high co-occurrence of being TGD and autistic have employed different methodologies to address the subject. They use different definitions of TGD identities and ASD, often relying on various proxy variables, and involve different populations, such as the general population, autistic populations, and clinically referred TGD populations comprising individuals experiencing gender dysphoria and gender incongruence (Kallitsounaki and Williams, 2023). The dissimilarities between studies in the literature make it challenging to draw definitive conclusions. Additionally, the risk of misclassification due to the use of autistic traits instead of diagnoses, along with the absence of control groups in many studies, has been criticized (Fortunato et al., 2022; Turban and van Schalkwyk, 2018). It has been suggested that these factors may have inflated the reported prevalence of ASD among TGD individuals (Turban, 2018).

When investigating the potential connection between TGD identities and ASD, focusing on people experiencing gender dysphoria is particularly important, as the co-occurrence with ASD may pose certain challenges, including difficulties in obtaining a diagnosis and accessing gender-affirming treatments (Strang et al., 2023). Furthermore, current knowledge about how ASD or different autistic traits are associated with gender dysphoria-related characteristics remains rather limited.

In this study, we aimed to investigate the prevalence of ASD diagnoses among people with gender dysphoria in comparison to a cisgender control group. We also investigated how autistic traits, measured with two different screening tools, differ between these groups. With this approach, we aimed to assess ASD diagnoses and different autistic trait clusters in the same study population. Lastly, we examined how ASD diagnoses and autistic traits are linked to self-reported levels of gender incongruence among people with gender dysphoria.

2. Methods

2.1. Study design and sample

This study is part of the Swedish Gender Dysphoria Study (SKDS), a multicenter, longitudinal clinical cohort study conducted in Sweden (Özel et al., 2023). The SKDS aims to investigate mental health and psychosocial outcomes in relation to gender dysphoria as well as gender-affirming treatments, among other aspects. Starting from 2016, people seeking healthcare for their gender dysphoria have been recruited through six specialized gender clinics in Sweden; being in contact with a specialized gender clinic, being at least 15 years old, and proficiency in Swedish were set as inclusion criteria for the SKDS. Participants were recruited at different stages of their gender dysphoria assessment and not all had received a diagnosis at the time of baseline evaluation in the SKDS. Participants in contact with gender-affirming healthcare are referred to as "participants with gender dysphoria" in this article. Participants with gender dysphoria have been followed-up for three years; data have been collected via online surveys and clinical assessments. An age- and county-matched cisgender control group was provided by Statistics Sweden, a governmental agency which is responsible for official statistics in Sweden. The control group is comprised of participants who do not have any gender dysphoria-related diagnoses in the national patient registers. Participants without gender dysphoria were only evaluated for baseline measures. More detailed information about the study design of the SKDS and recruitment can be found elsewhere (Özel et al., 2023).

A cross-sectional study design was used; all measures were collected during the initial assessment. The SKDS was approved by the Ethical Review Board in Uppsala (Dnr: 2016/013). The study followed the principles of the Helsinki Declaration, and all participants provided written informed consent before their participation.

2.2. ASD diagnoses and related traits

The National Patient Register in Sweden, provided by the Swedish National Board of Health and Welfare, contains International Classification of Diseases (ICD) diagnoses from physician visits; the inpatient data has been available since 1964, while the outpatient data has been available since 2001 (Ludvigsson et al., 2011). ASD diagnoses were retrieved from national patient registers between 2010 and 2023 for participants who consented to link their SKDS data with these registers. 328 participants with gender dysphoria (88.2 %) and 275 participants without gender dysphoria (82.8 %) gave consent for linkage to national patient registers. ASD was defined as having at least one diagnosis of ICD-10 codes F84.0, F84.1, F84.5, F84.8, or F84.9.

To assess autistic traits, the Ritvo Autism and Asperger Diagnostic Scale-14 (RAADS-14) and the Autism Spectrum Quotient (AQ) were administered online. The RAADS-14 is a self-report scale consisting of 14 items, with each item rated from 0 to 3, resulting in a total score ranging from 0 to 42 (Eriksson et al., 2013). It has three subscales: mentalizing deficits (ranging from 0 to 21), social anxiety (ranging from 0 to 12), and sensory reactivity (ranging from 0 to 9). Higher scores indicate more autistic traits. The RAADS-14 was developed within a Swedish sample based on a previous longer version of the scale (Eriksson et al., 2013).

The AQ is a self-administrated scale including 50 items (Baron-Cohen et al., 2001). Each item is rated as "definitely agree", "slightly agree", "slightly disagree", or "definitely disagree". The "agree" options (definitely or slightly) are scored as 1 point, resulting in a total score ranging from 0 to 50. The AQ has five subscales, each ranging from 0 to 10: social skills, attention switching, attention to details, communication, and imagination. Similar to the RAADS-14, higher scores indicate more autistic traits. The Swedish translation of the AQ was previously used in the literature (Lundqvist and Lindner, 2017).

2.3. Gender incongruence

Self-reported levels of gender incongruence were assessed online using the validated Swedish version of the Transgender Congruence Scale (TCS) (Iliadis et al., 2020; Kozee et al., 2012). The TCS consists of 12 items, with each item rated from 1 to 5, resulting in a total score ranging from 12 to 60. It has two subscales: appearance congruence (ranging from 9 to 45) and gender identity acceptance (ranging from 3 to 15). Using the formula *6 - item score*, each item of the scale was inverted for an easier interpretation; thus, higher TCS scores indicate greater incongruence in this study. Missing values in the TCS were found in 7.3 % of participants with gender dysphoria and 7.5 % of those without.

2.4. Covariates

The relationship between ASD or autistic traits and gender incongruence was adjusted for sex assigned at birth, age, and education level, as these variables are potential confounders. Education was categorized into two groups: less than 12 years of education and 12 or more years. Data on these covariates were collected through online surveys. Apart

from one participant with gender dysphoria missing information on education, there were no missing values in the covariates.

2.5. Statistical analysis

All analyses were performed using R version 4.2.2. No exclusions were made due to missing data, and missing values for the variables included in this study were imputed using multiple imputation with the mice package. 20 imputed datasets were generated and the imputation process was conducted over 20 iterations. We present pooled results which were calculated following Rubin's Rules (Rubin, 2004).

In terms of differences in ASD diagnoses between participants with and without gender dysphoria, pooled proportions for ASD diagnoses and the risk ratio (RR) for having an ASD diagnosis based on these proportions were calculated. Regarding autistic traits among participants with and without gender dysphoria, pooled mean scores and standard deviations (SD) are reported; mean differences (MD) and 95 % confidence intervals (CI) were calculated.

To investigate the relationship between ASD diagnoses, autistic traits, and self-reported levels of gender incongruence among participants with gender dysphoria, linear regression analyses were conducted. ASD diagnoses, total RAADS-14 score, and total AQ score were used as independent variables, while two subscales of the TCS (appearance congruence and gender identity acceptance) were used as outcome variables. Separate models were conducted for each independent and outcome variable. Crude models were not adjusted for any covariates; Model 1 was adjusted for birth-assigned sex, age, and education. An interaction term of birth-assigned sex and the respective autism variable in that model (i.e., ASD diagnosis, total RAADS-14 score, or total AQ score) was additionally included in Model 2. We also explored non-linear associations by fitting models containing restricted cubic splines with 2 and 3 degrees of freedom. Upon examining the Akaike Information Criterion (AIC) for the different models, we concluded that a linear association was the optimal fit.

Proportions of the variance in gender incongruence explained by ASD diagnoses and related traits were examined using R^2 measures. Model 0 included only birth-assigned sex, age, and education, without any autism-related variables, and was used as a reference to assess the additional variance attributed to autism variables. Models 1 and 2 were used as described above.

As sensitivity analyses, proportions and RR of having an ASD diagnosis, as well as mean differences in autistic traits between the two groups, were also calculated among participants with complete data on those scales. Results without multiple imputation are also presented.

3. Results

This current study includes 372 participants with gender dysphoria and 332 participants without, all of whom completed at least the baseline assessment of the SKDS. Sociodemographic characteristics of study participants are presented in Table 1. A total of 217 participants with gender dysphoria (58.3 %) and 225 participants without gender dysphoria (67.8 %) were assigned female at birth (AFAB). The mean age of participants in the gender dysphoria group was 26.5 years (range = 15–76; SD = 10.6), compared to 27.6 years (range = 15–71; SD = 11.3) for participants without gender dysphoria. Among participants with gender dysphoria, 135 (36.3 %) had at least a high school education (12 or more years), compared to 193 (58.1 %) of participants without gender dysphoria. The majority of participants (>91 %) in both groups were born in Sweden.

Proportions of ASD diagnoses are presented in Table 2. Among individuals AFAB, 24.4 % of those with gender dysphoria had an ASD diagnosis, versus only 3.6 % of participants without gender dysphoria. The corresponding proportions among individuals assigned male at birth (AMAB) were 21.5 % and 2.0 %, respectively. Among all participants, the unadjusted relative risk (RR) of having an ASD diagnosis was 7.8 times higher among individuals with gender dysphoria compared to those without (95 % CI = 3.9, 15.3). There was no statistically significant difference in the proportion of participants with an ASD diagnosis by birth-assigned sex. Proportions calculated among participants with complete data are presented in Table S1 without imputation, showing similar results.

Table 1
Sociodemographic characteristics of study participants.

	Gender dysphoria (N = 372)	No gender dysphoria (N = 332)
Birth-assigned sex, N (%)		
Female	217 (58.3 %)	225 (67.8 %)
Male	155 (41.7 %)	107 (32.2 %)
Age, mean (SD), years	26.5 (10.6)	27.6 (11.3)
Education, N (%)		
< 12 years	237 (63.7 %)	138 (41.6 %)
≥ 12 years	135 (36.3 %)	193 (58.1 %)
Missing	–	1 (0.3 %)
Country of birth		
Sweden	347 (93.3 %)	303 (91.3 %)
Other	23 (6.2 %)	28 (8.4 %)
Missing	2 (0.5 %)	1 (0.3 %)

Abbreviations: SD, standard deviation.
[a]ranges between 15 and 76
[b]ranges between 15 and 71.

Table 2
Proportions of ASD diagnoses among participants with and without gender dysphoria.

AFAB		AMAB		Total		
GD (N = 217)	No GD (N = 225)	GD (N = 155)	No GD (N = 107)	GD (N = 372)	No GD (N = 332)	RR[a] (95 % CI)
24.4 %	3.6 %	21.5 %	2.0 %	23.2 %	3.0 %	7.8* (3.9, 15.3)

Abbreviations: AFAB, assigned female at birth; AMAB, assigned male at birth; ASD, autism spectrum.
disorder; GD, gender dysphoria; RR, risk ratio.
*statistically significant.
[a] unadjusted.

Participants with gender dysphoria, both AFAB and AMAB, reported significantly higher total scores and subscores on the RAADS-14 compared to participants without gender dysphoria (Table 3). Concerning the total RAADS-14 score, no significant difference was observed between AFAB and AMAB among cisgender individuals (MD = 0.1; 95 % CI = −1.8, 2.0). In contrast, participants AFAB with gender dysphoria scored significantly higher than participants AMAB with gender dysphoria (MD = 5.1; 95 % CI = 2.9, 7.3). The RAADS-14 scores without using multiple imputation are presented in Table S2, with similar results observed.

The autistic traits measured by the AQ are displayed in Table 4. Among participants AFAB, those with gender dysphoria rated higher on both the total score and subscores compared to those without gender dysphoria. The MDs between the two groups were significant across various subscales, except for the attention to details subscale. Regarding participants AMAB, the MD of 1.6 for the total AQ score was not significant between participants with and without gender dysphoria (95 % CI = −0.4, 3.6). Participants AMAB with gender dysphoria showed significantly higher scores for social skills, attention switching, and communication subscales in comparison to cisgender participants (MDs of 0.7, 0.9, and 0.7, respectively). Among cisgender participants, the AMAB group scored significantly higher on the total AQ score compared to the AFAB group (MD = 2.0; 95 % CI = 0.2, 3.8). In contrast, among participants with gender dysphoria, the AFAB group scored significantly

Table 3
Autistic traits (RAADS-14) among participants with and without gender dysphoria.

	AFAB			AMAB			Total		
	GD (N = 217)	No GD (N = 225)	Mean difference (95 % CI)	GD (N = 155)	No GD (N = 107)	Mean difference (95 % CI)	GD (N = 372)	No GD (N = 332)	Mean difference (95 % CI)
RAADS-14 – total[a], mean (SD)	18.9 (11.4)	8.8 (8.7)	10.1* (8.2, 12.1)	13.8 (10.2)	8.7 (8.0)	5.1* (2.8, 7.5)	16.8 (11.2)	8.8 (8.5)	8.0* (6.6, 9.6)
RAADS-14 – mentalizing[b], mean (SD)	8.7 (6.6)	3.8 (4.7)	4.9* (3.8, 6.0)	5.8 (5.5)	3.9 (4.3)	1.9* (0.6, 3.2)	7.4 (6.3)	3.8 (4.6)	3.6* (2.8, 4.4)
RAADS-14 – social anxiety[c], mean (SD)	5.3 (3.7)	2.2 (3.0)	3.1* (2.5, 3.8)	4.8 (3.7)	3.1 (3.0)	1.7* (0.8, 2.5)	5.1 (3.7)	2.5 (3.1)	2.6* (2.1, 3.1)
RAADS-14 – sensory reactivity[d], mean (SD)	4.9 (3.0)	2.8 (2.6)	2.1* (1.6, 2.7)	3.3 (2.9)	1.7 (2.1)	1.6* (0.9, 2.3)	4.2 (3.1)	2.4 (2.5)	1.8* (1.4, 2.2)

Abbreviations: AFAB, assigned female at birth; AMAB, assigned male at birth; CI, confidence interval; GD, gender dysphoria; RAADS-14, Ritvo Autism and. Asperger Diagnostic Scale 14; SD, standard deviation.
*statistically significant.
[a] Ranges between 0 and 42.
[b] ranges between 0 and 21.
[c] ranges between 0 and 12.
[d] ranges between 0 and 9.

Table 4
Autistic traits (AQ) among participants with and without gender dysphoria.

	AFAB			AMAB			Total		
	GD (N = 217)	No GD (N = 225)	Mean difference (95 % CI)	GD (N = 155)	No GD (N = 107)	Mean difference (95 % CI)	GD (N = 372)	No GD (N = 332)	Mean difference (95 % CI)
AQ – total[a], mean (SD)	23.6 (9.2)	16.1 (7.7)	7.5* (5.9, 9.2)	19.7 (8.3)	18.1 (7.6)	1.6 (−0.4, 3.6)	22.0 (9.0)	16.7 (7.7)	5.3* (4.0, 6.6)
AQ – social skills[b], mean (SD)	4.9 (2.5)	2.8 (2.0)	2.1* (1.7, 2.6)	4.2 (2.5)	3.5 (2.3)	0.7* (0.0, 1.3)	4.6 (2.5)	3.0 (2.2)	1.6* (1.2, 2.0)
AQ – attention switching[b], mean (SD)	6.1 (2.6)	3.7 (2.5)	2.4* (2.0, 2.9)	4.8 (2.6)	3.9 (2.2)	0.9* (0.3, 1.5)	5.6 (2.7)	3.8 (2.4)	1.8* (1.4, 2.2)
AQ – attention to details[b], mean (SD)	5.0 (2.2)	4.6 (2.3)	0.4 (−0.0, 0.9)	4.5 (2.2)	4.2 (2.4)	0.3 (−0.3, 0.9)	4.8 (2.2)	4.5 (2.3)	0.3 (−0.0, 0.7)
AQ – communication[b], mean (SD)	4.2 (2.8)	2.3 (2.1)	1.9* (1.5, 2.4)	3.3 (2.4)	2.6 (2.2)	0.7* (0.0, 1.3)	3.9 (2.7)	2.5 (2.2)	1.4* (1.1, 1.8)
AQ – imagination[b], mean (SD)	3.2 (2.2)	2.6 (1.8)	0.6* (0.2, 1.0)	2.9 (1.8)	3.7 (2.2)	−0.8* (−1.4, −0.3)	3.1 (2.0)	3.0 (2.0)	0.1 (−0.2, 0.4)

Abbreviations: AFAB, assigned female at birth; AMAB, assigned male at birth; AQ, Autism Spectrum Quotient; CI, confidence interval; GD, gender dysphoria;. SD, standard deviation.
*statistically significant.
[a] Ranges between 0 and 50.
[b] ranges between 0 and 10.

higher on the total AQ score compared to the AMAB group (MD = 3.9; 95 % CI = 2.1, 5.7). The AQ scores without using multiple imputation are shown in Table S3. Those results revealed consistent patterns, although a few differences in statistical significance were observed.

No significant associations of having an ASD diagnosis with either appearance congruence or gender identity acceptance were found among participants with gender dysphoria (Table 5). Higher RAADS-14 scores were associated with greater gender incongruence, specifically in terms of gender identity acceptance (β = 0.03; 95 % CI = 0.00, 0.06); however, this association was not significant in the adjusted model (β = 0.03; 95 % CI = −0.00, 0.05). Higher AQ scores were related to increased appearance incongruence in both crude (β = 0.10; 95 % CI = 0.01, 0.19) and adjusted models (β = 0.09; 95 % CI = 0.00, 0.18). No significant interaction effect between autism variables and birth-assigned sex was observed. R^2 measures for the regression analyses are shown in Table S4. Adding autism variables to the regression models accounted for no more than a 1.2 % point increase in the variation explained in gender incongruence.

4. Discussion

This current study initially investigated the prevalence of ASD diagnoses among people with and without gender dysphoria. Participants with gender dysphoria, including both individuals AFAB and AMAB, had a significantly higher prevalence of ASD compared to their cisgender counterparts. No difference in ASD prevalence was found between the AFAB and AMAB groups within the gender dysphoria group. Similarly, participants with gender dysphoria scored higher on measures of autistic traits than cisgender participants. When stratified by birth-assigned sex, participants AFAB with gender dysphoria scored higher on both the RAADS-14 and the AQ than cisgender participants AFAB. Among participants AMAB, the difference between those with and without gender dysphoria was significant only for RAADS-14 scores. Within the gender dysphoria group, participants AFAB showed significantly higher autistic traits than participants AMAB. Lastly, there was no association of ASD diagnoses and RAADS-14 scores with gender incongruence within the gender dysphoria group. However, a significant positive association was observed between AQ scores and appearance incongruence.

Our results support the previously proposed co-occurrence of ASD

Table 5
Associations between ASD diagnoses, autistic traits and gender incongruence among people with gender dysphoria.

	Outcomes					
	Appearance congruence[a], beta (95 % CI)			Gender identity acceptance[b], beta (95 % CI)		
	Crude Model	Model 1	Model 2	Crude Model	Model 1	Model 2
ASD diagnosis	1.08 (−0.82, 2.97)	1.00 (−3.15, 2.90)	−0.03 (−3.11, 3.04)	0.19 (−0.56, 0.94)	0.15 (−0.61, 0.90)	0.59 (−0.60, 1.79)
ASD diagnosis x birth-assigned sex	NA	NA	1.72 (−2.23, 5.67)	NA	NA	−0.73 (−2.26, 0.80)
RAADS-14 total score[c]	0.05 (−0.02, 0.12)	0.05 (−0.03, 0.12)	−0.03 (−0.15, 0.10)	0.03* (0.00, 0.06)	0.03 (−0.00, 0.05)	0.04 (−0.01, 0.09)
RAADS-14 total score x birth-assigned sex	NA	NA	0.12 (−0.04, 0.27)	NA	NA	−0.03 (−0.08, 0.03)
AQ total score	0.10* (0.01, 0.19)	0.09* (0.00, 0.18)	0.02 (−0.13, 0.17)	0.03 (−0.00, 0.07)	0.03 (−0.01, 0.06)	0.03 (−0.03, 0.09)
AQ total score[d] x birth-assigned sex	NA	NA	0.12 (−0.07, 0.30)	NA	NA	−0.01 (−0.08, 0.07)

Abbreviations: AQ, Autism Spectrum Quotient; ASD, autism spectrum disorder; CI; confidence interval; NA, not applicable; RAADS-14, Ritvo Autism and Asperger Diagnostic Scale 14; TCS, Transgender Congruence Scale.
*statistically significant.
Crude Model is unadjusted. Model 1 is adjusted for birth-assigned sex, age, and education. Model 2 additionally includes an interaction term for birth-assigned sex and the relevant autism-related variable (AMAB is coded as 0, AFAB is coded as 1).
[a] Ranges between 0 and 45.
[b] ranges between 0 and 15.
[c] ranges between 0 and 21.
[d] ranges between 0 and 50.

and gender dysphoria in the literature. Since studies employed different tools to measure ASD diagnoses, including prerecorded health databases, chart reviews, and self-reported diagnoses (Rea et al., 2024), it is challenging to make direct comparisons. The 23.2 % prevalence of ASD among individuals with gender dysphoria found in this study closely aligns with the prevalence of 22.5 % reported in the Australian population aged 14 to 25 years (Strauss et al., 2021), the 26 % prevalence observed in a Finnish clinical youth cohort (Kaltiala-Heino et al., 2015), and the 21.3 % prevalence reported among clinically referred school-aged children for gender dysphoria in Canada (Leef et al., 2019). On the other hand, lower prevalence rates of ASD among TGD individuals, though still higher than in the general population, have also been reported - for instance, 9.6 % in the Norwegian health register and 6 % in data from a pediatric research network in the USA (David et al., 2025; Nunes-Moreno et al., 2022). These dissimilarities in prevalence rates between studies could be due to numerous methodological differences, including sampling strategies or data accuracy in employed data sources, and variations in access to healthcare for obtaining an ASD diagnosis across different countries. In Sweden, establishing an ASD diagnosis requires an extensive clinical investigation by a multidisciplinary team, which may enhance the reliability of national patient registers as well as the robustness of our findings on ASD prevalence.

Presenting subclinical autistic traits without ASD diagnoses may also lead to certain difficulties for people with gender dysphoria, which highlights the importance of focusing also on autistic traits. Our findings on the higher RAADS-14 and AQ scores within the gender dysphoria group affirm the high prevalence of autistic traits among TGD people when compared to cisgender people (Kallitsounaki and Williams, 2023). Several studies using the AQ have reported similarly increased rates, and to our knowledge, the only previous study that used both the RAADS-14 and the AQ demonstrated similar trends in autistic traits among people seeking gender-affirming treatments (Lehmann et al., 2020). The differences across the subscales of RAADS-14 between participants with and without gender dysphoria were consistent in this study, underscoring increased difficulties in mentalizing, social anxiety, and altered sensory reactivity among people with gender dysphoria. However, some discrepancies were observed in the AQ subscales. The sensitivity of the AQ across studies was shown between 0.75 and 0.95 (Baghdadli et al., 2017), while Eriksson and colleagues (2013) reported a sensitivity of 0.97 for the RAADS-14 in a Swedish population. Moreover, the attention to details subscale has been suggested to be an unrelated construct within the scale because of its low intra-scale correlations, and the internal consistency of the imagination subscale has been found to be weak (Bezemer et al., 2021). These nuances regarding the psychometric properties of the scales might partly explain our non-significant results with the AQ. Additionally, the sensitivity of these scales has not been addressed in populations with gender dysphoria, which represents an important direction for future research. Overall, all autistic trait clusters seem to be pertinent for both participants AFAB and AMAB with gender dysphoria.

Previous studies have yielded inconsistent results regarding differences in ASD diagnoses and autistic traits by birth-assigned sex among TGD individuals. Among people with gender dysphoria, our results demonstrate higher prevalence rates of autistic traits within participants AFAB than AMAB, which is in line with several other studies addressing this issue (Cooper et al., 2018; David et al., 2025; Hendriks et al., 2022; Kung, 2020; Nobili et al., 2018, 2020; Vermaat et al., 2018). No significant differences between birth-assigned sexes (Hisle-Gorman et al., 2019; Pasterski et al., 2014; Skagerberg et al., 2015; van der Miesen et al., 2018a) and increased rates for individuals AMAB (de Vries et al., 2010; Heylens et al., 2018; van der Miesen et al., 2024) have also been reported by others. The dissimilarities between birth-assigned sexes might indicate potential differences in neurodevelopmental processes in individuals AFAB and AMAB. Nonetheless, the screening measures used for ASD have primarily been developed with males in mind, and it should be acknowledged that they may yield biased results when considering sex differences (Loomes et al., 2017). Potential gender differences have also been suggested regarding camouflaging autistic traits among people with autism (Hull et al., 2020). Conflicting results based on birth-assigned sex within this study and across studies might have been influenced by these potential sources of bias.

There is no consensus regarding the underlying mechanisms of the high co-occurrence of ASD and gender dysphoria. Different factors, including biological, psychological, and social, have been proposed to explain this co-occurrence (van der Miesen et al., 2016). Among the biological hypotheses, the extreme male brain (EMB) theory has been frequently cited in previous studies (Wattel et al., 2024). According to the EMB theory, females tend to have a greater inclination toward empathizing, while males are generally more inclined toward systemizing, and autistic people show more male patterns (Baron-Cohen, 2002). Additionally, higher prenatal testosterone levels were proposed to lead to autistic traits and gender dysphoria (Auyeung et al., 2009; Jones et al., 2012). Even though our results regarding participants AFAB with gender dysphoria seem to align with the EMB theory, we cannot

infer that they support the EMB theory, considering the lack of biological measures such as hormone levels in this study. Besides, the EMB theory does not provide an explanation for increased prevalence rates of ASD diagnoses and autistic traits among people AMAB with gender dysphoria. A better-developed theory is needed to explain the connection between ASD and gender dysphoria, given the contrasting findings in relation to the EMB theory (Kung et al., 2016; Whitehouse et al., 2012) and criticism raised (Ridley, 2019). Perceptions among TGD people about ASD and gender dysphoria should also be taken into consideration when interpreting the findings. For instance, "gender--loaded stereotypes" about ASD, such as the EMB theory, were shown to be unappreciated in a qualitative study conducted with adults with ASD and gender dysphoria (Coleman-Smith et al., 2020).

Apart from biological hypotheses, the literature has discussed differences in gender development between autistic and neurotypical people, obsessions originating from autistic traits and rigid thinking among individuals with gender dysphoria, and mentalizing impairments among autistic people leading to symptoms of gender dysphoria (Wattel et al., 2024). Although our study did not aim to investigate the underlying mechanisms, explaining this phenomenon solely through individual symptom clusters, such as obsessions, seems unlikely. This is supported by our results which indicate higher prevalence rates of various autistic traits, as also speculated by van der Miesen and colleagues (2018b). Furthermore, our findings contradict previous claims that increased levels of autistic traits among TGD individuals result from the misclassification of other symptoms (Fortunato et al., 2022; Turban and van Schalkwyk, 2018). Unlike the measurement of autistic traits using screening tools, ASD diagnoses are not expected to be over-reported or inflated due to other accompanying psychological difficulties. Our results on ASD diagnoses and autistic traits, showing a high co-occurrence of autism and gender dysphoria, align well with each other.

Evidence on the associations between ASD and characteristics of gender identity and gender dysphoria is scarce. A recent study involving TGD youth in Australia found no difference in gender identity, expression, and dysphoria between people with and without ASD (Tollit et al., 2024). Likewise, no differences in gender and sexuality profiles (Fischbach et al., 2024) or childhood gender nonconformity and gender dysphoria (Kallitsounaki and Williams, 2022) between autistic and non-autistic individuals have been reported. Our results, showing no significant associations between ASD diagnoses and self-reported levels of gender incongruence, are in line with these previous findings. The only significant association in this study was observed for AQ scores, which appear to be less sensitive in comparison to ASD diagnoses and the RAADS-14. This significant association might have been influenced by accompanying anxiety or related factors. Our findings do not support the idea that gender dysphoria and related experiences result from ASD, as previously discussed (Coleman-Smith et al., 2020). If gender dysphoria symptoms were manifestations of ASD, significant associations with gender incongruence would be expected. Furthermore, in our regression models, autism-related variables explained minimal variance in gender incongruence among individuals with gender dysphoria.

A major strength of our study is that we utilized both ASD diagnoses and two different screening tools for ASD together, each focusing on various dimensions. Having a cisgender control group is also a strength, as many studies lack this comparison. However, this study has also limitations. Even though national patient registers offer many advantages, they may not capture ASD diagnoses in certain cases, such as for individuals who moved to Sweden later in life and may not have been diagnosed. Given that the majority of participants in both groups were born in Sweden, this should not lead to misclassification that could bias our results. The screening tools for ASD used in our study were not specifically developed for TGD individuals and may not fully assess all aspects of ASD in this population. To our knowledge, no such tool is routinely used. Additionally, along with birth-assigned sex, gender identity is crucial for understanding the dynamics between ASD and gender dysphoria. Due to high levels of missing data, we were unable to incorporate gender identities in this study.

5. Conclusion

In the present study, we demonstrate that the prevalence rates of ASD diagnoses and autistic traits are higher among people with gender dysphoria compared to cisgender people. No association was found between having an ASD diagnosis and self-reported levels of gender incongruence among individuals with gender dysphoria. Our results support the high co-occurrence of ASD and gender dysphoria, but do not support the idea that gender dysphoria and related symptoms are manifestations of ASD.

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CRediT authorship contribution statement

Fatih Özel: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Richard A. White:** Writing – review & editing, Methodology, Conceptualization. **Kristen D. Clark:** Writing – review & editing, Conceptualization. **Malin Indremo:** Writing – review & editing, Conceptualization. **Isabelle Zejlon:** Writing – review & editing, Formal analysis, Conceptualization. **Joëlle Rüegg:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization. **Fotios C. Papadopoulos:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare no conflict of interest.

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