Gender, assigned sex at birth, and gender diversity:

Windows into diagnostic timing disparities in autism

Goldie A. McQuaid, PhD , Department of Psychology, George Mason University, Fairfax, VA, USA.
Allison B. Ratto, PhD, Center for Autism Spectrum Disorders, Division of Neuropsychology, Children's National Hospital, Washington, DC, USA.
Allison Jack, PhD, Department of Psychology, George Mason University, Fairfax, VA, USA.
Alexis Khuu, BS, Center for Autism Spectrum Disorders, Division of Neuropsychology, Children's National Hospital, Washington, DC, USA.
Jessica V. Smith, BS, Center for Autism Spectrum Disorders, Division of Neuropsychology, Children's National Hospital, Washington, DC, USA.
Sean C. Duane, BA, Department of Speech, Language, and Hearing Sciences, The George Washington University, Washington, DC, USA.
Ann Clawson, PhD, Gender and Autism Program, Children's National Hospital, Washington, DC, USA.
Nancy Raitano Lee, **PhD,** Department of Psychological and Brain Sciences, Drexel University, Philadelphia, PA, USA.
Alyssa Verbalis, PhD, Center for Autism Spectrum Disorders, Division of Neuropsychology, Children's National Hospital, Washington, DC, USA.
Kevin A. Pelphrey, PhD, Department of Neurology, University of Virginia School of Medicine, Charlottesville, VA, USA.
Lauren Kenworthy, PhD, Center for Autism Spectrum Disorders, Division of Neuropsychology, Children's National Hospital, Washington, DC, USA.
Gregory L. Wallace, PhD, Department of Speech, Language, and Hearing Sciences, The George Washington University, Washington, DC, USA.
John F. Strang, PsyD, Gender and Autism Program, Children's National Hospital, Washington, DC, USA.

Running title: Gender, assigned sex, and diagnosis age

Key words: age at diagnosis, autism, diagnosis, gender, sex

Manuscript word count (not including title, abstract, acknowledgment, references, tables, and figure legends): 4,420 words

Corresponding author: Goldie A. McQuaid, Psychology Department, George Mason University 4400 University Drive, 3F5 Fairfax, VA 22030, USA, gmcquaid@gmu.edu

Abstract

Objective

Later autism diagnosis is associated with increased mental health risks. Thus, understanding factors related to disparities in diagnostic timing is important to reduce psychiatric burden for autistic people at disproportionate risk for mental health problems. “Sex” has captured attention in relation to differences in timing in autism recognition and diagnosis. However, literature to date does not characterize, differentiate, or account for gender identity beyond assigned sex at birth. Consideration of gender is key, as gender diversity may be more common in autistic relative to neurotypical people, and autism is proportionally overrepresented in gender-diverse populations. We examined age at autism diagnosis by assigned sex at birth, gender identity, and gender diversity (gender-diverse vs. cisgender) status, separately.

Method

Three independent autistic cohorts representing different ascertainments were examined: a research-recruited academic medical center sample (*N*=193; aged 8.0-18.0y); a clinic-based sample (*N*=1550; 1.3-25.4y); and a community-enriched sample (*N*=244, 18.2-30.0y).

Results

Disparities in diagnostic timing were observed in the clinic-based and community-enriched samples: people assigned female at birth, people of female gender, and gender-diverse people were diagnosed with autism significantly later than persons assigned male at birth, persons of male gender, and cisgender persons, respectively.

Conclusion

Sex at birth, gender identity, and gender diversity may each uniquely relate to disparities in diagnostic timing of autism. The influence of ascertainment strategies, particularly in studies

examining assigned sex at birth or gender identity, should be considered. Further research into autism diagnosis in adulthood and the role of sociodemographic factors is needed.

Introduction

Earlier timing of an autism diagnosis is associated with better outcomes.[1,2] Conversely, later age at autism diagnosis is associated with elevated psychiatric comorbidity,[3,4] lower quality of life,[5] and increased self-harm.[6] Thus, understanding factors that may contribute to disparities in diagnostic timing may help reduce psychiatric burden and improve life outcomes in autistic people.

To date, a key variable that has been associated with delayed autism diagnosis is "female sex," though as described below, *studies have rarely differentiated assigned sex at birth versus gender identity*. Evidence indicates that people referred to as "female" in the literature (PRF; undifferentiated in prior research as to whether "female" refers to assigned sex at birth or gender) without co-occurring intellectual disability receive an autism diagnosis at a later age[4,7–9] and with greater difficulty[10,11] relative to people referred to as "male" (PRM; again, undifferentiated in the literature as to whether "male" refers to assigned sex at birth or gender). This literature demonstrates autistic PRF may manifest core autism features differently than autistic PRM.[12,13] For example, social communication features and restricted and repetitive behaviors and interests may present differently among autistic PRF.[14] Relative to autistic PRM, autistic PRF may show greater attention to social stimuli[15] and demonstrate higher social motivation.[16,17] Across the lifespan, autistic PRF may also evidence greater efforts to establish friendships and to "fit in" socially.[18] These potential differences in clinical presentations for PRF may impact referral and diagnosis.[19] Differences in autistic presentations may intersect with other, *external factors*—for instance, the predominance of young-cisgender-male conceptualizations of autism in patterns of referral,[20,21] clinical diagnostic training,[22] and research samples.[23]

Although increasing attention has been given to comparisons of PRF and PRM to help

explicate differences in timing in the recognition and diagnosis of autism, a key limitation of the extant literature is that it does not characterize, differentiate, or account for gender identity beyond assigned sex at birth (see[24,25]). Thus, although the literature describes potential differences in the presentation(s) of autistic PRF and how these may relate to diagnostic timing relative to autistic PRM, we do not know whether these studies' reporting of sex/gender refers to assigned sex at birth or gender identity.

Until very recently, scant attention was devoted to the potential distinctiveness of gender identity beyond assigned sex at birth. Considering gender identity is critical, however, as *gender diversity experiences and gender-diverse identities may be more common in autistic relative to neurotypical individuals, and autism is proportionally overrepresented in gender-diverse populations*.[26–31]

To elucidate disparities in diagnostic timing, it is crucial to consider both gender identity and assigned sex at birth independently (see[24,25]). Initial findings suggest that gender identity, assigned sex at birth, and gender diversity status (i.e., cisgender vs. gender-diverse) may each relate to differential phenotypic patterns in autistic people.[32] Further, there is emerging qualitative and quantitative evidence that autism may be later identified in some gender-diverse individuals,[32,33] and that patterns of first observed autism signs may vary by assigned sex at birth in transgender adolescents.[32]

Independent of the literature on diagnostic timing in PRF, a body of evidence indicates that autistic PRF report elevated co-occurring anxiety and depression relative to both autistic PRM[34–39] and neurotypical PRF.[38,40] Further, in a reversal of sex-based suicide rates in the general population,[41] autistic PRF are at greater risk of completed suicide relative to autistic PRM, and are 13 times more likely to die by suicide than non-autistic PRF.[42] Autistic gender-

diverse individuals are at heightened risk for mental health difficulties, above and beyond the risks of autistic and transgender populations independently.[43] Both autistic PRF and autistic gender-diverse individuals are at increased risk for physical and sexual abuse.[44–46] Enhanced risk for mental health problems is conferred, independently, by later age of autism diagnosis,[3,4,6,47] female "sex,"[34–39,42] female gender,[32] or gender diversity.[43,48,49] Later autism diagnosis among female and gender-diverse persons (and the corresponding eclipsed access to autism-related supports) may substantially elevate risk for psychiatric comorbidity and increase vulnerability to victimization.[19]

The current study seeks to address critical gaps in the literature on diagnostic timing in autism. For the first time (to our knowledge), we examine age at autism diagnosis simultaneously by assigned sex at birth, gender identity, and gender diversity (i.e., gender-diverse vs. cisgender) status. Our research questions are investigated across three independent cohorts that represent different ascertainment approaches, as well as age ranges, in order to enhance the robustness and generalizability of findings. The inclusion of datasets that span well into adulthood is critical for a study of autism diagnostic timing that investigates both assigned sex at birth *and* gender, as individuals often realize their gender diversity in adolescence or adulthood; younger recruitments may notably underrepresent and underidentify individuals who will ultimately discover their gender diversity later in development.

Specifically, we tested the following hypotheses.

Hypothesis 1: We hypothesize people assigned female at birth and people of female gender identity will be diagnosed significantly later than people assigned male at birth or of male gender identity, respectively. Critically, because previous studies of diagnostic timing have not distinguished assigned sex at birth and gender identity, this study explores patterns of diagnostic

timing by assigned sex at birth and gender, independently.

Hypothesis 2: Based on initial qualitative findings[33] and observations of international clinicians expert in both gender diversity and autism,[50] we hypothesize gender-diverse individuals will be diagnosed later than cisgender individuals.

Methods

The current study examined three samples that implemented different ascertainment strategies and recruited individuals from a range of developmental periods. Characteristics of these samples are presented in Table 1. Essential information concerning ascertainment strategies for each sample and respective inclusionary/exclusionary criteria as they relate to the current study are summarized below. See Supplemental Materials and Supplemental Table 1 for details of ascertainment procedures, and for additional characterization, where applicable, of participants.

Research-recruited academic medical center sample of autistic youth: GENDAAR

Autistic youth aged 8.0-18.0y were recruited using academic medical center research recruitment strategies for inclusion as part of Wave 1 of the 'GENDAAR' project (NIH Data Archive Data Collection #2021). A key component of recruitment for the GENDAAR cohort was its oversampling of youth assigned female sex at birth to achieve a sex-balanced study sample. Expert clinicians confirmed *Diagnostic and Statistical Manual of Mental Disorders*-based autism diagnoses using the Autism Diagnostic Interview-Revised (ADI-R),[51] and the diagnostic algorithm for module 3 or 4, as appropriate, of the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2).[52] Participants from the GENDAAR study included in the analyses reported here *either* met the ADI-R algorithm cut-off for each of the 3 domains *or*

diagnostic criteria according to the ADOS-2. If a participant met on the ADI-R and/or ADOS, but the clinician evaluated their presentation to be questionable, or inconsistent with a diagnosis of autism, the participant was excluded from analyses. For inclusion in analyses, a score of ≥70 on at least one scale of the Differential Abilities Scales, Second Edition (DAS-II)[53] was required. The GENDAAR sample in the current study was comprised of 193 autistic youth. A subsample of participants reported on here are also reported on elsewhere.[54]

Clinic-based sample of autistic youth and young adults: Children's National Hospital (CNH)

The CNH sample was obtained from a large (*N*>5,000) clinical sample of youth and young adults seen for clinical evaluation in an outpatient autism center and neuropsychology clinic. Participants were included in these analyses if they 1) had complete data available for date of autism diagnosis, assigned sex at birth, and gender; and 2) either received their initial diagnosis of autism at the time of evaluation, or in the case of gender-diverse autistic youth, had available documentation of the date of original autism diagnosis. All participants were diagnosed with autism by a clinician (psychologist or psychiatrist), with advanced training and expertise in autism and related conditions, based on *DSM-5*[55] diagnostic criteria, utilizing both developmental history and direct observation and clinical assessment.

The final CNH sample included 1,550 autistic persons ranging from 1.3 to 25.4y. Gender and gender diversity status were captured when communicated by the youth through oral report or in the assessment protocol. At the time of assessment, there was not a specific measure of gender for youth, as no measure had yet been validated to capture gender for autistic children.

In the CNH sample, apart from the gender-diverse autistic youth, participants with a prior diagnosis of autism were excluded from analyses, as age of diagnosis was not systematically collected for those who presented to the clinic with an established autism diagnosis. In the case

of gender-diverse autistic youth, a comprehensive record review was conducted for each individual to identify the initial date of autism diagnosis from previous evaluation reports and the electronic health record. This approach for retrospective age of diagnosis confirmation was required as many gender-diverse youth (and especially gender-diverse autistic youth[33]) do not realize their gender diversity until the teen years. Many of these young people are diagnosed with autism prior to "coming out"; therefore, including only that subset of gender-diverse youth who realize their gender diversity before they are diagnosed with autism would significantly bias the sample.

Community-enriched sample of autistic adults: SPARK

Autistic adults were recruited via Simons Powering Autism Research's (SPARK)[56] Research Match service as part of a broader online study of adult outcomes. This community-enriched sample consisted of 244 autistic adults aged 18.2-30.0y, which comprises a subset of those reported on elsewhere.[57] Participants with a self-disclosed professional diagnosis of autism were included in analyses reported here. SPARK does not independently confirm participants' autism diagnosis. However, SPARK partners with and recruits from expert autism clinical sites, in part, to increase the likelihood that participants have a professional community-based diagnosis autism.[56] A study examining the electronic health records of 254 SPARK participants confirmed an autism diagnosis in 98.8% of the sample;[58] this study concluded that the validity of reported autism diagnoses, including self-disclosed diagnoses, were confirmed with "high confidence."[58]

Measures

GENDAAR. As part of a demographics survey, families reported on their child's age of autism diagnosis and assigned sex at birth, and their child's ethno-racial identity. No information

concerning gender identity or gender diversity status was collected from the Wave 1 GENDAAR participants. Data were collected between 2012 and 2017.

CNH: As part of the clinical evaluation, families completed a demographics survey to provide information about assigned sex at birth, gender and gender identity, and race/ethnicity. CNH clinical evaluations for participants reported on here took place between 2013 and 2022.

SPARK: SPARK provided information collected from autistic adults concerning their age at autism diagnosis and assigned sex at birth. As part of a larger demographics survey, participants reported their gender identity. Data were collected during December 2019 and January 2020.

Categorization by gender

Due to small cell sizes, the gender of participants using gender descriptors other than binary female or male (e.g., gender non-conforming, gender queer, non-binary, another/other gender identity) was categorized as gender other than binary female or male. Gender-diverse participants reported a gender identity other than the sex assigned at birth. For the SPARK dataset, cisgender persons reported a gender identity identical to their sex assigned at birth. For the CNH dataset, the cisgender classification was given to all participants for whom there was no mention of gender differing from assigned sex at birth by the child or parent. Clearly, for younger children, and potentially some adolescents, the cisgender grouping might ultimately not be the correct classification because gender diversity self-awareness may emerge over time. It is also important to acknowledge that some autistic youth might not have been "out" to others, and so the cisgender group might have included some gender-diverse individuals, unknown to the clinician.

Ethics statement

GENDAAR. Parents provided written informed consent, and youth provided written assent. Procedures were conducted in compliance with ethical standards set forth by the universities' Institutional Review Boards (IRB). *CNH*. Archival data were used, and the study was conducted in compliance with standards established by the institution's IRB, including procedures for informed consent. *SPARK*. The study was approved by The George Washington University IRB. Across the three study samples, all procedures performed involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Data analysis

All analyses were conducted in R and are described in detail below.

Assigned sex at birth: Female, male

Within the three samples (GENDAAR, CNH, SPARK), independent samples t-tests were conducted to examine whether autistic participants assigned female at birth differed for age of autism diagnosis from those assigned male at birth. For these tests, the MKinfer package[59] in R was used, with *p*-values computed by Monte Carlo simulation using 10,000 replications.

Gender identity: Female, male

Within the CNH and SPARK samples, we additionally examined whether participants differed for age at autism diagnosis according to gender (female, male). Due to small sample sizes for participants within gender categories other than the binary female or binary male categories, the focus of analyses was on binary female and male genders; however, follow-up exploratory analyses examined whether female, male, and genders other than binary female or male in these samples differed for diagnostic timing. Independent samples *t*-tests with *p*-values

computed via Monte Carlo simulation with 10,000 replications compared age of autism diagnosis for binary female and male gender identities.

Gender identity exploratory analyses: Female, male, not binary female or male gender

In the CNH and SPARK samples, follow-up exploratory analyses were conducted via robust ANOVAs using the WRS2 package[60] in R, using the bootstrap (10,000 bootstrap samples) version of the ANOVA for trimmed means. Pairwise follow-up analyses used bootstrap testing to derive *p*-values adjusted for multiple comparisons using the false-discovery rate (FDR) approach, with $p<.05$ considered significant, and ξ (a robust, generalized form of Cohen's *d* that allows heteroscedasticity)[61] as the measure of effect size.

Gender diversity status: Gender-diverse, cisgender

Within the CNH and SPARK samples, independent samples *t*-tests with *p*-values computed via Monte Carlo simulation with 10,000 replications (using the MKinfer package[59] in R) examined whether cisgender and gender-diverse autistic individuals differed for diagnostic timing.

Results

Figure 1 visualizes diagnostic timing across the three samples for assigned sex at birth, and across the CNH and SPARK samples for gender identity and gender diversity status.

Assigned sex at birth: Female, male

GENDAAR. Compared to autistic youth assigned male at birth (M=5.58y), those assigned female at birth (M=6.25y) were diagnosed an average of 0.67y later, a difference that was not statistically significant (t=-1.24, p=.221, d=-.18).

CNH. Compared to autistic participants assigned male at birth (M=7.41y), autistic

participants assigned female at birth (M=8.67y) were diagnosed significantly later (t=-4.70, p<.00001, d=-.27), with a difference of 1.26y in mean age of diagnosis.

SPARK. Compared to autistic adults assigned male at birth (M=9.94y), those assigned female at birth (M=15.72y) received an autism diagnosis significantly later (t=-6.25, p<.00001, d=-0.82), on average 5.78y later.

Gender identity: Female, male

CNH. Compared to autistic individuals of male gender (M=7.34), autistic individuals of female gender (M=8.49) were diagnosed significantly later (t=-4.33, p<.00001, d=-0.25) , with a difference of 1.15y in mean age of diagnosis.

SPARK. Compared to autistic adults of male gender (M=10.81y), those of female gender (M=14.97y) were diagnosed significantly later (t=-4.24, p<.00001, d=-0.57), on average 4.16y later.

Gender identity exploratory analyses: Female, male, not binary female or male gender

CNH. Results showed a significant main effect for gender identity group (F(2,39.28)=24.53, p<.00001, ξ=0.57). Follow-up pairwise tests, adjusted for multiple comparisons, revealed that compared to those of male gender (M=7.34y), both those of female gender (M=8.49y; t=-4.31, p_{adj}<.0001, d=-0.25) and those with genders that were not binary female or male (M=13.45y; t=-6.69, p_{adj}<.00001, d=-1.28) received an autism diagnosis significantly later (with a mean difference in age of diagnosis of 1.15y and 6.11y, respectively). In addition, those with genders that were not binary were diagnosed significantly later than those of female gender (t=-4.66 p_{adj}<.00001, d=-0.98), on average 4.96y later.

SPARK. A significant main effect for gender identity group (F(2,66.5)=11.38, p<.0001, ξ=0.42) was found. Pairwise comparisons revealed that relative to those of male gender

(*M*=10.81y), those of female gender (*M*=14.97y; *t*=-4.08, p_{adj}<.01, *d*=-0.57) and those with genders that were not binary (*M*=16.78; *t*=-3.43, p_{adj}<.01, *d*=-0.79) were diagnosed with autism significantly later (average differences in age of diagnosis were 4.16y and 5.97y, respectively). Those participants with genders that were not binary were diagnosed an average of 1.81y later relative to those of female gender, a difference that was not statistically different (*t*=-1.13, p_{adj} =.258, *d*=-0.24).

Gender diversity status: Cisgender, gender-diverse

CNH. Relative to cisgender (*M*=7.33y) autistic individuals, gender-diverse (*M*=13.01y) individuals were diagnosed significantly later (*t*=-12.89, *p*<.00001, *d*=-1.20), with a difference of 5.68y in the mean age of diagnosis.

SPARK. Relative to cisgender (*M*=12.73y) adults, gender-diverse (*M*=16.73y) autistic adults were diagnosed significantly later (*t*=-3.12, *p*<.01, *d*=-0.53), on average 4.0y later.

Discussion

Supported by three independent samples, each of which involved differing developmental periods and implemented different recruitment strategies and autism diagnostic procedures, this study provides an unprecedented window into autism diagnostic disparities by investigating assigned sex at birth and gender, separately. Previous work has reported later age of autism diagnosis in people referred to as "female" (PRF) relative to people referred to as "male" (PRM)[11,62–65]; however, these studies did not differentiate gender from assigned sex at birth. Independent investigation of assigned sex at birth and gender identity revealed distinct patterns of results in analyses across samples. Findings reported elucidate the roles of female gender and female assigned sex at birth, independently, in later age of autism diagnosis.

A single study to date that has examined gender (but not sex assigned at birth) as a factor in diagnostic timing, found that, relative to male gender, female gender and gender that was not binary female or male predicted later age at autism diagnosis.[9] Results of the current study demonstrate that gender-diverse persons are diagnosed later than cisgender persons, and that persons with a gender that was not binary female or male were diagnosed significantly later than both persons of male gender and persons of female gender. The complexity and nuance of our findings illustrate the importance of actively and independently characterizing assigned sex at birth and gender in clinical research, particularly in autistic populations, as doing so yields distinctive insights. Given the proportional over-occurrence of gender diversity in autistic people and of autism and increased autistic traits in gender-diverse people,[26–31] it is vital that characterization of sociodemographic factors include both assigned sex at birth and gender identity.

The results reported here have additional important implications for research and clinical practice. In the research-recruited academic medical center sample, which used stringent inclusionary criteria, while those assigned female sex at birth were diagnosed later than those assigned male sex at birth, this difference was not statistically significant. This contrasts with findings showing significantly later age of diagnosis in persons assigned female at birth relative to those assigned male at birth in both the clinically- and community-enriched samples. These findings underscore the potential impacts of ascertainment and diagnostic procedures–even in studies that have oversampled for persons assigned female at birth, as in the research-recruited academic medical center sample. Thus, it is particularly important that ascertainment and diagnostic procedures be considered carefully in studies for which gender or assigned sex at birth are variables of interest.

Specifically, the use of inclusionary/exclusionary criteria yoked to cut-points on measures that were developed and validated based on predominantly young male samples, and that are known to underidentify female persons may introduce systematic bias into samples.[23,66] This bias in turn may artifactually limit the ability to detect gender or sex differences in the presentations and experiences of autism. Moreover, these biases may obscure veridical gender or sex differences, as autistic persons within such samples *may be more similar to one another because they have been passed through a filter that captures certain autism presentations while systematically missing others*.

Additionally, this study has identified that gender diversity is a predictor of later diagnosis. Therefore, studies of diagnostic timing moving forward should capture assigned sex at birth as well as gender and gender diversity. There is a complexity in terms of ascertaining diagnostic timing for gender-diverse people: Identifying the date of autism diagnosis itself is insufficient, as this date of diagnosis may precede when the person came to understand themselves as gender-diverse. Thus, in cross-sectional studies of diagnostic timing, careful consideration of the timing of diagnosis relative to when the person self-identified as a gender different from the sex assigned at birth is necessary. Broadly, the findings reported here suggest that whereas diagnostic clinics tend to focus on early years, there is a need for diagnostic clinics that span not only adolescence but across adulthood. In the case of gender diversity programs, which serve youth who often report significant autistic characteristics in their referrals,[27] it may be prudent for providers to refer more regularly for autism assessment given the later diagnostic timing of persons who are gender-diverse.

Findings of later autism diagnosis among gender-diverse individuals concord with descriptions from gender clinics of high numbers of youth with suspected, but not yet diagnosed,

autism (email communications, December 2022, with S. Leibowitz, MD, Director of the THRIVE Clinic gender program at Nationwide Children's Hospital and A.I.R. van der Miesen, MD PhD with the Center for Expertise on Gender Dysphoria at VU University, Amsterdam, The Netherlands). In fact, gender diversity may obfuscate autism-related signs in some children, as the social and behavioral differences observed in gender-diverse youth may be attributed solely to gender minority stress (i.e., societal stress associated with being gender-diverse). Clinical accounts from families with gender-diverse children in the Gender and Autism Program at Children's National (i.e., the first specialty clinic dedicated to the intersection of autism and gender diversity; personal communications, December 2022, with J. Strang, PsyD, Director of the Gender and Autism Program at Children's National Hospital and A. Clawson, PhD, neuropsychologist with the same program) support this as a possible driver of later autism diagnosis in some youth. Specifically, families describe that during development a great amount of attention focused on the gender-related experiences and needs of their children; after the gender-related needs were sufficiently supported, these families note that the social and behavioral challenges continued, and only then were they referred for autism-related assessment. International clinical guidance on the intersection of gender diversity and autism recommends screening all gender-diverse youth for autism,[67] given the significant proportional over-occurrence of autism in gender diversity (i.e., ~11% of gender-diverse individuals are autistic[31]). Yet, there is emerging evidence that autism-related screening measures may not function typically among gender-diverse youth.[68] Further, given that autism diagnostic measures were developed and normed in primarily cisgender male populations, it is unclear whether problems with autism diagnostic tools observed in girls and women[23] are also present for gender-diverse individuals.

Despite its notable strengths, this study has limitations. In the clinically- and community-enriched samples, relative to persons reporting a binary female or male gender, fewer people reported a gender that was not binary female or male. As such, the analyses on gender that included these persons were exploratory, and the results reported should be considered preliminary. In youth samples, because many gender-diverse people come to know their gender diversity later in development, we cannot know how many youth may be miscategorized. Additionally, in the clinically-enriched sample, although gender was captured as it was revealed in clinic, we cannot know if some gender-diverse youth lacked the privileged language to describe their identities[32,33] or if they felt uncomfortable sharing this information in the presence of family or the clinician. Future studies should employ an autism-friendly gender self-report measure to elucidate the role of gender and gender diversity in diagnostic timing in autism; the Gender Self-Report[69] may provide such a tool.

The current study also shows that for research studies investigating diagnostic timing, it is essential that samples span adolescence and into adulthood. *The ability to detect factors related to patterns in diagnostic timing is constrained by the age of the sample investigated*: Restricting the age range at the upper limit such that those persons in the sample have, relatively speaking, timely (i.e., earlier) diagnosis, systematically overlooks autistic people who are missed earlier in development but who go on to receive an autism diagnosis in adolescence or adulthood (i.e., later diagnosed people), who are disproportionately likely to be assigned female at birth and/or gender diverse.

Future studies examining diagnostic timing should study an age range that includes an adequate density of sampling among not only children, but also adolescents and adults. The phenotypic presentation of those diagnosed earlier versus later may differ in ways that can

inform diagnostic referral and assessment and ultimately help to reduce disparities in diagnostic timing and concomitant risks related to delayed autism diagnosis. Thus, understanding both socio-demographic characteristics as well as the presentations of autism associated with these characteristics are needed.

Characterization of samples that include examination of factors that also, separately, may contribute to differences in diagnostic timing (and that may distinguish the groups studied here) is needed. One such factor is cognitive ability. Across the three samples examined here, persons with co-occurring intellectual disability were largely absent. No measure of IQ was collected in the current study's community-enriched sample. In the research sample, autistic individuals with intellectual disability were excluded, and estimated IQ was typically in the average to high-average range. In the clinically-enriched sample, the collection of IQ was not a high priority, and IQ data were systematically missing for gender-diverse individuals. Recent work suggests that gender identity diversity is associated with higher scores on a polygenic index created based on its ability to explain significant variance in cognitive performance, with greater gender diversity associated with polygenic scores predicting higher IQ.[70] This finding is relevant to studies examining diagnostic timing in autism given indications that autistic people with higher IQ tend to be diagnosed later relative to those with lower IQ.[54,71] Thus, examination of IQ, in addition to gender and gender diversity, is needed to fully understand differential patterns of diagnostic timing in autistic transgender and non-binary people.

Studies of autism diagnostic timing must be interpreted within the context of not just who is included in a given sample, but also who is excluded. For example, cohorts comprised exclusively of autistic children and teens will (necessarily) fail to represent those who receive their diagnosis in adulthood - that is, those individuals potentially *most* impacted by delays in

diagnosis. Ultimately, it is only with the equitable inclusion of those people who are at greatest risk of being overlooked and underidentified earlier in development that we can fully understand and truly begin to address disparities in diagnostic timing.

Acknowledgements

GENDAAR sample: We thank all of the participating youth and families for their commitment and contributions to this project. Additionally, we would like to express our appreciation to the clinical and research staff who contributed to recruitment, data collection, and assessments.

CNH sample: We are grateful to all of the youth and families who shared their clinical data for use in this and other research. Furthermore, we wish to thank all of the clinical and research staff who enabled both the clinical care and data entry and management.

SPARK sample: We wish to express our gratitude to the autistic adults in SPARK, as well as the SPARK clinical sites, and SPARK staff. We appreciate obtaining access to recruit participants through SPARK Research Match on SFARI Base.

Funding

GENDAAR sample: This work was supported by a National Institute of Mental Health (NIMH) Autism Center of Excellence Network Award (R01 MH100028; PI: K.A.P.).

CNH sample: This research was supported by the Clinical and Translational Science Institute, Children's National (UL1TR001876), DC Intellectual and Developmental Disabilities Research Center (U54 HD090257) a National Institutes of Health Clinical and Translational Science Award (KL2TR001877, PI: J.F.S.), and a Fahs Beck Foundation Award (PI: J.F.S.).

SPARK sample: This research was supported by start-up funds from The George Washington University to G.L.W.

References

1. Mandell DS, Novak MM, Zubritsky CD. Factors associated with age of diagnosis among children with autism spectrum disorders. *Pediatrics*. 2005;116(6):1480-1486. doi:10.1542/peds.2005-0185
2. Fernell E, Eriksson, Gillberg C. Early diagnosis of autism and impact on prognosis: a narrative review. *Clin Epidemiol*. 2013;5:33. doi:10.2147/CLEP.S41714
3. Green RM, Travers AM, Howe Y, McDougle CJ. Women and autism spectrum disorder: Diagnosis and implications for treatment of adolescents and adults. *Curr Psychiatry Rep*. 2019;21(4):1-8. doi:10.1007/s11920-019-1006-3
4. Rødgaard E-M, Jensen K, Miskowiak KW, Mottron L. Childhood diagnoses in individuals identified as autistics in adulthood. *Mol Autism*. 2021;12(1):73. doi:10.1186/s13229-021-00478-y
5. Atherton G, Edisbury E, Piovesan A, Cross L. Autism through the ages: A mixed methods approach to understanding how age and age of diagnosis affect quality of life. *J Autism Dev Disord*. 2022;52(8):3639-3654. doi:10.1007/s10803-021-05235-x
6. Hosozawa M, Sacker A, Cable N. Timing of diagnosis, depression and self-harm in adolescents with autism spectrum disorder. *Autism*. 2021;25(1):70-78. doi:10.1177/1362361320945540
7. Giarelli E, Wiggins LD, Rice CE, et al. Sex differences in the evaluation and diagnosis of autism spectrum disorders among children. *Disabil Health J*. 2010;3(2):107-116. doi:10.1016/j.dhjo.2009.07.001
8. Begeer S, Mandell DS, Wijnker-Holmes B, et al. Sex differences in the timing of identification among children and adults with autism spectrum disorders. *J Autism Dev*

Disord. 2013;43(5):1151-1156. doi:10.1007/s10803-012-1656-z

9. Huang Y, Arnold SRC, Foley K-R, Lawson LP, Richdale AL, Trollor JN. Factors associated with age at autism diagnosis in a community sample of Australian adults. *Autism Res*. 2021;14(12):2677-2687. doi:https://doi.org/10.1002/aur.2610
10. Lai M-C, Baron-Cohen S. Identifying the lost generation of adults with autism spectrum conditions. *The Lancet Psychiatry*. 2015;2(11):1013-1027. doi:10.1016/S2215-0366(15)00277-1
11. Gesi C, Migliarese G, Torriero S, et al. Gender differences in misdiagnosis and delayed diagnosis among adults with autism spectrum disorder with no language or intellectual disability. *Brain Sci*. 2021;11(7). doi:10.3390/brainsci11070912
12. Lai M-C, Lombardo M V., Auyeung B, Chakrabarti B, Baron-Cohen S. Sex/gender differences and autism: Setting the scene for future research. *J Am Acad Child Adolesc Psychiatry*. 2015;54(1):11-24. doi:10.1016/j.jaac.2014.10.003
13. Werling DM, Geschwind DH. Sex differences in autism spectrum disorders. *Curr Opin Neurol*. 2013;26(2):146-153. doi:10.1097/WCO.0b013e32835ee548
14. McFayden TC, Albright J, Muskett AE, Scarpa A. Brief report: Sex differences in ASD diagnosis—A brief report on restricted interests and repetitive behaviors. *J Autism Dev Disord*. 2019;49(4):1693–1699. doi:10.1007/s10803-018-3838-9
15. Harrop C, Jones D, Zheng S, Nowell SW, Boyd BA, Sasson N. Sex differences in social attention in autism spectrum disorder. *Autism Res*. 2018;11(9):1264-1275. doi:https://doi.org/10.1002/aur.1997
16. Sedgewick F, Hill V, Yates R, Pickering L, Pellicano E. Gender differences in the social motivation and friendship experiences of autistic and non-autistic adolescents. *J Autism*

Dev Disord. 2016;46(4):1297-1306. doi:10.1007/s10803-015-2669-1

17. Burrows CA, Grzadzinski RL, Donovan K, et al. A data-driven approach in an unbiased sample reveals equivalent sex ratio of autism spectrum disorder–Associated impairment in early childhood. *Biol Psychiatry*. 2022;92(8):654-662. doi:10.1016/j.biopsych.2022.05.027
18. Lawson LP. Sex differences in autism spectrum disorders across the lifespan. *Curr Dev Disord Reports*. 2019;6(2):57-66. doi:10.1007/s40474-019-00164-y
19. Bargiela S, Steward R, Mandy W. The experiences of late-diagnosed women with autism spectrum conditions: An investigation of the female autism phenotype. *J Autism Dev Disord*. 2016;46(10):3281-3294. doi:10.1007/s10803-016-2872-8
20. Whitlock A, Fulton K, Lai M-C, Pellicano E, Mandy W. Recognition of girls on the autism spectrum by primary school educators: An experimental study. *Autism Res*. 2020;13(8):1358-1372. doi:https://doi.org/10.1002/aur.2316
21. Loomes R, Hull L, Mandy WPL. What is the male-to-female ratio in autism spectrum disorder? A systematic review and meta-analysis. *J Am Acad Child Adolesc Psychiatry*. 2017;56(6):466-474. doi:10.1016/j.jaac.2017.03.013
22. Lockwood Estrin G, Milner V, Spain D, Happé F, Colvert E. Barriers to autism spectrum disorder diagnosis for young women and girls: A systematic review. *Rev J Autism Dev Disord*. 2020;8(4):454-470. doi:10.1007/s40489-020-00225-8
23. D'Mello AM, Frosch IR, Li CE, Cardinaux AL, Gabrieli JDE. Exclusion of females in autism research: Empirical evidence for a "leaky" recruitment-to-research pipeline. *Autism Res*. 2022;15(10):1929-1940. doi:https://doi.org/10.1002/aur.2795
24. Lai M-C, Lin H-Y, Ameis SH. Towards equitable diagnoses for autism and attention-

deficit/hyperactivity disorder across sexes and genders. *Curr Opin Psychiatry*. 2022;35(2):90-100. doi:10.1097/YCO.0000000000000770

25. Strang JF, van der Miesen A, Caplan R, Hughes C, DaVanport S, Lai M-C. Both sex- and gender-related factors should be considered in autism research and clinical practice. *Autism*. 2020;24(3):539-543. doi:10.1177/1362361320913192

26. Warrier V, Greenberg DM, Weir E, et al. Elevated rates of autism, other neurodevelopmental and psychiatric diagnoses, and autistic traits in transgender and gender-diverse individuals. *Nat Commun*. 2020;11(1):1-12. doi:10.1038/s41467-020-17794-1

27. van der Miesen A, Hurley H, De Vries ALC. Gender dysphoria and autism spectrum disorder: A narrative review. *Int Rev Psychiatry*. 2016;28(1):70-80. doi:10.3109/09540261.2015.1111199

28. Stagg SD, Vincent J. Autistic traits in individuals self-defining as transgender or nonbinary. *Eur Psychiatry*. 2019;61:17-22. doi:10.1016/j.eurpsy.2019.06.003

29. Hisle-Gorman E, Landis CA, Susi A, et al. Gender dysphoria in children with autism spectrum disorder. *LGBT Heal*. 2019;6(3):95-100. doi:10.1089/lgbt.2018.0252

30. Strauss P, Cook A, Winter S, Watson V, Wright Toussaint D, Lin A. *Trans Pathways: The Mental Health Experiences and Care Pathways of Trans Young People*.; 2017.

31. Kallitsounaki A, Williams DM. Autism spectrum disorder and gender dysphoria/incongruence. A systematic literature review and meta-analysis. *J Autism Dev Disord*. Published online May 20, 2022. doi:10.1007/s10803-022-05517-y

32. Strang JF, Anthony LG, Song A, et al. In addition to stigma: Cognitive and autism-related predictors of mental health in transgender adolescents. *J Clin Child Adolesc Psychol*.

2023;52(2):212-229. doi:10.1080/15374416.2021.1916940

33. Strang JF, Powers MD, Knauss M, et al. “They thought it was an obsession”: Trajectories and perspectives of autistic transgender and gender-diverse adolescents. *J Autism Dev Disord*. 2018;48(12):4039-4055. doi:10.1007/s10803-018-3723-6

34. Mandy W, Chilvers R, Chowdhury U, Salter G, Seigal A, Skuse D. Sex differences in autism spectrum disorder: Evidence from a large sample of children and adolescents. *J Autism Dev Disord*. 2012;42(7):1304-1313. doi:10.1007/s10803-011-1356-0

35. Solomon M, Miller M, Taylor SL, Hinshaw SP, Carter CS. Autism symptoms and internalizing psychopathology in girls and boys with autism spectrum disorders. *J Autism Dev Disord*. 2012;42(1):48-59. doi:10.1007/s10803-011-1215-z

36. Sedgewick F, Leppanen J, Tchanturia K. Gender differences in mental health prevalence in autism. *Adv Autism*. 2021;7(3):208-224. doi:10.1108/AIA-01-2020-0007

37. Uljarević M, Hedley D, Rose-Foley K, et al. Anxiety and depression from adolescence to old age in autism spectrum disorder. *J Autism Dev Disord*. 2020;50(9):3155-3165. doi:10.1007/s10803-019-04084-z

38. Oswald TM, Winter-Messiers MA, Gibson B, Schmidt AM, Herr CM, Solomon M. Sex differences in internalizing problems during adolescence in autism spectrum disorder. *J Autism Dev Disord*. 2016;46(2):624-636. doi:10.1007/s10803-015-2608-1

39. Lever AG, Geurts HM. Psychiatric co-occurring symptoms and disorders in young, middle-aged, and older adults with autism spectrum disorder. *J Autism Dev Disord*. 2016;46(6):1916-1930. doi:10.1007/s10803-016-2722-8

40. South M, Beck JS, Lundwall R, et al. Unrelenting depression and suicidality in women with autistic traits. *J Autism Dev Disord*. 2020;50(10):3606-3619. doi:10.1007/s10803-

019-04324-2

41. Osterman MJK, Martin JA. *National Vital Statistics Reports, Volume 63, Number 6*. Vol 63(6).; 2014. Accessed November 5, 2018. https://www.cdc.gov/

42. Hirvikoski T, Mittendorfer-Rutz E, Boman M, Larsson H, Lichtenstein P, Bölte S. Premature mortality in autism spectrum disorder. *Br J Psychiatry*. 2016;208(03):232-238. doi:10.1192/bjp.bp.114.160192

43. Strauss P, Cook A, Watson V, et al. Mental health difficulties among trans and gender diverse young people with an autism spectrum disorder (ASD): Findings from Trans Pathways. *J Psychiatr Res*. 2021;137:360-367. doi:10.1016/j.jpsychires.2021.03.005

44. Brown-Lavoie SM, Viecili MA, Weiss JA. Sexual knowledge and victimization in adults with autism spectrum disorders. *J Autism Dev Disord*. 2014;44(9):2185-2196. doi:10.1007/s10803-014-2093-y

45. Ohlsson Gotby V, Lichtenstein P, Långström N, Pettersson E. Childhood neurodevelopmental disorders and risk of coercive sexual victimization in childhood and adolescence - a population-based prospective twin study. *J Child Psychol Psychiatry*. 2018;59(9):957-965. doi:10.1111/jcpp.12884

46. Brown KR, Peña EV, Rankin S. Unwanted sexual contact: Students with autism and other disabilities at greater risk. *J Coll Stud Dev*. 2017;58(5):771-776. doi:10.1353/csd.2017.0059

47. Mandy W, Midouhas E, Hosozawa M, Cable N, Sacker A, Flouri E. Mental health and social difficulties of late-diagnosed autistic children, across childhood and adolescence. *J Child Psychol Psychiatry*. 2022;63(11):1405-1414. doi:10.1111/jcpp.13587

48. Murphy J, Prentice F, Walsh R, Catmur C, Bird G. Autism and transgender identity:

Implications for depression and anxiety. *Res Autism Spectr Disord*. 2020;69:101466. doi:10.1016/j.rasd.2019.101466

49. Hall JP, Batza K, Streed CG, Boyd BA, Kurth NK. Health disparities among sexual and gender minorities with autism spectrum disorder. *J Autism Dev Disord*. 2020;50(8):3071-3077. doi:10.1007/s10803-020-04399-2

50. Strang JF, Kenworthy L, Lawson W, Namur V, van der Miesen A, Wimms H. World Professional Association for Transgender Health Global Education Institute (WPATH GEI) Neurodiversity Workshop. Published online 2022:July 22, 2022.

51. Rutter M, Le Couteur A, Lord C. *Autism Diagnostic Interview-Revised*. Western Psychological Services; 2003.

52. Lord C, Rutter M, DiLavore P, Risi S, Gotham K, Bishop SL. *Autism Diagnostic Observation Schedule–2nd Edition (ADOS-2) Manual (Part I): Modules 1-4*. Western Psychological Services; 2012.

53. Elliott CD. *Differential Ability Scales, 2nd Edition*. The Psychological Corporation; 2007.

54. Harrop C, Libsack E, Bernier R, et al. Do biological sex and early developmental milestones predict the age of first concerns and eventual diagnosis in autism spectrum disorder? *Autism Res*. 2021;14(1):156-168. doi:10.1002/aur.2446

55. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. 5th ed.; 2013.

56. The SPARK Consortium. SPARK: A US cohort of 50,000 families to accelerate autism research. *Neuron*. 2018;97(3):488-493. doi:10.1016/j.neuron.2018.01.015

57. McQuaid GA, Lee NR, Wallace GL. Camouflaging in autism spectrum disorder: Examining the roles of sex, gender identity, and diagnostic timing. *Autism*.

2022;26(2):552-559. doi:10.1177/13623613211042131

58. Fombonne E, Coppola L, Mastel S, O'Roak BJ. Validation of autism diagnosis and clinical data in the SPARK cohort. *J Autism Dev Disord*. 2022;52(8):3383-3398. doi:10.1007/s10803-021-05218-y

59. Kohl M. MKinfer. Published online 2022. https://www.stamats.de

60. Mair P, Wilcox R. Robust statistical methods in R using the WRS2 package. *Behav Res Methods*. 2020;52(2):464-488. doi:10.3758/s13428-019-01246-w

61. Wilcox RR, Tian TS. Measuring effect size: A robust heteroscedastic approach for two or more groups. *J Appl Stat*. 2011;38(7):1359-1368. doi:10.1080/02664763.2010.498507

62. Russell G, Stapley S, Newlove-Delgado T, et al. Time trends in autism diagnosis over 20 years: A UK population-based cohort study. *J Child Psychol Psychiatry*. 2022;63(6):674-682. doi:https://doi.org/10.1111/jcpp.13505

63. McCormick CEBB, Kavanaugh BC, Sipsock D, et al. Autism heterogeneity in a densely sampled U.S. Population: Results from the first 1,000 participants in the RI-CART Study. *Autism Res*. 2020;13(3):474-488. doi:10.1002/aur.2261

64. Fusar-Poli L, Brondino N, Politi P, Aguglia E. Missed diagnoses and misdiagnoses of adults with autism spectrum disorder. *Eur Arch Psychiatry Clin Neurosci*. 2020;1:3. doi:10.1007/s00406-020-01189-w

65. Russell G, Steer C, Golding J. Social and demographic factors that influence the diagnosis of autistic spectrum disorders. *Soc Psychiatry Psychiatr Epidemiol*. 2011;46(12):1283-1293. doi:10.1007/s00127-010-0294-z

66. Mo K, Sadoway T, Bonato S, et al. Sex/gender differences in the human autistic brains: A systematic review of 20 years of neuroimaging research. *NeuroImage Clin*.

2021;32:102811. doi:https://doi.org/10.1016/j.nicl.2021.102811

67. Strang JF, Meagher H, Kenworthy L, et al. Initial clinical guidelines for co-occurring autism spectrum disorder and gender dysphoria or incongruence in adolescents. *J Clin Child Adolesc Psychol*. 2018;47(1):105-115. doi:10.1080/15374416.2016.1228462

68. Leef JH, Brian J, VanderLaan DP, et al. Traits of autism spectrum disorder in school-aged children with gender dysphoria: A comparison to clinical controls. *Clin Pract Pediatr Psychol*. 2019;7(4):383-395. doi:10.1037/cpp0000303

69. Strang JF, Wallace GL, Michaelson JJ, et al. The Gender Self-Report: A multidimensional gender characterization tool for gender-diverse and cisgender youth and adults. *Am Psychol*. Published online January 30, 2023. doi:10.1037/amp0001117

70. Thomas TR, Tener AJ, Pearlman AM, et al. Dimensional gender diversity is associated with greater polygenic propensity for cognitive performance and interacts with other genetic factors in predicting health outcomes. *medRxiv*. Published online 2022. doi:https://doi.org/10.1101/2021.11.22.21266696

71. Saban-Bezalel R, Zachor DA, Ben-Itzchak E. Relationship between cognitive ability and predictors for age at the time of autism spectrum disorder diagnosis. *Psychiatry Res*. 2022;315:114696. doi:10.1016/j.psychres.2022.114696

Table 1. Participant characteristics: GENDAAR, CNH, and SPARK samples

	GENDAAR (*N*=193)	**CNH** (*N*=1550)	**SPARK** (*N*=244)	**Test statistic**[a]	***p*-value**	**Effect size**	**Significant post hoc contrasts**[a]
Age at diagnosis, y				$F(2,1984)=$ 161.80	.0001	$\eta^2=0.14$	GENDAAR < CNH < SPARK
Mean (SD)	5.88 (3.70)	7.71 (4.57)	13.40 (7.63)				
Median (Range)	5.0 (1.33-17.0)	6.50 (1.30-25.36)	12.50 (1.33-29.33)				
Age at assessment, y				$t(435)=-38.72$	<.00001	$d=-3.77$	
Mean (SD)	12.61 (2.91)	--	24.67 (3.47)				
Median (Range)	12.42 (8.0-18.0)		25.17 (18.17-30.00)				
Gender, *n* (%)	--			$\chi^2(2)=132.61$	<.0001	$V=0.27$[b]	
Female		372 (24.00%)	116 (47.54%)				
Male		1154 (74.45%)	103 (42.21%)				
Genders that are not binary female or male		24 (1.55%)	25 (10.25%)				
Assigned sex at birth, n (%)				$\chi^2(1)=148.02$	<.0001	$V=0.27$	GENDAAR > CNH; SPARK > CNH; SPARK > GENDAAR
Female	86 (44.56%)	372 (24.00%)	146 (59.84%)				
Male	107 (55.44%)	1177 (75.94%)	98 (40.16%)				
No binary designated sex related to variations in sex traits/intersex	--	1 (0.06%)	--				
Gender identity, *n* (%)				$\chi^2(1)=28.91$	<.0001	$V=0.13$	
Gender-diverse		104 (6.71%)	41 (16.80%)				
Cisgender		1446 (93.29%)	203 (83.20%)				
Ethno-racial identity, *n* (%)[c]							
Black	9 (4.66%)	274 (17.68%)	5 (2.05%)				
Asian	6 (3.11%)	120 (7.74%)	2 (0.82%)				
More than one race[d]	32 (16.58%)	109 (7.03%)	24 (9.84%)				
Native American/Native Alaskan[e]	1 (0.52%)	0 (0%)	2 (0.82%)				
Native Hawaiian/Pacific Islander[f]	1 (0.52%)	1 (0.06%)	0 (0%)				
White	142 (73.57%)	578 (37.29%)	203 (83.20%)				
Missing/Unknown/Other	2 (1.04%)	289 (18.65%)	8 (3.28%)				
Latina/o/e[h]	30 (15.54%)	179 (11.55%)	31 (12.70%)				
Not Latina/o/e	161 (83.42%)		210 (86.07%)				
Latina/o/e/ status missing/unknown	2 (1.04%)		3 (1.23%)				

[a] For the independent samples *t*-test, *p*-values were computed by Monte Carlo simulation using 10,000 replications. A robust ANOVA used 10,000 bootstrap samples, and follow-up comparisons used pairwise permutation testing to derive *p*-values adjusted for multiple comparisons using the false-discovery rate (FDR) approach with values $p < .05$ considered significant. The Chi-square test of independence *p*-values were computed by Monte Carlo simulation with 10,000 replicates.

[b] Comparisons of samples for assigned sex at birth are for female, male.

[c] As reflected in the table, ethno-racial identity was queried differently in the three samples. Note that in the CNH sample, unlike in the GENDAAR and SPARK sample characterizations, *Latina,o,e* is not exclusive of race. Given differences in the ways in which ethno-racial identity was queried in the three samples, we provide descriptive statistics but no comparison(s) across the samples.

[d] This category was termed "More than one race" in GENDAAR and SPARK, and "Mixed" in CNH.
[e] This category was termed “American Indian/Alaska Native” in GENDAAR, “Native American/Alaska Native" in SPARK, and "American Indian" in CNH.
[f] This category was termed "Native Hawaiian/Pacific Islander" in GENDAAR, "Native Hawaiian or other Pacific Islander" in SPARK, and "Pacific Islander" in CNH.
[g] This category was termed "Hispanic or Latino descent" in GENDAAR and SPARK, and “Hispanic” in CNH.

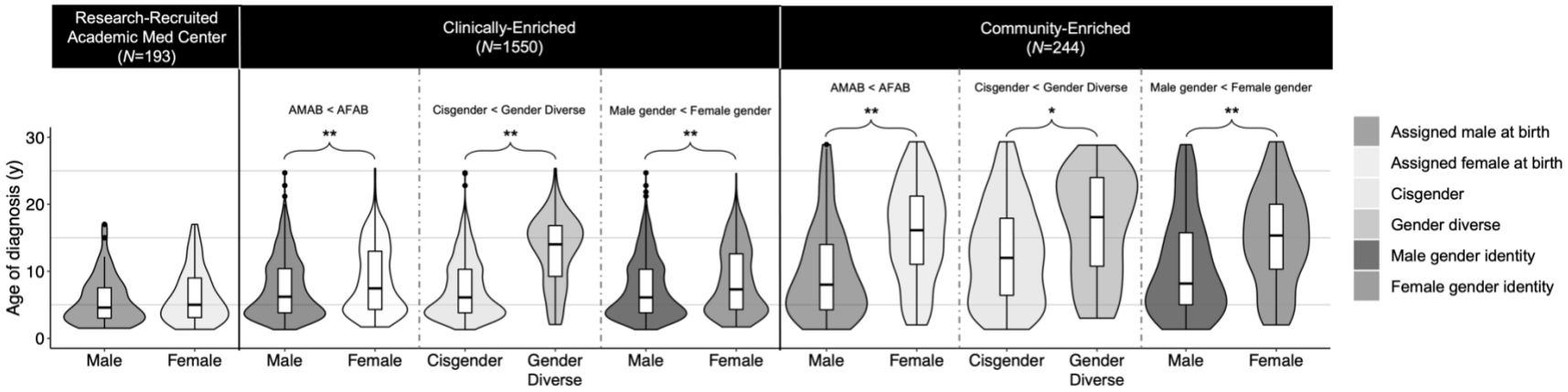

Figure 1. Diagnostic timing by assigned sex at birth (male, female), gender diversity status (cisgender, gender-diverse), gender (male, female): Disparities in clinically-enriched and community-enriched samples. AMAB=assigned male at birth; AFAB=assigned female at birth. *= $p<.01$, ** $p<.00001$.

SUPPLEMENTAL MATERIALS

Additional information concerning ascertainment and participant characteristics for each of the three study samples is reported below.

Research-recruited academic medical center sample of autistic youth: GENDAAR

The GENDAAR study included four data collection sites (Yale University, University of Washington, Boston Children's Hospital/Harvard Medical School, and University of California, Los Angeles), a data coordinating center at the University of Southern California, and a data analytic and study coordination center at the University of Virginia.

Participants for whom age of autism diagnosis was recorded as ≤12 months were excluded from analyses. The broader GENDAAR study's exclusionary criteria included co-occurring intellectual disability. FSIQ was estimated via the Differential Abilities Scales, Second Edition (DAS-II)[1] General Conceptual Ability Standard Score, and an FSIQ >70 was an criterion for inclusion in the broader study. For the current study, to be more inclusive of participants recruited into GENDAAR, youth with a score of ≥70 on any single DAS-II subscale were included analyses reported here.

See Supplemental Table 1 for additional characteristics of the GENDAAR sample. For further information concerning inclusionary/exclusionary criteria for the broader GENDAAR study see[2–4] inter alia.

Clinic-based sample of autistic youth and young adults: Children's National Hospital (CNH)

Of the 1550 youth and young adults, 1235 were administered the Autism Diagnostic Observation Schedule (ADOS)[5] or its recent revision, the ADOS-2[6], with 78.29% (1212/1550) of the total sample meeting criteria for an ASD and 1.48% (23/1550) not meeting criteria. Out of the total sample, 90.58% (1404/1550) did not have Autism Diagnostic Interview, Revised (ADI-

R[7]) information available. Of those with available ADI information, 7.94% (123/1550) met criteria, and 1.48% (23/1550) did not meet ADI criteria.

As detailed in the Methods, all participants received an autism diagnosis from a psychologist or psychiatrist with advanced training and expertise in autism and related conditions. This diagnosis utilized both developmental history and direct observation and clinical assessment and was made based on based on *DSM-5*[8] diagnostic criteria.

Diagnostic information was entered by the evaluating clinician directly into the database, and the clinician was prompted by the data entry system to indicate for each diagnosis entered whether this was a new/first-time diagnosis (i.e., the child did not have a diagnosis of ASD before the visit). Given that this was a clinical sample, information about family income and parental education were not systematically collected and thus are not reported.

Community-enriched sample of autistic adults: SPARK

Participants were "independent adults," which SPARK designates as individuals ≥18y without a court-appointed legal guardian, and therefore able to consent for themselves. Given SPARK's criteria for the determination of "independent adult" status, participants are unlikely to have a co-occurring intellectual disability. Consistent with this, and as part of medical history collected in the present study, no participant self-disclosed a past or current diagnosis of intellectual disability.

As part of a demographics survey participants also reported on current household income, their highest level of education, and highest level of parental education, and these variables are summarized in Supplemental Table 1.

Consistent with the self-disclosed clinical diagnoses of participants in the current study, 90% of the sample with scores on the Autism Spectrum Quotient-Short Form (AQ-28)[9] (*n*=240)

met AQ-28 screening criteria (total score of >65).

Supplemental Table 1. Additional characterization of the research-recruited academic medical center recruited (GENDAAR) and community-enriched (SPARK) samples

A. GENDAAR Sample	*N*=193
IQ: Differential Abilities Scales, Second Edition (DAS-II)	
Full-scale IQ	
Mean (SD)	100.7 (20.03)
Median (Range)	99 (47-167)
Verbal IQ	
Mean (SD)	100.95 (21.33)
Median (Range)	102 (31-159)
Non-verbal IQ	
Mean (SD)	101 (18.25)
Median (Range)	100 (51-158)
Spatial IQ	
Mean (SD)	99.01 (17.47)
Median (Range)	97 (51-158)
Diagnostic assessment/ confirmation, *n* (%)	
Met ADOS-2	
Yes	179 (92.75%)
No	14 (7.25%)
Met ADI-R	
Yes	180 (93.26%)
No	13 (6.74%)
Met ADOS-2 & ADI-R	
Yes	166 (86.01%)
No	27 (13.99%)
Total household income, *n* (%)	
$5,001-$10,000	2 (1.03%)
$10,001-$15,000	5 (2.60%)
$15,001-$25,000	5 (2.60%)
$25,001-$35,000	9 (4.66%)
$35,001-$50,000	12 (6.22%)

$50,001-$75,000	15 (7.77%)
$75,001-$100,000	19 (9.84%)
$100,001-$150,000	20 (10.36%)
>$150,000	33 (17.10%)
Not reported	73 (37.82%)
Parental highest level of education, *n* (%)	
Associate's degree/Some college	39 (20.20%)
Bachelor's degree	45 (23.32%)
GED	2 (1.04%)
Graduate degree	71 (36.79%)
High school diploma	10 (5.18%)
Less than high school	2 (1.04%)
Some graduate work	10 (5.18%)
Not reported	14 (7.25%)

B. SPARK sample	*N*=244
Participant highest level of education, *n* (%)	
Associate's degree/some college	88 (36.07%)
Bachelor's degree	44 (18.03%)
GED	10 (4.10%)
Graduate/professional degree	13 (5.32%)
High school diploma	66 (27.05%)
Some high school	7 (2.87%)
Trade or vocational school	16 (6.56%)
Total household income, *n* (%)	
<$20,000	81 (33.20%)
$21,000-$35,000	41 (16.80%)
$36,000-$50,000	22 (9.01%)
$51,000-$65,000	12 (4.92%)
$66,000-$80,000	14 (5.74%)
$81,000-$100,000	9 (3.69%)
$101,000- $130,000	8 (3.28%)
$131,000-$160,000	5 (2.05%)

>$160,0009	3 (1.23%)
Unknown/Prefer not to answer	49 (20.08%)
Parental highest level of education, *n* (%)	
Associate's degree/some college	49 (20.08%)
Bachelor's degree	62 (25.41%)
GED	5 (2.05%)
Graduate/professional degree	67 (27.46%)
High school diploma	38 (15.57%)
Some high school	4 (1.64%)
Trade or vocational school	11 (4.51%)
Not reported	8 (3.28%)

Note. ADOS-2=Autism Diagnostic Observation Schedule, Second Edition; ADI-R=Autism Diagnostic Interview, Revised

Supplemental Materials References

1. Elliott CD. *Differential Ability Scales, 2nd Edition*. The Psychological Corporation; 2007.
2. Jack A, Sullivan CAW, Aylward E, et al. A neurogenetic analysis of female autism. *Brain*. 2021;144(6):1911-1926. doi:10.1093/brain/awab064
3. Lawrence KE, Hernandez LM, Bowman HC, et al. Sex differences in functional connectivity of the salience, default mode, and central executive networks in youth with ASD. *Cereb Cortex*. 2020;30(9):5107-5120. doi:10.1093/cercor/bhaa105
4. Harrop C, Libsack E, Bernier R, et al. Do biological sex and early developmental milestones predict the age of first concerns and eventual diagnosis in autism spectrum disorder? *Autism Res*. 2021;14(1):156-168. doi:10.1002/aur.2446
5. Lord C, Rutter M, DiLavore PC, Risi S. *Autism Diagnostic Observation Schedule (ADOS)*. Western Psychological Services; 2000.
6. Lord C, Rutter M, DiLavore P, Risi S, Gotham K, Bishop SL. *Autism Diagnostic Observation Schedule–2nd Edition (ADOS-2) Manual (Part I): Modules 1-4*. Western Psychological Services; 2012.
7. Rutter M, Le Couteur A, Lord C. *Autism Diagnostic Interview-Revised*. Western Psychological Services; 2003.
8. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. 5th ed.; 2013.
9. Hoekstra RA, Vinkhuyzen AAE, Wheelwright S, et al. The construction and validation of an abridged version of the Autism-Spectrum Quotient (AQ-Short). *J Autism Dev Disord*. 2011;41(5):589-596. doi:10.1007/s10803-010-1073-0