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Missed and Prior Diagnoses in Children Later Diagnosed with Autism

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Abstract

Awareness of autism is rising, yet social determinants of health continue to impact rates, ages of diagnosis, and diagnostic load. Different psychiatric labels carry stigmas; unequal rates of diagnoses may indicate biases in the healthcare system. This study investigates six prior diagnoses (ADHD, disorders of conduct, adjustment, anxiety, mood, and intellectual disability) assigned to children who are later diagnosed with autism. The study investigates how race, sex, and geographic factors were associated with age of diagnosis and diagnostic load. This study utilized a sample of 13,850 children aged 2-10 who were diagnosed with autism on Missouri Medicaid between 2015 and 2019. The sample was 78.16% male and 14.43 % Black, with 57.95% of children living in urban regions of the state. Results indicated that being White, living urban, and having more prior diagnoses was associated with older age of autism diagnosis, $F(4, 12229) = 577.25$, $p < .001$. Using logistic regressions, being White was associated with a child being more likely diagnosed with all prior diagnoses aside from intellectual disability. Being male was related to a higher likelihood of ADHD, but lower likelihood of intellectual disability. Findings showed that living rural was related to a higher likelihood of ADHD, Conduct, and intellectual disability diagnosis. Overall, being White was associated with older age of diagnosis and higher likelihood of most diagnoses, even in urban-only samples, potentially reflecting more access to providers and more office visits. Living in rural areas was also associated with earlier diagnosis and more prior diagnoses such as ADHD and conduct, which may be due to types of providers or specialists seen. Future research should look at barriers to diagnosis and the advantages and disadvantages of a higher diagnostic load.

Missed and Prior Diagnoses in Children Later Diagnosed with Autism

Autism is a complex neurodevelopmental disability involving an array of symptoms, including difficulties with social skills and communication, as well as certain motor stereotypies and rigid behaviors (APA, 2013). Many autistic children and adults also display significant atypical sensory responses to the environment (APA, 2013). Diagnostic rates of autism have been rising significantly in the past 20 years (Nevison & Zahorodny, 2019), with researchers pointing to many theorized reasons. These include efforts to increase diagnostic service availability (Gordon-Lipkin et al., 2016; Mazurek et al., 2019; Rotholz et al., 2017), increased awareness, expanded diagnoses (Fombonne, 2020), decreased stigma (Grinker, 2020), improved diagnosis in racial/ethnic minorities (Nevison & Zahorodny, 2019) and other factors. Autism can be reliably diagnosed around 2 years old (Rogers, 2000), but the average age of diagnosis in the United States is around 4 - 5 years old (Shaw et al., 2021; Maenner et al., 2020; Zwaigenbaum & Penner, 2018), approximately aligned with school entry. Within the field, proper linguistic terms are changing rapidly. In this paper, the author uses “autistic” and “autism” as identity-first language terminology per preferences voiced by the autistic community and “autistic disorder” when referring to official ICD 10 coding (Vivanti, 2020). We recognize that different fields, populations, and providers have preferences amongst these and other terms (e.g., autism spectrum disorder, person-first language).

The process of getting a diagnosis can look different for families based on various factors including providers in their area, family financial resources, and severity of diagnosis; it may even be delayed to adulthood for some (Huang et al., 2020). As an example, Durkin and colleagues (2017) reported that diagnoses of autism are associated

with socioeconomic status (SES), with increasing familial SES related to increasing likelihood of autism diagnosis throughout elementary school. The authors suggest that families with lower SES are under- diagnosed due to socioeconomic barriers. Furthermore, prevalence differences between high and low SES remained constant over the researchers' study period (2002-2010; Durkin et al., 2017), indicating that finances have remained a stubborn barrier for families.

Unfortunately, as diagnostic rates increase, disparities in these rates persist, as exemplified by the differences seen based on SES. Historically, Black children were diagnosed less frequently and are still diagnosed later than non-Hispanic White children in the US (Jo et al., 2015; Ennis-Cole et al., 2013; Mandell et al., 2002; Valicenti-McDermott et al., 2012). Females are still diagnosed less frequently and at later ages (McDonnell et al., 2020). Rural regions lag urban regions in these same domains (Williams, 2005). Recently, however, Nevison and Zahorodny (2019) have found racial and ethnic minority children having diagnostic rates which out-pace those of White children. The most recent data from the CDC shows that Black and White children are diagnosed at similar rates by age 8, and Hispanic/Latino children are still diagnosed at lower rates (Shaw et al., 2021). As autism awareness and prevalence rates rise, there may be uneven growth amongst privileged and marginalized groups in diagnostic processes which are difficult to accurately measure, but need to be addressed.

Although research shows the age of diagnosis getting younger, factors such as lower socioeconomic status, higher IQ scores, and less severe symptomology intractably continue to contribute to delayed diagnosis (Mazurek et al., 2014). Rate of diagnosis is one way to measure disparity, but there are questions in the field about whether true rate

of autism may be lower in biological females than males, making rate of diagnosis an imperfect gage of access or disparity (Rylaarsdam & Guemez-Gamboa, 2019). Age of diagnosis is also a measure of disparity, as autism is not suspected to onset later or earlier depending on sociodemographics, but rather be related to early access to diagnostic evaluations (Mazurek et al., 2014). This paper will examine sociodemographic factors associated with age of diagnoses. Furthermore, the paper will examine prior diagnoses of children who are later diagnosed with autism as a possible measure of disparity in autism evaluation access.

Diagnostic process

Diagnostic evaluations and proper diagnosis are the first steps for intervention planning (Huerta & Lord, 2012). The diagnosis of autism, however, is typically a multi-step process. It often begins with a referral from a pediatrician at a well-child visit, screening tools such as the M-CHAT (Dumont-Mathieu & Fein, 2005), surveillance, caregiver reporting, and then formal diagnostic assessment and cognitive testing (Huerta & Lord, 2012). A qualitative study on underserved autistic populations by Elder and colleagues (2016) found that community leaders and parents are concerned that pediatricians are uncomfortable with autism diagnostic processes, and do not screen or refer properly due to lack of knowledge. Pediatricians and general practitioners are more likely to be comfortable with screening for, diagnosing, and medicating a condition like ADHD, the most common childhood disorder (Wolraich et al., 2019). Furthermore, Bellesheim and colleagues (2020) report that many, particularly rural, pediatricians do not perform screenings in line with American Academy of Pediatrics recommendations (Hyman et al., 2020). This is in part because they feel under-qualified on how to use

screeners and early developmental difficulties. The researchers also highlighted lack of knowledge at the parent and school levels regarding autism, all contributing to delayed diagnoses and service access. In that study, parents stated a need for more widespread education about early signs of autism. Families in this qualitative study also discussed the significant financial burdens involved in securing care for their autistic children, pointing to the way socioeconomic status can influence the diagnostic process.

Huerta and Lord (2012) remind clinicians and researchers alike that no single tool, nor symptom expression, is perfectly diagnostic for autism. Rather, a collection of assessment measures and expertise in autism is necessary. Two of the primary tools used are the Autism Diagnostic Interview-Revised (Rutter et al., 2003) for parents and the Autism Diagnostic Observation Schedule, 2nd edition (Lord et al., 2000) for the client. These are administered by a graduate level licensed practitioner and interpreted for families through diagnostic evaluations (Lord et al., 2000), access to which is limited. Programs such as Autism ECHO, which train primary care practitioners to diagnose autism, expand access in underserved areas. These are illustrative examples of a stepped care model, which greatly improve access to this specialized type of diagnosis and care (Mazurek et al., 2017; Mazurek et al., 2019).

When diagnosis of autism is missed or delayed, children may accumulate psychiatric or health diagnoses through multiple providers, which are later more parsimoniously explained by autism. Autistic people are often diagnosed with comorbidities (Levy et al., 2010), and many children are also given (sometimes multiple) inaccurate diagnoses before autism as an interpretation of their symptoms (Mazefsky et al., 2012). As medical records rarely remove diagnoses, these inaccurate diagnoses may

follow the child to adulthood and lead to prescription and intervention decisions which do not best match their needs or are stigmatizing (Mazefsky et al., 2012). More diagnoses may lead to higher prescription dosages and loads, causing challenges with medication management, compliance, side effects, or other later complications (Espadas et al., 2020a; Espadas et al., 2020b; Houghton et al., 2017; Park et al., 2016). Autistic children and families can also lose months or years of early interventions which might support later independent functioning due to delay in diagnosis. Autistic children may benefit from specialized early interventions as well as coordinated care from healthcare specialists (Farmer et al., 2014). It is important to note that there is still ongoing debate over the ethics and purpose of some psychological treatments, which focus on eliminating stimulation behaviors and overcoming the autism diagnosis. That said, most current interventions with autistic children are not designed to 'cure,' but rather to support adaptive behaviors, independent living, school readiness, and more (Bailey et al., 2004). A qualitative study by Cridland and colleagues (2014) focused on adolescent autistic girls who were age 6-14 when diagnosed, much later than the earliest possible at 2 years old. Several mothers in the study reported having to teach certain difficult and specialized subjects (e.g., facial expressions, toilet training) due to lack of access to early intervention services from delayed diagnosis, which they stated was stressful (Cridland et al., 2014).

Despite the benefits of early interventions indicated by some research (Peter-Scheffer et al., 2011), other research has pointed out the bias and flaws of research on these interventions. In particular, high risk of bias in publication results from low sample size, non-blind trials, and lack of data transparency have been repeatedly found upon

meta-analytic or systematic review (French & Kennedy, 2018; McConachie & Diggle, 2007; Oono et al., 2013), calling into question the veracity of reported large improvement gains. Criticism within the autistic community of interventions, particularly Applied Behavioral Analysis, highlights the ableist principles of trying to erase signs of disability, or make someone appear more neurotypical rather than embracing who they are. This ideology centers the comfort of neurotypical people rather than accommodating autistic people and their needs (Grinker, 2020). There are types of intervention other than ABA, for example speech-language therapy (Auert et al., 2012), occupational therapy (Case-Smith & Arbesman, 2008), and augmentative and alternative communication devices (Light et al., 1998), which are generally supported by people in the community as well as providers.

Individuals with typical or above average IQ and autism may not present with overt symptoms, resulting in delay in referral for evaluation until later in life (Fusar-Poli et al., 2020). This can lead to prior misdiagnoses for behaviors later accounted for by autism or missed diagnoses completely. Fusar-Poli and colleagues (2020) reported on cases of adults, from low IQ through superior IQ, with missed diagnoses of autism and who were later diagnosed in a university hospital setting in Italy. Prior diagnoses included personality disorders, bipolar spectrum disorders, attention deficit/hyperactivity disorder, anxiety disorders, and obsessive- compulsive disorder. In their study, a third of the sample had no prior diagnoses at all. The authors suggest that psychiatric conditions are more prevalent among autistic people than in the general population (Fusar-Poli et al., 2020).

Diagnostic Age

In the research field, age of autism is widely used as a proxy for disparities in access to evaluations and services (Jo et al., 2015; van ‘t Hof et al., 2020). Although children are being increasingly diagnosed before school age and younger with rising awareness and resource allocation in schools, lower socioeconomic status and higher IQ are both still related to later age of diagnosis (Mazurek et al., 2014). Earlier age of diagnosis also reduces the likelihood of inaccurate diagnoses pre-dating the autism diagnosis.

Earlier age of diagnosis with autism can also lead to Individualized Education Plans (IEP) or 504 plans as children enter school age. These are specialized accommodation plans and learning supports agreed upon by the school and parents to support a child’s learning environment. Early diagnosis allows for IEPs to be supportive of learning environments for children, keeping efforts focused on prevention of behaviors. When children have a diagnosis, they are less likely to receive disciplinary measures or punishment for behaviors perceived to be related to their disability (Slaughter et al., 2019). When children do not have proper and accurate diagnoses, their IEPs (based on educational diagnoses) are likely to be reactionary and feature escalating punitive measures (Bean, 2013; Gudiño et al., 2008). School discipline has increasingly become focused on punishment, with some disciplinary measures moving to criminalization and incarceration for school-based infractions (e.g., truancy; Annamma et al., 2019). When early diagnosis is not distributed equitably, wealthy, urban, White male children may have a better chance than other children of receiving IEP services focusing on prevention of behavioral issues related to disability.

Prior diagnoses

Determining if other diagnoses assigned to autistic children or adults are differential, comorbid, or better explained by autism symptoms themselves is hard, even for expert level clinicians (Matson & Williams, 2013; Rosen et al., 2018; Van Schalwyk et al., 2015). In retrospective literature, it may be impossible for researchers to understand whether prior diagnoses are inaccurate or comorbid. The current literature often discusses them as comorbid. This leaves many autistic people with a high diagnostic load and complicated diagnostic pictures the veracity of which are difficult to ascertain. Many pediatricians report challenges such as insufficient time in appointments to assess for autism, lack of knowledge about the disorder, and complex symptom presentation (Mazurek et al., 2020). Davidovitch and colleagues (2015) found that in a sample of children diagnosed late with autism (at age 6 or 12), only 42% had prior notes in their electronic medical record indicating possible autism symptoms.

Further complicating the picture, autistic people are at increased likelihood for medical (e.g., seizure disorders, gastrointestinal disorders) and psychiatric comorbid diagnoses (Rosen et al., 2018). Additional diagnoses are typically studied as comorbid, rather than prior or incorrect, although Mazesfky and colleagues (2013) have presented evidence suggesting there may be substantial over-diagnosing in this population. Significant literature has investigated the phenotypic, neurodevelopmental, symptomatic, and genetic/ environmental risk factor overlap among Oppositional Defiant Disorder (ODD), Conduct disorder (CD), autism, and Attention Deficit/Hyperactivity Disorder (ADHD), as well as the high rate of co-diagnosis (Geluk et al., 2012).

ADHD

Overlap between autism and ADHD is widely discussed (Lai et al., 2019), even though until relatively recently (DSM-5; APA, 2013), providers could not assign both diagnoses as co- occurring (Rosen et al., 2018). Rosen and colleagues (2018) posit comorbidity between autism and ADHD around 30%. Symptoms of inattention, such as lack of eye contact, or fine motor stereotypy (which can be viewed as fine motor hyperactivity), can be particularly difficult to differentiate between the two disorders. Frazier and colleagues (2011) found that autistic children with a comorbid ADHD diagnosis were significantly more likely to be medicated (i.e., nearly 60%) than ADHD or autism alone.

Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD)

Positive correlations among autism, ADHD, ODD, and CD symptoms have been found in both boys and girls (Kerekes et al., 2014; Rosen et al., 2018). Regarding autism and ODD, it is particularly difficult to determine whether symptoms such as lack of empathy or severe emotion dysregulation truly constitute a secondary diagnosis or are better captured by the autism diagnosis alone (Rosen et al., 2018). This is important because different disciplinary measures may be recommended at school or home based on etiology (i.e., ODD diagnosis requires vindictiveness/spite as drivers of behavior; autism is characterized by lack of understanding of such social interactions). Geluk and colleagues (2012) point out that many externalizing disorders such as ODD and CD are highly over-represented in the criminal justice system, meaning that they may carry a particularly stigmatizing weight.

Anxiety and Depression

Anxiety is considered the most common comorbid diagnosis with autism (Lai et al., 2019; Rosen et al., 2018). This may present as social anxiety, or more generalized anxiety, or may be environmentally determined (e.g., related to sensory concerns or routine disruptions). Symptoms of anxiety, depression, or other disorders may present differently in autistic clients. For example, depression may move special interests to more morbid fixations, and both anxiety and depression may intensify traditional autism symptoms (Rosen et al., 2018). Lai and colleagues (2011) found comparable symptomology of anxiety, depression, and obsessive- compulsive disorder (OCD)-related symptoms in both male and female autistic participants.

Adjustment Disorders

Little research exists on adjustment disorders as a collective diagnostic group, and their differentiation from healthy or typical reactions to stress are unclear (Casey & Bailey, 2011). This ambiguity may lead them to be heavily leaned upon by general practitioners in the case that clinicians are not comfortable making an autism diagnosis. Adjustment disorders are considered temporary by nature (Wilmhurst, 2013), in response to relevant stressors in the child's environment. Adjustment disorders may be related to traumas, may include anxious or depressive symptoms, defiant or externalizing behavioral symptoms, or other symptoms (APA, 2013). Often, adjustment disorders are viewed as a way to support medical billing purposes when other diagnoses are not appropriate or haven't been evaluated (Casey & Bailey, 2011). They are also commonly used by general practitioners to secure referrals to psychiatric or psychological services (Chomienne et al., 2011). Psychiatry offices are where adjustment disorders are most

likely to be diagnosed, often for the purposes of providing a prescription (Casey & Bailey, 2011).

Empathy

Transdiagnostically, symptoms of empathic response and emotion regulation are features of many of the above diagnoses (among others). Important distinctions between cognitive empathy deficits for autism and emotional empathy deficits in ODD and CD have been pointed out (Jones et al., 2010; Rueda et al., 2015; Sanz et al., 2016; Schwenk et al., 2012). Typically, cognitive empathy deficits in autism refer more often to lack of theory of mind, whereas emotional empathy deficits in CD refer to lack of emotional response to another's pain.

Furthermore, Bons and colleagues (2013) have highlighted similarities and differences between emotional empathy deficits in autism and CD. They hypothesize that lack of attention to the eyes of others is an important component in both disorders' empathy deficits. They point, however, to the reasons for this as hyper-responsive amygdala in autism and hypo-responsive amygdala in CD (Bons et al., 2013).

Emotion Regulation

Emotion regulation difficulties are another hypothesized transdiagnostic symptom between these multiple disorders which may lead to confusion in diagnosis (ADHD, ODD, CD, Anxiety, etc; Mazefsky et al., 2012; Rosen et al., 2018; Schoorl et al., 2016). Emotion regulation difficulties are strongly linked to aggressive behaviors in children as well (Schoorl et al., 2016), because aggression in this population is often an impulsive, reactive behavior. Increased interpersonal or physical aggression may be one example of behavioral manifestation which crosses the boundaries between diagnoses like ODD, CD,

ADHD, and autism.

Previous Literature Examining Multiple Prior Diagnoses

As Mazefsky and colleagues (2012) point out, accuracy in diagnoses for autistic people is critical to avoid providing unnecessary, possibly harmful treatments, and ensure that autism symptoms are understood and managed in the most effective way possible. If autism diagnoses are delayed, a clinician may miss important context for certain behaviors or symptoms, relying only on prior diagnoses for context. Whether prior diagnoses are accurate and serve as comorbidities, or are inaccurate, delayed autism diagnoses can greatly impact long-term health outcomes. The current study will discuss and assess prior diagnoses, without assessing whether these were corrected through an autism diagnosis or remain comorbid, as that task is not possible in a retroactive dataset such as the one used in the proposed study.

Mandell and colleagues (2007) published a large-scale Medicaid-claims data-based study to examine prior diagnoses children received before autism. The investigation used 1999 data in Philadelphia and focused on children aged 3-16 years old, who were diagnosed with Autistic Disorder (a DSM-IV prequel to Autism Spectrum Disorders as seen in DSM-5; APA, 1998). The authors found that more than 56% of the 406 children in the sample received a diagnosis other than autism on their first mental health visit. Most commonly, it was ADHD. When the authors examined how race impacted what diagnosis was assigned at first mental health visit in this group of misdiagnosed children, they found that Black children were five times more likely to receive a diagnosis of adjustment disorder compared to ADHD prior to their autism diagnosis, and more than 2.5 times more likely to receive a diagnosis of Conduct

Disorder (Mandell et al., 2007). The researchers also found that boys were significantly more likely than girls to receive a diagnosis of adjustment disorder, and somewhat more likely than girls to receive a diagnosis of conduct disorder (with ADHD as the default referent diagnosis). The sample was 79% male, which may have inhibited much sex comparison. Additionally, the authors did not report findings related to anxiety spectrum disorders. As the authors discuss, these missed diagnoses cost families months to years of intervention and support lost, as well as the ordeal of setting up more provider appointments to get the correct diagnoses. The researchers suggested possible reasons that diagnoses differed by race and sex, including symptom presentation, parent report, or clinician bias (Mandell et al., 2007), but we need more research examining how racial and ethnic background as well as sex and gender presentation relate to presentations of autism and timing of diagnosis.

Inequities in Autism Research Participant Samples

Intersectionality is a term coined by Crenshaw (1989) referring to a civil rights effort to look at discrimination and oppression through the lens of multiple identities, for example, Black feminism. Related to Critical Race Theory (Delgado, 2001), intersectionality is a theory focusing on inequitable and prejudiced power structures which marginalize groups with multiple identities in complex ways not always brought to the foreground of conversations around race, feminism, or other activism movements (Crenshaw, 2019). These combined identities may influence the way a person is perceived by others and the way they themselves see and understand the world. With the spread of intersectionality outside of the field of law into the social sciences, some theorists and researchers have pointed out that it risks losing its true definition through

being applied too broadly (Collins, 2015).

An intersectional approach can be applied to health sciences, in that health disparities arise from unequal access and treatment through healthcare services, which is further influenced by multiple factors of identity (Bishop-Fitzpatrick et al., 2017). There is, however, a tendency to de-politicize this research in psychology, examining overlapping identity groups (e.g., LGBT and autistic) without looking at who holds power or power structures impacting those groups (Buchanan & Wiklund, 2021; Grzanka et al., 2020). Disability studies, within the field of education research, tends to better capture the way that healthcare and education systems impact people with disabilities (including autistic people), and other overlapping identities which change these relationships (Kim, 2021; Mallipeddi & VanDaalen, 2021; Saxe, 2017a; Saxe, 2017b). This also includes gender identity and sexual orientation as identities (Cain & Velasco, 2018; Hillier et al., 2020), a growing part of autism research.

Attempting to apply intersectionality to research in autism, while imperfect, might be leveraged to reveal ways in which race, ethnicity, biological sex, geographical location, cognitive ability, and many other factors intersect with healthcare service systems and schools to impact diagnostic age, diagnostic load, and other health variables (Cascio et al., 2021; Singh & Bunyak, 2019). A systematic review by Lovelace and colleagues (2021) found that only two research articles, both case studies, have been published centering the experiences of autistic Black girls. The case studies indicated providers were influenced by racist and sexist beliefs, concretized in their medical case notes, which is concerning due to their relative power over their Black female patients (Lovelace et al., 2021). Furthermore, research has shown that both girls and Black

children are more likely to be diagnosed when they have co-occurring intellectual disability (Baio et al., 2018; Jeste & Geschwind, 2014; Fombonne, 2009; Mandell et al., 2009; Rivet & Matson, 2011), revealing disparities at the intersection of race, gender, and ability in the clinical field of autism.

Race

As mentioned, Black children are diagnosed at later ages than the autism population at large and historically have been diagnosed at lower prevalence rates (Ennis-Cole et al., 2013; Jo et al., 2015; Mandell et al., 2002; Valicenti-McDermott et al., 2017). Constantino and colleagues (2020) found that Black children were receiving a diagnosis on average around age 5, three and a half years after parents' first reported concerns. The literature is unclear whether differences in symptom presentation of autism are influenced by cultural background or environment, and if so, what those differences in symptom presentation might be (Burkett et al., 2015; Sell et al., 2012; Tek & Landa, 2012). Autistic Black children's intersectional identity as both Black and disabled leaves them at particular risk of exclusion and discrimination from healthcare services which should support them. Black children may have difficulty securing coordinated care, obtaining diagnosis, or feeling mistreated by providers (Bishop-Fitzpatrick & Kind, 2017; Cascio et al., 2020; Nowell et al., 2015). Furthermore, gold-standard measures for autism evaluation, such as the ADI-R and the ADOS-2 have also been criticized for their cultural relevance to diverse populations. Almost no research in the field of autism is focused on the experience of autistic Black girls, leaving a huge sociodemographic hole in the literature (Lovelace et al., 2021).

Biological Sex & Gender

Females are diagnosed with autism at a lower rate than males, approximately 4:1. The ratio is reduced further to 2:1 when looking only at children with co-occurring intellectual disability (Hull & Mandy, 2017). A current debate in the field is whether this discrepancy represents true differential rates of autism, with a female protective effect causing reduced prevalence in girls, or whether girls are being under-diagnosed due to bias in diagnostic measures (Hull & Mandy, 2017; Kreiser & White, 2014). Data on differences in autism presentation are mixed. Some findings have shown women with stronger social skills (Lai et al., 2011), and other researchers find no differences (Tillman et al., 2018). Lai and colleagues (2011) point out that the data supporting use of the gold-standard measure (i.e., the ADOS-2) in diagnosing autism in females are rather weak. Some researchers have argued for sex-specific cut off scores in different diagnostic instruments. One reason is data showing that girls may have lower symptom rates but be further from the sex-specific means of symptoms (Lundstrom et al., 2019). In other words, autistic girls may differ more from the neurotypical girls on symptoms like sensory sensitivity, behavioral flexibility, and verbal/social skills than autistic boys do from neurotypical boys, but still have reduced symptom rates compared to autistic boys. Tillman and colleagues (2018) used a large, combined European sample to compare female and male autism presentations on the ADI-R and ADOS-2. They included adults and children with low IQ and intellectual disabilities in their data, only excluding those with "profound," disability, increasing the applicability of their findings to the true autism population. They found partially reduced symptomology in major autism domains in girls compared to boys, which could indicate true differences in presentation of

symptoms by sex or gender. This study will look at biological sex as a factor in ASD diagnosis and will use female or girl in reference to biological sex at birth. There are interesting and important questions about gender identity factors in the ASD population; but these are outside the scope of this paper.

Geographical diversity

Families living in rural areas report less access to education on early identification and intervention options for autistic children, as well as fewer trained providers (Antezana et al., 2017; Murphy & Ruble, 2012; Zhang et al., 2017). Families in rural areas may have to travel further for autism-specialized providers and wait longer for services (Antezana et al., 2017; Mello et al., 2016). Within the rural community of families of autistic children, lower SES and education levels among parents may also serve as barriers (Antezana et al., 2017; Zhang et al., 2017), as higher parental education has been shown to lead to earlier diagnosis and access of interventions.

To manage distance-to-care burdens, rural schools can become a primary resource for rural families (Murphy & Ruble, 2012). Receiving diagnoses and interventions through schools, however, may mean delays in services compared to the general population (Antezana et al., 2017). Rural schools may also have more limited options for therapies, and social skills interventions, speech/language, or others may be limited due to funding and providers in the area. Living in more rural areas is related to higher rates of intellectual disability within autism (Palmer et al., 2010), and urban areas report rates of autism 2.5 times higher than rural areas (Williams et al., 2005). More recent research in Denmark found similar results, with a dose- response association where increased urbanicity led to increased risk of autism (Lauritsen et al., 2013). Some research into

telehealth options has attempted to address the urban/rural service gap through virtual portals for ABA and other interventions, but research into this is mixed and in early stages (Antezana et al., 2017). Children in rural parts of the country are more likely to be diagnosed or seen by a general practitioner, who may struggle to diagnose autism. Programs like Missouri Autism ECHO allow specialized autism experts to train rural providers on diagnosis and interventions as well to expand access (Nowell et al., 2020). Studies looking at the impact of living in a rural region also must contend with the high degree of overlap between rural and low socioeconomic status variables.

Socioeconomic diversity

Socioeconomic status (SES) plays an important role in the autism literature field as well and among families of autistic children. SES can impact families' abilities to access evaluations, coordinated care, educational supports, early intervention services, and support through adulthood. Research suggests that higher SES is associated with higher rates of autism, most likely due to access to diagnostic resources (rather than true prevalence differences; Durkin et al., 2010; Thomas et al., 2012). This may skew the research participant population to a higher SES, as they receive more diagnoses and earlier diagnoses (Cascio et al., 2021). Howard and colleagues (2021) found that in North Carolina, median household income of a country was associated with autism and intellectual disability, but in opposite directions. Although higher median income correlated to raised rates of autism, lower median income was associated with raised rates of intellectual disability. The authors speculate that counties with lower median incomes may not have the resources to adequately screen and evaluate for autism. SES is an important part of the autism field at large, however, this study is largely focused not on a

diverse SES population, but a unipolar distribution of low-income families.

Missouri Medicaid

The Missouri Medicaid system may be an effective way to approach asking questions about inequality in autism diagnosis, access, and services. Medicaid covers approximately 870,000 people in Missouri, and approximately 35% of Medicaid expenditures are on care for families and children (Missouri Foundation for Health, 2020). Missouri has high spending per person in Medicaid enrollment compared to other states, meanwhile, it is ranked in the bottom third of states on many health indicators such as coverage, access, and equality (Shoyinka & Lauriello, 2012). Mental health care in Missouri has been particularly troubled, with significant suicidality, incarceration, and poor mental health rates, especially in children (Shoyinka & Lauriello, 2012). Approximately half of the population with mental health problems live in underserved areas, such as rural areas and underserved urban regions (Shoyinka & Lauriello, 2012). That being said, Semansky and colleagues (2013), found Missouri to have the highest number of community-based services for autistic children in the country. Missouri offers several sources of support for teachers of autistic children, including teaching assistants, consultations in schools, and additional training programs (Henderson, 2011).

Current Study

Missed diagnoses can lead to years of early intervention lost, having a powerful negative impact on school readiness, behavior management and self-regulation skills (K et al., 2017). Missed diagnoses of autism also contribute to older age at diagnosis and reveal an inequality in access to diagnostic evaluations and healthcare supports. Prior diagnoses for a child who is later diagnosed with autism can vary widely, from anxiety,

depression, ADHD, adjustment disorder and more (Aggarwal & Angus, 2015; Kentrou et al., 2019). This study examined age at diagnoses as well as what earlier diagnoses were received for autistic children between the ages of 1-10 enrolled in Missouri Medicaid. Although not a random sample of children in Missouri, Missouri Medicaid can answer questions about children's health, access to healthcare services, and familial medical experience in the state of Missouri. It covers about 37% of children, in rural and urban areas, many with disabilities, and specifically highlights the experience of low income and racially diverse children who may be atypical for research samples in the field of autism (Missouri Foundation for Health, 2020). Prior researchers (Mandell et al., 2007) examined this question in Pennsylvania with Medicaid claims data from 1993-1999, but many changes in the diagnostic criteria (ICD and DSM), provider training, autism de-stigmatization, and social attention to issues of equity have occurred since that time. The question also warrants further investigation as diagnostic disparities in race and sex remain and, in some cases, grow (McDonnell et al., 2020). This study utilized an intersectional theoretical lens, exploring how multiple elements of a child's identity (race, sex, disability, and geographical region) may impact their access to a diagnosis and experience within the medical system.

Aim 1. The first aim of this study was to examine how age of diagnosis of autism from 2 to 10 years old in Missouri differs based on sociodemographic factors, with a second blocked analysis looking at the added variance contribution of number of prior diagnoses. There were predicted to be impacts on child's age at diagnosis based on different aspects of their identity as they navigate the healthcare system in Missouri. Specifically, the following were hypothesized:

1a. Black children would have a delayed diagnostic age of autism compared to White children.

1b. Girls would have a delayed diagnostic age of autism compared to boys in the sample.

1c. Children living in rural areas would have a delayed diagnostic age of autism compared to those living in an urban setting in the sample.

Aim 2. The second aim of this study was to examine prior diagnoses assigned to children who later receive an autism diagnosis and look at whether race, sex, or geographic location impact those diagnoses.

Specifically, the following were hypothesized:

2a. Black children would be more likely to receive prior diagnoses of behavioral conduct disorders compared to the larger population based on prior work (Mandell et al., 2007).

2b. Girls would be more likely to receive anxiety-OCD related disorders compared to boys.

2c. Children in rural regions would be more likely to receive diagnoses of ADHD and adjustment disorders compared to children in urban settings.

Exploratory Aim: The author would stratify by race, geography, and sex to look at differences in prior diagnoses as an exploratory hypothesis.

Methods

Participants

Participants were Medicaid enrollees with dates of birth between January 2005 and November 2018 AND who received a diagnosis of autism between September 2015 and February 2020. Autism diagnosis must have occurred between September 2015 through February 2020, to prevent skew in the data due to the lack of provider visits in

2020 due to the Covid-19 pandemic. In late 2014, the Medicaid system began to convert from ICD-9 to ICD-10, so to keep the autism diagnoses as controlled as possible, we only included children diagnosed in the ICD-10 range. Diagnoses of autism were accepted in ICD-10 coding system (F84.0 Autistic Disorder). Children with Medicaid claims data for at least one year prior to autism diagnosis were included in analyses (n = 13,851). Only White and Black identified participants were included in the main analyses of the study (n = 12,241), as other racial subgroups were too small of samples to make conclusions. Participant ethnicity was not available to the researchers.

Missouri Medicaid covers adults and children in Missouri who are categorized as low income or very low income (i.e., for a household size of 2, income before taxes below $23,169 qualifies, for a household of four, income before taxes below $35,245 qualifies). Other factors which impact qualification include being pregnant, having a child, having a disability or a member of the household, have a disability, or being 65 or older. Medicaid covers approximately 870,000 people in Missouri, which constitutes 37% of children in Missouri(Missouri Foundation for Health, 2020).

Medicaid eligibility (i.e., through disability or low-income qualifications) was included as part of initial data gathering. Families that qualified for Medicaid because of a pre-existing disability diagnosis were excluded from overall sample so as not to falsely deflate or inflate the prior diagnostic data (n=1,610).

Procedure

Data security procedures and protocol were approved by University of Missouri-St. Louis Institutional Review Board. Participants were autistic children diagnosed in the Missouri Medicaid system. Prior diagnoses were accepted in ICD 9 or 10 coding systems,

while autism diagnosis had to be in the ICD 10 system. The Missouri Medicaid team provided requested data through the University of Missouri at Columbia's Center for Health Policy. It was de-identified by the Center for Health Policy. To maintain confidentiality, the date of birth was removed from the dataset. Instead, age in weeks at autism diagnosis and all prior diagnoses was tabulated before dataset was received by authors.

Variables

Sociodemographics.

Sex and race were collected through Medicaid claims and enrollment files. Geographical status was categorized as rural or urban based on the county code provided in the data and standardized Missouri Medicaid urban/rural classifications. Missouri counties are considered rural by Medicaid if there are less than 150 people per square mile and they don't contain any part of a central city in a "Metropolitan Statistical Area." For example, Cape Girardeau, Jasper, St. Louis County, and Clay county are all considered urban. Contrastingly, Hickory, Polk, Dade, and Lawrence counties are all considered rural (See Appendix A; Missouri Department of Health and Senior Services, 2020). Descriptive statistics are provided for the larger sample.

Behavioral Diagnoses.

In line with Mandell and colleagues (2007), missed diagnosis were considered to occur if children in the sample received any diagnosis other than autism or no diagnosis during various health visits, within 6 primary categories: ADHD and related disorders, Conduct and related disorders (ODD and CD), Adjustment disorders, Anxiety-OCD and related disorders, Emotion and Mood disorders, and Intellectual Disability Disorders. It

was accepted in ICD-9 or ICD-10 codes. 'No prior diagnoses' was also considered as a category. We were not able to distinguish between those missed diagnoses that may more accurately be described as comorbid diagnoses, and which may have been incorrect diagnoses. There is not substantial research evidence that children who do not have autism are being over-diagnosed with autism (Merten et al., 2017).

Data analytics plan

Power analyses. With an N of 12,241 for the main analyses, power was considered strong and analyses are considered sufficiently powered to detect a small effect size.

Preliminary analyses. Preliminary analyses checked t-tests, correlations, and ANOVA testing; whether age at diagnosis was related to each of the predicted variables (sex [1 = male], geography [1 = urban], race [1 = White], disability [1 = had Medicaid code of intellectual disability pre-autism diagnosis]). Average age of diagnosis of autism in Missouri children on Medicaid was calculated, and then other sub-groups compared to this average (median and mode will also be investigated and reported). The author examined if children got another diagnosis before autism, and whether those diagnoses were associated with sociodemographic variables.

Main analyses by hypothesis

Aim 1. The author used a blocked linear regression with sociodemographics as predictors and age of autism diagnosis as the outcome.

Aim 2. The a priori plan was to use multinomial logistic regression with the specific prior diagnosis as the outcome, with geography, race, and sex as predictor variables. Authors chose to analyze a subsample of the total group, only children

identified as White or Black racial background, due to the small sample size of other racial backgrounds, like the procedure used by Mandell et al (2007). Due to a large proportion of children having a high diagnostic load, meaning many different prior diagnoses across the 6 categories, the plan was switched to running six individual logistic regressions, with post-hoc explorations of multiple overlapping diagnoses. The outcomes in logistic regressions were the presence or absence of the following: ADHD diagnosis, conduct related diagnosis, adjustment and related diagnosis, anxiety and related diagnosis, mood and related diagnosis, and intellectual disability diagnosis. All outcomes all coded as no diagnosis (0) or presence of diagnosis (1) in record. Due to running multiple analyses, the Benjamini-Hochberg False Discovery Rate (Benjamini-Hochberg, 1995) correction was used to protect against multiple comparisons inflation of type 1 error. The analysis was run adjusting for the 22 regression findings between aim 1 and aim 2. The False Discovery rate is a preferred multiple comparisons correction because it protects against type one error while preserving power for disproving the null. Post-hoc analyses also investigated sub-groups and intersectional concerns in the sample, such as Black girls, and geographical location by racial background.

Exploratory: In exploratory analyses, trends within race, sex, and geographical locale were assessed based on patterns in the descriptive analyses. Even if these are not significant on their own, a closer look at sub-populations may reveal trends hidden within the data.

Results

Descriptives and Preliminary Analyses

Full Sample. Table 1 represents descriptives from the full sample. The sample consisted

of 78.16% male children and was approximately reflective of Missouri's larger state racial and ethnic diversity, with 73.94% White, 14.43% Black, 0.24% American Indian/Alaska Native, 0.77% Asian, and 0.14% Native Hawaiian or Pacific Islander. The average age of autism diagnosis was 360.81 weeks (approximately 6.9 years; SD = 162.43 weeks, skew =.245, kurtosis= -.892), the median age of diagnosis of ASD was 340 weeks (6.5 years), and the mode was 156 weeks (2.9 years [weeks are rfounded off due to approximated birthday by week]). In the broader Missouri population, about 37% of people are considered to live in rural areas (Missouri Department of Health, 2020), however, in this Medicaid sample, 42.05% of the population lived in a county Medicaid identifies as rural. All variables were normally distributed.

An independent samples *t*-test indicated a significant difference between sexes in average age of diagnosis in the full sample, $t(13848) = 2.339$, $p = .019$, 95% CI [1.23, 14.36], Cohen's $d = 0.048$, a small effect size**.** Females were diagnosed at a younger age (female average = 344.71 weeks [6.5 years], male average = 352.52 weeks [6.8 years]). No significant difference was found between the age of diagnosis in rural vs. urban populations when examining the full population; $t(13836) = 1.83$. $p = .067$. 95% CI [-0.36, 10.60], Cohen's $d = 0.032$. In total, 34.38% had a prior behavioral diagnosis of any kind (n = 4,763). In the sample, 16.28% (2,256) had one prior diagnosis, 8.95% (1,240) had two prior diagnoses, 5.29 % (734) had three prior diagnoses, 2.85% (395) had four prior diagnoses, 0.88 % (122) had five prior diagnoses, and 0.12% (16) had all six categories of prior diagnoses**.** There was a significant difference between age of ASD diagnosis between those who had an intellectual disability diagnosis before, and those who did not; $t(13848) = -18.96$, $p < .001$, 95% CI [-151.20, -122.88], Cohen's $d = -0.855$,

a large effect

size. Those with ID were diagnosed significantly older, on average 137 weeks older (2.6 years).

Subsample: Black and White Participants

Tables 2, 3 and 4 show descriptive statistics of the sub-sample of Black and White participants only, which was used for the main analyses (n = 12,241**).** Among White participants, no significant differences in average age of diagnosis were found between urban and rural populations ($t(10,232) = -1.53$, $p = .126$, 95% CI [-11.08, 1.36]; Cohen's $d = -0.030$), nor

between male and female ($t(10,240) = 1.21$, $p = .225$, 95% CI [-2.86, 12.17]; Cohen's $d = -0.029$). Among Black participants, no significant differences in average age of diagnosis were found between urban and rural ($t(1,996) = 0.05$, $p = .959$, 95% CI [-22.099, 23.28]; Cohen's $d = 0.004$). There were differences based on sex, $t(1996) = 2.082$, $p = .037$, 95% CI [1.04,34.89]; Cohen's $d = 0.115$; a small effect size (see race-specific differences in Table 3, and sex-specific differences in Table 4). An independent samples *t*-test revealed that Black girls were diagnosed significantly younger than Black boys. Comparing average ages of diagnosis across our three intersectional variables, Black urban-living females were diagnosed youngest, at 321.94 weeks (approximately 6.2 years), and Black rural-living females were diagnosed oldest at 372.78 weeks (approximately 7.2 years), although, notably, this sub-group is constituted by only 37 participants. Urban-living White males are the next oldest average age subgroup, diagnosed at on average 369.96 weeks (approximately 7.1 years).

In this subsample, 36.11% had prior diagnosis of any kind (n = 4420); in particular, 16.87% (2066) had one prior diagnosis, and 0.12 % or 15 had all six categories

of prior diagnoses. The most common overlap was ADHD and Conduct and related disorders, where 69.4% of children that had ADHD also had conduct disorder diagnoses. The second most common overlap was ADHD and anxiety and related disorders, where 41.7% of those with ADHD also had anxiety and related disorders. Please see Figure 1 for intersectional sociodemographic comparisons. The average age of diagnosis in the subsample was 362.35 weeks (6.9 years; SD = 160.15), the median age of diagnosis of ASD is 355 weeks (6.8 years), and the mode is 156 (3.0 years).

Main Analyses

Aim 1: Age of Autism Diagnosis.

A two-block hierarchical multiple regression was conducted to measure the impact of race, sex, geographical status, and in the second block, number of prior diagnoses on age of diagnosis (see table 5). The first block of the model was significant, $F(3, 12229) = 16.72$, $p < .001$, and explained .4% of the variance. Contrary to hypotheses, Being White and living urban were associated with older age of diagnosis for children. The second block of the model, was also significant, $F(4, 12229) = 577.253$, $p < .001$. It explained 15.9% of the variance and R^2 change was equal to 0.155. In the second block, being White, living urban and having more prior diagnoses was associated with older age of diagnosis.

Aim 2: Examining Prior Diagnoses.

Next, a series of logistic regressions were run to examine likelihood of receiving particular diagnoses prior to autism diagnosis. The standard binary logistic regression models were analyzed for multicollinearity and all variance inflation factor scores were below 2.5.

Predictors were race, sex, and urban/ rural divisions. Due to a large proportion of children having a high diagnostic load (19.12% had more than one prior diagnosis) across multiple categories of behavioral diagnosis, running individual logistic regressions for each diagnosis corrected with a the Benjamini-Hochberg False Discovery Rate to control for type 1 error was deemed more appropriate for capturing the influence of these social determinants of health on pre-autism diagnostic loads. All significant findings remained so after this multiple comparisons control. Results of the six logistic regressions are below.

ADHD Model. Results of the logistic analysis (Table 6) indicate that the 3-variable model accounted for a significant portion of the variability in whether there was a pre-diagnosis of ADHD, X^2 (3) = 113.73, $p < .001$; Nagelkerke $R^2 = 0.013$, a small effect size. Contrary to hypotheses, being White was associated with a child being more likely of receiving a diagnosis of ADHD. Consistent with hypotheses, being male, and living in a more rural area all were associated with a child being more likely of receiving a diagnosis of ADHD. In particular, being White was associated with a child being 1.55 times more likely to be diagnosed with ADHD compared to being Black; being male 1.38 times more likely to be diagnosed with ADHD, compared to being female.

Conduct and Related Model. Results of the logistic analysis (Table 7) indicate that the 3- variable model accounted for a significant portion of the variability in whether there was a pre- diagnosis of conduct and related disorders, X^2 (3) = 90.62, $p < .001$; Nagelkerke $R^2 = 0.012$. Contrary to hypotheses, being white and living rurally were both associated with a child being more likely to be diagnosed with conduct and related disorders. Being White was associated with a 1.55 times higher likelihood of being

diagnosed with conduct and related disorders, while living in a rural area left a child 0.24 times (Exp (B)=0.76) less likely to receive this diagnosis. The findings on sex were not statistically significantly related.

Adjustment and Related Model. Results of the logistic analysis (Table 8) indicate that the 3-variable model accounted for a significant portion of the variability in whether there was a pre- diagnosis of adjustment and related disorders, X^2 (3) = 31.14, $p < .001$; Nagelkerke $R^2 = 0.007$. Contrary to hypotheses, being White was associated with a 1.76 times higher likelihood of being diagnosed with adjustment and related disorders. Sex and geographic region were not statistically significantly related.

Anxiety and Related Model. Results of the logistic analysis (Table 9) indicate that the 3- variable model accounted for a significant portion of the variability in whether there was a pre- diagnosis of anxiety and related disorders, X^2 (3) = 96.90, $p < .001$; Nagelkerke $R^2 = 0.016$. Being White was associated with 2.49 times greater odds of an anxiety diagnosis. Contrary to hypotheses, sex and geographic region were not statistically significantly related.

Mood and Related Model. Results of the logistic analysis (Table 10) indicate that the 3- variable model accounted for a significant portion of the variability in whether or not there was a pre-diagnosis of mood and related disorders, X^2 (3) = 17.12, $p < .001$; Nagelkerke $R^2 = 0.003$. Being White was associated with a 1.45 times more likely chance of being diagnosed with a mood or related disorder. Contrary to hypotheses, sex and geographic region were not statistically significantly related.

Intellectual Disability Model. Results of the logistic analysis (Table 11) indicate that the 3-variable model accounted for a significant portion of the variability in whether

there was a pre- diagnosis of mood and related disorders, X^2 (3) = 17.414, $p < .001$; Nagelkerke $R^2 = 0.005$.

Consistent with hypotheses, being female and living in a rural area were associated with a child being more likely to be diagnosed with an intellectual disability. Boys were 0.24 times (Exp (B)=0.76) less likely to receive this diagnosis, while those living in urban settings were 0.33 (Exp (B)=0.77) times as likely. Race was not significantly related.

Post-hoc Exploratory Analyses.

Post-hoc and exploratory analyses were initiated to investigate nuances around social determinants of health examined in the models. This was considered especially important due to findings which often violated *apriori* predictions. Please refer to Table 12 and Figure 2 for intersectional analyses and a more detailed look at specific sub-populations in the data. Looking rurally, percentages of populations with prior diagnoses are very similar among White females, Black males, and White males (range 29.76% to 37.56%). One outlier was rural Black females, who had a high prior diagnostic rate of 51.35%, but with only n = 37 in the dataset, this is not considered a large enough sample to draw well-founded conclusions.

Urban White females and males appear similar with prior diagnostic rates of 36.34% and 36.55%, but look significantly different than Urban Black populations, where males had a prior diagnostic rate of 27.86% and females had a prior diagnostic rate of 20.63%. Chi-square distribution testing with a Bonferroni corrected significant difference testing was used to examine particular discrepancies more closely for significant differences. Specifically, differences in ADHD and Adjustment disorders had

the most striking disparity in racial and sex differences, which required further probing.

First, the author investigated urban males. The differences between Black and White urban males (see Table 12) on prior diagnoses was significant, X^2 (1) = 34.99, p< .001, phi = .081, which is a small effect size. White males having significantly more prior diagnoses than Black males. Next, urban females were investigated more closely. The differences between Black and White urban females on prior diagnoses was significant, X^2 (1) = 29.83, p< .001, phi = 0.14, a small effect size, with White females receiving significantly more prior diagnoses than Black females.

Then, differences in ADHD were more closely examined in the rural and urban combined sample. The differences between Black and White participants on prior diagnoses of ADHD was significant, X^2 (1) = 62.44, p< .001, phi = 0.072, a small effect size, with White children receiving significantly more prior diagnoses of ADHD. The differences between females and male participants on prior diagnoses of ADHD was significant, X^2 (1) = 37.96, p< .001, phi = 0.056, a small effect size, with male children receiving significantly more prior diagnoses of ADHD**.** The differences between Black and White participants on prior diagnoses of adjustment disorder was significant, X^2 (1) = 25.10, p < .001, phi = 0.045 a small effect size, with White children receiving significantly more prior diagnoses of adjustment disorder. The differences between females and male participants on prior diagnoses of adjustment disorder were not significant, p = .197, phi = -0.012.

The differences in conduct and related disorders were closely examined in the urban subsample to get a better idea of racial and sex differences in urban regions. The difference between diagnostic rates of conduct disorders in Black and White children in

urban samples was significant, X^2 (1) = 32.59, p< .001, phi = 0.093, a small effect size, with White children having significantly higher rates of diagnosis than Black children. Next, particularly the male, urban sample was examined, as these were considered likely to be driving differences, given that male and female rates of conduct and related disorders in the sample were relatively similar (15.45% and 17.02%). In the urban male sample, racial differences in diagnostic rates of conduct and related were significant, X^2 (1) = 22.96, p< .001, phi = 0.065, a small effect size, with White males being diagnosed at significantly higher rates than Black males.

Discussion

This project examined children with autism diagnoses enrolled in Missouri Medicaid and asked what diagnoses they received prior to autism. It also examined the age of autism diagnosis in this population and related sociodemographic factors. This study contributes to the literature through its large and racially diverse sample size, relative to other research samples in autism (Diemer et al., 2022), and focus on intersectional identities of participants by looking at the ways that geographic region, SES, race, and sex all impact experiences with disability diagnosis. This is one of the few large-scale studies on autism centering participants with low socioeconomic status, who are often not included in research samples (Durkin et al., 2010). This study investigates prior diagnoses without relying on parent report, using medical record data instead. Descriptive analyses examined the full sample, main analyses and post-hoc analyses were limited to only Black and White participants due to large disparities in enrollment numbers for Asian, Pacific Islander, American Indian/Alaska Native racial groups.

The first hypothesis of this study was that Black children, girls, and those living in

rural areas would all have older ages of diagnosis compared to White children, boys, and those living in urban areas. The data showed that being Black was actually associated with a younger age of diagnosis (around 6 months younger), contrary to the hypothesis. Jo and colleagues (2015) have similar findings; that non-Hispanic White children actually had an older age of diagnosis compared to their peers with minoritized racial backgrounds. This could have to do with severity of symptoms or other contributors. The authors theorized that this could partly be because children with more mild symptoms of autism, who are also of a minoritized racial background might be under-represented. Recent data suggests that the disparity in racial groups for autism diagnosis is closing (Maenner et al., 2020), but the findings of this study contrast a trend in which Black children are typically found to be diagnosed at an older age compared to White children (Mandell et al., 2002). Another possibility is that White children and in particular White boys are getting more diagnoses from the medical system overall due to differences in access to care or types of providers seen. It is important to note that Black children only represent 14.43% of our sample. It's not clear whether that matches overall population of Missouri Medicaid or Black children are comparatively not receiving autism diagnoses. This means that whether underdiagnosing is occurring relatively to the broader population cannot be determined at this time.

The findings for age of diagnosis and sex were not significant, despite the average age of diagnosis for girls being slightly younger than for boys (6 weeks). Girls were more likely to be diagnosed with intellectual disability, which is consistent with the extant literature (Fombonne, 2009; Jeste & Geschwind, 2014). This suggests that girls may have had more functional impairment, flagging them for evaluation earlier. Again, this could

point to an under- representation of girls with more subtle symptoms of autism compared to boys, with girls only representing 21.84% of our autistic sample.

Living in an urban area was associated with an older age of diagnosis as well, also contrary to hypotheses. Rural and urban differences in autism prevalence have not been thoroughly explored in the research, the current extant literature would suggest that barriers are high for children and families who live in rural settings, making this finding rather surprising (Antezana et al., 2017; Ning et al., 2019). Children in rural areas, similarly to girls, were more likely to also be diagnosed with intellectual disability. This could be a primary driver of this finding, as children with intellectual disability may receive more attention and evaluation at an earlier age due to functional impairment. That said, it may also be the case that rural children are underrepresented in cases of autism where there is no cognitive impairment, or where symptoms of autism could be considered more subtle.

Another possible explanation is that recent work to reduce barriers to autism diagnosis in rural areas, such as the Autism ECHO project, which focus on training rural providers to have more confidence in autism diagnosis, have been effective in addressing some of this gap (Mazurek et al., 2017). Increased awareness and education efforts could be aiding in reducing gaps between rural and urban areas. Nonetheless, the findings of this study go beyond that, not just finding a lack of disparity in rural areas, but actually suggesting that children were older when receiving autism diagnoses in urban areas in Missouri.

The overlap between race and urbanicity is not to be ignored in this dataset, where less than two percent of the sample were both Black and living in rural areas. The Black

population in the sample was overwhelmingly living in urban regions, and this could have been a driver in the age of diagnosis differences in rural and urban as Black children were more likely to be diagnosed younger. Among White participants in the sample, the proportion of children with prior diagnosis was relatively equal across rural / urban and sex differences.

One possibility for the findings opposite to hypotheses in race, sex, and rural/urban is that socioeconomic status is a major driver of these findings. Using Missouri Medicaid data, with all participants in relatively comparable lower SES, affects the variability and new trends emerge.

Research does highlight the importance of SES in autism diagnosis, with higher autism prevalence in higher SES samples. In contrast, in prior findings, racial disparities in diagnosis were still present along the entire SES gradient (Durkin et al., 2017). This trend of higher SES being associated with higher prevalence of ASD is counter to most other childhood disabilities, which tend to show more prevalence in lower SES (e.g., down syndrome; Durkin et al., 2017). Research has shown that even when looking at public school populations, where evaluations for autism are available through the school, the SES gradient remains. This might be explained by the concept mental health literacy (Castillo et al., 2020), wherein wealthier or more highly educated parents have greater knowledge of autism and are able to advocate for their child's diagnosis more effectively.

This study reported on children from a lens of integrated identity, looking at the ways that race, sex, and geographic region impact their experiences with the healthcare system. These sociodemographic factors combine to create unique experiences of the world as well as impact aspects of care, including provider biases, and access to services.

The average age of autism diagnosis in the group overall was almost 7 years old, although the most common age of diagnosis was almost three years old. Global mean age is currently around 60 months (or 5 years; Van't Hof et al., 2021), and the CDC reports that the US average age of autism diagnosis is 4.5 years (CDC, 2023). This means that the average age of autism diagnosis in the Missouri Medicaid system is about 2.5 years older than the country at large. Because these diagnoses are coming after school has already started (around age 5 or 6) the ability for the children to get individualized education plans (IEPs) set up which were appropriate for their specific symptoms and needs in place in time for the school year is limited. This puts students at risk for unnecessary and unhelpful punitive measures. Furthermore, as this study only included children aged 10 and younger, it is likely that the true average age of child autism diagnosis is even older, when adolescents are included in the sample. That being said, the modal age of around 3 years old is a strong indicator that the most common age of autism diagnosis for children in the Missouri Medicaid system is closer to an ideal age for early interventions and pre-school supports.

Prior Diagnoses

Having no prior diagnoses before the autism diagnosis was associated with being Black and living in an urban area. More prior diagnoses were associated with later age of autism diagnosis. This makes sense as an increased diagnostic load could be an indicator of a complex presentation, comorbidity, and sometimes indicates increased internalizing or externalizing behaviors (Casanova et al., 2020). It could also be related to access to medical care, with more diagnoses just reflecting more visits to doctors and different types of doctor's offices. Race was a significant predictor of being diagnosed with almost

every prior diagnosis we examined, aside from intellectual disability, suggesting connections among race, access to healthcare, diagnostic load, and age of autism diagnosis. Again, this can reflect both the ways that providers or teachers are viewing children, as well as beliefs that families hold about child development (for example, less diagnostic-seeking behaviors at early signs of atypical development, or more tolerance for variability in child development). In the second hypothesis, the author predicted that Black children would be more likely to be diagnosed with conduct disorders, girls would be more likely to be diagnosed with Anxiety and related disorders, and children in rural regions would be more likely to receive ADHD and adjustment and related disorders. Few of these *apriori* predictions were supported by the data.

Our sample found similar rates of ADHD co-diagnosis with autism (24%) as Rosen and colleagues (30%; 2018). In the ADHD model, children who were White, males and living rurally were all more likely to be diagnosed with ADHD prior to their autism diagnosis. There is significant research supporting racial disparities in the diagnosis of ADHD, wherein Black children are diagnosed significantly less often even when presenting similar symptoms (Winders-Davis et al., 2021). Prior research has suggested that similar symptom presentation between ADHD and conduct and related disorders has sometimes led to White children receiving more ADHD diagnoses and children from minoritized racial groups receiving more conduct and related disorders (Fadus, et al., 2020), which can contribute to the increased school disciplinary measures due to the stigmatized nature of the disorder. ADHD is commonly diagnosed by pediatricians, who children living rurally have more access to (American Academy of Pediatrics, 2000). Similarly, in the conduct and related disorders model, being White and living rurally were

both related to more likely to be diagnosed with conduct disorder before autism. This could be explained as more prevalent in rural areas because school providers are more comfortable offering this diagnosis. Boys and girls did not have statistically significantly different rates of diagnosis, in line with prior research which actually indicates that rates of conduct disorders are similar across genders (Rowe et al., 2010).

The relationships among race, sex and geographic region in ADHD and conduct and related disorders warranted further investigation in post-hoc analyses. In particular, descriptive analyses revealed that a much larger percentage of White children were diagnosed with ADHD (27.45%) compared to Black children (18.95%). As rural populations were overwhelmingly White, a more specific look into urban populations with ADHD and conduct and related disorders was important. When looking at just urban males in post-hoc analysis, urban White boys had statistically significantly more diagnoses than urban Black boys. The same was found with urban female children; White girls had statistically significantly more ADHD diagnoses than Black girls. Prior research has found these disparities in Black and White children with ADHD diagnosis, with Black children having significantly lower rates of diagnosis, and lower rates of medication (Coker et al., 2016; Shi et al., 2021; Winders Davis et al., 2021). While biological and genetic indicators may be possible causes of disparities between male and female prevalence of ADHD (Merikangas & Almasy, 2020), racial disparities in ADHD diagnostic rates are typically hypothesized in the field to be more strongly influenced by environmental factors such as provider bias or structural racism (Moody, 2016; Winders Davis et al., 2021). This could have to do with parent beliefs about symptoms or diagnosis (Miller et al., 2009), cultural influences on comorbidity (Slobodin & Masalha,

2020), cultural insensitivity in diagnostic processes and racism in schools (Moody, 2016; Kang & Harvey, 2020), and ability and desire to utilize available services (Eiraldi et al., 2006).

In conduct and related disorders, results of these analyses show that being White was strongly associated with being diagnosed with conduct and related disorders, even in the urban sample. This result held true in the urban male sample, with race as the primary driver of results. In this research project, conduct and related disorders are being diagnosed prior to autism disorders, and in childhood (before age 10), indicating an early onset for the disorder. Conduct disorder is part of a family of externalizing disorders, including ADHD. Conduct disorders and autism are both commonly associated with the often misunderstood symptom of 'lack of empathy' (Schwenk et al., 2012). Understanding nuances of cognitive and emotional empathy and emotional reactivity may help clarify distinctions amongst these disorders (Fairchild et al., 2019).

The conclusions drawn from the data on anxiety disorders, mood and related disorders, and adjustment disorders have many similarities. Our study found lower rates of anxiety and autism comorbidity (around 10%) than is hypothesized in the literature, where anxiety is considered the most common comorbidity (Lai et al., 2019; Rosen et al., 2018). This is likely due to anxiety being diagnosed after autism, where our study only includes only those diagnoses assigned before. In the model which measured factors associated with prior diagnosis of anxiety and related disorders, sex was not a significant predictor. In this way, *apriori* hypotheses were not supported. That being said, Lai and colleagues (2011), also found similar rates of anxiety, depression, and OCD symptoms in male and female autistic participants, so there is some precedent in the literature for these

findings. Geographic region was also not a significant driver of pre-diagnostic picture when it came to anxiety, depression, or adjustment disorders. Being White was associated with having an anxiety disorder (almost 2.5 times more likely), adjustment disorder (1.76 times as likely), and mood disorder (1.45 times as likely). Research on race and anxiety, mood, and adjustment disorders is still unfolding connections among racial identity, culture, SES, and prevalence in pediatric populations.

Mandell and colleagues (2007) hypothesized in their work that providers might be using adjustment disorder when they are hesitant to assign a diagnosis to a child with complex symptoms. With that being said, one study of children with autism found racial differences in comorbid treatment including in psychiatric services such as anxiety and depression treatment and evaluation (Broder-Fingert et al., 2013). This study found that Black autistic children had fewer appointments and evaluations from psychiatrists, but the researchers could not determine or comment on whether this was due to reduced need or access. While autism is considered in the literature primarily biological in nature (Parellada et al., 2014), anxiety and mood disorders likely feature a combination of environmental and biological precedents (Schiele & Domshke, 2018). One possible explanation for these findings is that Black families serve as a protective factor for children with autism or neurodevelopmental disorders, reducing comorbid rates of anxiety and depression. Many protective factors have been hypothesized to be part of cultural values and family structures in the Black community including hope, resilience, social support, feelings of efficacy, extended family network support and more (Keyes, 2009; Liu et al., 2017; Taylor, 2010; Taylor et al., 2015).

Mandell and colleagues (2007), which this work aims to extend, had very

different findings. The prior study found that Black children were more likely to be diagnosed with another condition before autism. In this study, Black children were more likely to have no prior diagnoses. This study also expanded on the initial question to investigate rural and urban differences and differences based on sex. Mandell hypothesized that his 1993-1999 Philadelphia Medicaid sample might be diagnostically complex; contributing to multiple prior diagnoses or comorbidities, as well as later age of diagnosis, a similarity between the two studies. As discussed, emotion regulation is a significant symptom within autism (Mazefsky et al., 2011), and a common thread with many of the examined comorbidities, whether they be externalizing and aggressive, such as ADHD (Steinberg & Drabick, 2015) and conduct disorders (Schoorl et al., 2016), or internalizing, such as anxiety (Cisler et al., 2010) and depression (Young et al., 2019). Miscategorization of normal reactions within disorders as 'externalizing behaviors' can exacerbate stigma associated with a child and may hold particular importance for members of marginalized communities who may already be wrongly perceived as aggressive (Beltran et al., 2021; Grimmet et al., 2016). There are a few reasons that the findings from this study may not match the original Mandell results. First, autism diagnostic rates in general, and in particular among people of color, have increased due to resource allocation and increased awareness about autism (Nevison & Zahorodny, 2019). Also, since 1999, the DSM -5 has eliminated Asperger's disorder and put autism on a spectrum, meaning that more people might fall under the umbrella of autism (APA, 2013). Finally, changes to the healthcare system mean that more people have access to healthcare in the United States in 2015 as compared to the last 1990s, which might allow for more access to diagnostic care and services, increasing rates of diagnosis.

Intellectual disability diagnostic rates in this data (3.7%) were much lower than they are hypothesized to be in autism at large, which is around 31% (Baio et al., 2018). In line with prior research and author hypotheses, being a girl was significantly related to more likely to have co- occurring intellectual disability. One possible reason that the percent of children with intellectual disability is so uncharacteristically low is the order of diagnosis. It may be that children are receiving their intellectual disability diagnosis later, after an autism diagnosis, and thus are not in our sample. Children may be carrying 'developmental delay' diagnoses, or other similar terms, in medical records which were not included in analyses. Furthermore, children who were brought on Medicaid with a diagnosis of intellectual disability may have been cut during data cleaning procedures which excluded participants who came on Medicaid due to a disability diagnosis.

Concerns and limitations

One limitation is that the authors cannot speak to the accuracy or severity of these prior diagnoses; as detailed above, it is possible to be accurately assigned autism and other diagnoses comorbidly, or also possible that prior diagnoses are being replaced by the autism diagnosis. Medical records tend to accrue diagnoses without replacing officially and this can be stigmatizing for children with heavy diagnostic loads (Angell & Soloman, 2014). While most research suggests that rising autism rates are related to increased awareness, an increase in recognition in populations of color and girls, and other reasons, it is also possible that misdiagnosis or overdiagnosis is occurring. Some current research also hints that if over or underdiagnosis is occurring, it could be related to stigma and cultural biases (Azim et al., 2020).

The author cannot speak to how children were diagnosed with autism and the

certainty of that diagnosis, but some research has indicated that in the case of autism, medical records are typically accurate. Fombonne and colleagues (2004) showed that medical records were, in fact, highly accurate in autism diagnoses. That being said, Medicaid claims are a billing mechanism, and not a replication of medical records. Inconsistent coverage, for example when wages and income in a family fluctuate, through a parent's marriage, when changes to the eligibility criterion for Medicaid, and more, can all impact Medicaid coverage and lead to impacts on claims data and health effects for enrollees (Bensken et al., 2022).

Although medical record review can facilitate sampling a large, diverse group, there are also people excluded when we use this sample. One large limitation with this data is that ethnicity was not available to the researchers. US Census data indicates that around 5% of Missourians identify as Hispanic or Latino, and this population can face unique challenges when it comes to accessing evaluations for autism, diagnostic processes, health disparities, and more (Zuckerman et al., 2014). Participants are included and categorized by race in this study, which means the data cannot reveal unique and important features of experiences of ethnic minorities. Furthermore, race is a social construct, and serves as a proxy variable for many other related variables such as experiences of discrimination, cultural influences, health disparities, and many other contributors to experiences (Bryant et al., 2022).

Moreover, while Medicaid data allows the unique opportunity for the author to include participants across urban and rural regions, there may be people in very rural parts of the state, with no internet access, nor help to enroll, who feel overwhelmed, isolated, and unable to make use of this resource, or have negative stereotyped beliefs

about accepting governmental help and thus refuse to enroll in Medicaid. Indeed, even making urban and rural regions into a dichotomous variable also collapses variability within those geographical labels, for example how well-resourced an area is, how populated, and racial and socioeconomic differences within urban or rural areas. Undocumented immigrants may not enroll in Medicaid out of fear of utilization of state systems. Furthermore, this study will not be reflective of what families in higher SES communities experience, those with private insurance or paying out of pocket for services.

This study, despite its high power and strong sample size, overall showed small effect sizes of race, geographical region, or sex on, especially, age of diagnosis, but also on pre- diagnostic pictures. This likely means that there are many other factors which influence these outcomes.

Future Directions

While this project updates the field's understanding of prior diagnoses and influences of race, sex, and geographic region on those presentations, there is much more to be done in terms of the examination of racism, sexism and ableism in neurodevelopmental disorders and comorbidities. First, an investigation into what other factors influence age of diagnosis and prior diagnostic picture would be recommended. These factors could include social support to the family, early childhood care centers, screeners used in primary care office, number of early childhood pediatric well-child visits, among other factors. A comparison to sociodemographics in the broader Missouri Medicaid child data would help researchers understand whether under (or over) diagnosis is occurring in the sample, or whether numbers match broader trends of

sociodemographics in Medicaid. A gap in the literature remains as to the experiences, strengths, symptom presentations, diagnostic processes, and provider experiences for Black autistic girls. Future research could use large datasets such as this to examine these experiences from the quantitative perspective. Almost half of children in Missouri (45%) are covered by Medicaid, this makes it an invaluable resource for data on diverse healthcare experiences in the state (Kaiser, 2019).

Another important direction is related to access. While Medicaid, by its very existence, increases access to healthcare by offering state-funded insurance, access to healthcare is more complex than only insurance coverage, and many other things contribute to a family's ability to access medical care. This can be related to hours of operation of doctors' offices, parents' literacy levels, distance to doctor's office or pharmacy, coverage or availability of certain prescriptions, availability of providers and waitlists, language barriers, provider bias toward family, family comfort, treatment by medical practitioners, and more. Some aspects of this dataset could be used to investigate these questions further. For example, looking further into who is giving these autism diagnoses (i.e., what type of provider; a psychologist, medical doctor, occupational therapist, etc.). Understanding which providers are diagnosing children with autism could tell a lot about access in urban and rural areas, about the expansion of rates of autism, and provider specialties. Furthermore, what medications are autistic children being prescribed? Hypotheses vary in terms of disparities in access to prescriptions, and families can have strong beliefs about what medications their children should take which can dictate usage.

Some debate is ongoing in the autism literature as to whether emotion regulation

is a core aspect of autism, and related to its core criterion such as rigidity or sensory sensitivity, relevant to its physiology such as prefrontal cortex differences, or rather a very common albeit separate comorbid feature (Mazefsky et al., 2011). The comorbidity and shared transdiagnostic symptomology amongst autism and other disorder investigated here may be genetic, environmental (as it pertains to experiences of growing up with disability), or a combination of these. Future researchers may want to examine emotion regulation as a transdiagnostic construct, which would underlie autism as well as many of the comorbidities investigated in this study.

Finally, in Missouri, when looking at and comparing urban and rural areas, further gradations of both of these should be considered. While urban-living may be associated generally with better access to care, some urban centers in Missouri may have fewer providers per capita and longer waitlists than areas of rural Missouri. Furthermore, rural regions can have significant diversity. Some rural areas are relatively well-resourced when it comes to healthcare, more populated, and have more funding. Comparatively, in other parts of the state families may need to drive multiple hours to get to regular doctor appointments and have fewer financial resources. Further examination and quantification of access related to geographic region could support efforts to make healthcare more equitable in the state.

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(N.d.)

Tables

Table 1
Descriptive Statistics of the Full Sample

Variables	n	% or Mean	Range or SD
Average Age of Dx with ASD	13850	360.812	162.43
Sex (Male)	13851	78.16%	0-1
Race			
1. White	10242	73.94%	0-1
2. Black/African American	1999	14.43%	0-1
4. American Indian/Alaska Native	48	0.34%	0-1
5. Asian	107	0.77%	0-1
6. Native Hawaiian/ Pacific Islander	19	0.14%	0-1
7. Multiracial	322	2.32%	0-1
Unknown			0-1
Geography (Urban)	13851(80260	57.95%	0-1
Pre-diagnostic pictures			
Diagnosed with ADHD and related	3384	24.43%	0-1
Diagnosed with Conduct and related	2210	15.95%	0-1
Diagnosed with Adjustment and Related	850	6.13%	0-1
Diagnosed with Anxiety and related	1320	9.53%	0-1
Diagnosed with Mood and related	948	6.84%	0-1
Diagnosed with Intellectual Disability and related	512	3.70%	0-1

Table 2.
Descriptive Statistics of the Sub-Sample of Black and White Participants

Variables	n	% or Mean	Range or SD
Average Age of Dx with ASD	12240	362.35	160.15
Sex (Male)	12241(9581)	78.27	0-1
Race			0-1
White	10242	83.69%	
Black/African American	1999	16.33%	
Geography (Urban)	12241(6925)	56.57%	0-1
Pre-diagnostic pictures			
Diagnosed with ADHD and related	3191	26.06%	0-1
Diagnosed with Conduct and related	2042	16.68%	0-1
Diagnosed with Adjustment and Related	785	6.41%	0-1
Diagnosed with Anxiety and related	1226	10.00%	0-1
Diagnosed with Mood and related	899	7.34%	0-1
Diagnosed with Intellectual Disability and related	479	3.91%	0-1

Table 3
Detailed Descriptives by Racial Groupings

	Racial groups			Effect size Cohen's D or Phi
Variables	White	Black	*p*	
Sex (Male)	78.08%	79.24%	.250	-0.010
Geography (Urban)	50.11%	89.65%	< .001	-0.295
ASD dx	366.59	340.60	<.001	0.163
Pre-diagnostic pictures				
Diagnosed with ADHD and related	27.45%	18.95%	<.001	0.072
Diagnosed with Conduct and related	17.77%	11.11%	<.001	0.066
Diagnosed with Adjustment and Related	6.90%	3.91%	<.001	0.045
Diagnosed with Anxiety and related	11.07%	4.60%	<.001	0.080
Diagnosed with Mood and related	7.74%	5.30%	<.001	0.035
Diagnosed with Intellectual Disability and related	3.87%	4.10%	.634	-0.004

Note: Significance based on p value from a chi square or t test. DF for all chi square =1, for T test, 12,238. To interpret phi, a small effect size is .1 or less, medium is .3, and .5 is a large effect. For Cohen's d, .2 or under is considered to be a small effect size.

Table 4
Subsample Descriptives by Sex Group

	Sex			Effect size Cohen's *d* or Phi
Variables	Female	Male	*p*	
Race (Black)	15.6%	16.5%	.250	-0.010
Geography (Urban)	57.4%	56.3%	.319	-0.009
ASD dx	357.26	363.76	<.001	-0.041
Pre-diagnostic pictures				
Diagnosed with ADHD and related	21.42%	27.35%	<.001	0.056
Diagnosed with Conduct and related	15.45%	17.02%	.054	0.017
Diagnosed with Adjustment and Related	6.95%	0.00%	.197	-0.012
Diagnosed with Anxiety and related	11.01%	9.74%	.052	-0.018
Diagnosed with Mood and related	7.41%	7.32%	.890	-0.001
Diagnosed with Intellectual Disability and related	5.00%	3.61%	.001	-0.030

Note: Significance based on p value from a chi square or t test. DF for chi square =1. To interpret phi, a small effect size is .1 or less, medium is .3, and .5 is a large effect. For Cohen's d, .2 or under is considered to be a small effect size.

Table 5

Linear Regression with Outcome of Age of Diagnosis

Predictor	Unstandardized B	Unstandardized S.E.	Standardized Beta	T	Significance	95% Confidence Interval
Block 1 Model						
Race (White = 1)	15.13	3.77	0.04	4.01	<.001	[7.733, 22.523]
Sex (Male = 1)	4.49	3.22	0.01	1.39	0.164	[-1.827, 10.803]
Geographic (Urban = 1)	9.49	2.81	0.03	3.38	<.001	[3.983, 14.991]
Block 2 Model						
Race (White = 1)	15.13	3.77	.04	4.01	<.001	[7.73, 22.52]
Sex (Male = 1)	4.49	3.22	.01	1.39	.164	[-1.83, 10.80]
Geographic (Urban = 1)	9.49	2.81	.03	3.38	<.001	[3.98, 14.99]
Any prior diagnoses cumulative	54.86	1.16	0.40	47.43	<.001	[52.597, 57.132]

Note: r squared block 1 =.004, r squared block 2 = .159, N = 12230. The Benjamini-Hochberg False Discovery Rate (Benjamini-Hochberg, 1995) correction was used to protect against multiple comparisons inflation of type 1 error, all findings remain significant.

Table 6
ADHD Model

Predictor	B	S.E.	Wald	df	Significance	Exp (B)	95 % CI
Race (White = 1)	0.44	0.06	47.83	1	<.001	1.55	[1.37, 1.76]
Sex (Male = 1)	0.33	0.05	38.60	1	<.001	1.39	[1.25, 1.54]
Geographic (Urban = 1)	-0.11	0.04	6.75	1	0.009	0.89	[0.82, 0.97]

Note: -2 Log likelihood = 13925.69, Nagelkerke R Square = 0.013, N = 12,231. The Benjamini-Hochberg False Discovery Rate (Benjamini-Hochberg, 1995) correction was used to protect against multiple comparisons inflation of type 1 error, all findings remain significant.

Table 7
Conduct and Related Model

Predictor	B	S.E.	Wald	df	Significance	Exp (B)	95 % CI
Race (White = 1)	0.44	0.08	31.23	1	<.001	1.55	[1.33, 1.81]
Sex (Male = 1)	0.12	0.06	3.80	1	0.051	1.13	[0.99, 1.27]
Geographic (Urban = 1)	-0.27	0.05	28.33	1	<.001	0.76	[0.69, 0.84]

Note: -2 Log likelihood = 10942.27, Nagelkerke R Square = 0.012, N = 12,231. The Benjamini-Hochberg False Discovery Rate (Benjamini-Hochberg, 1995) correction was used to protect against multiple comparisons inflation of type 1 error, all findings remain significant.

Table 8
Adjustment and Related Model

Predictor	B	S.E.	Wald	df	Significance	Exp (B)	95 % CI
Race (White = 1)	0.56	0.13	20.08	1	<.001	1.76	[1.37, 2.25]
Sex (Male = 1)	-0.11	0.09	1.55	1	0.213	0.90	[0.76, 1.06]
Geographic (Urban = 1)	-0.09	0.08	1.46	1	0.228	0.91	[0.79, 1.06]

Note: -2 Log likelihood = 5798.65, Nagelkerke R Square = 0.007, N = 12,231. The Benjamini-Hochberg False Discovery Rate (Benjamini-Hochberg, 1995) correction was used to protect against multiple comparisons inflation of type 1 error, all findings remain significant.

Table 9
Anxiety and Related Model

Predictor	B	S.E.	Wald	df	Significance	Exp (B)	95 % CI
Race (White = 1)	0.91	0.11	64.01	1	<.001	2.49	[1.99, 3.12]
Sex (Male = 1)	-0.13	0.07	3.52	1	0.061	0.88	[0.76, 1.01]
Geographic (Urban = 1)	-0.08	0.06	1.73	1	0.189	0.92	[0.82, 1.04]

Note: -2 Log likelihood = 7863.631, Nagelkerke R Square = 0.016, N = 12,231. The Benjamini-Hochberg False Discovery Rate (Benjamini-Hochberg, 1995) correction was used to protect against multiple comparisons inflation of type 1 error, all findings

Table 10
Mood and Related Model

Predictor	B	S.E.	Wald	df	Significance	Exp (B)	95 % CI
Race (White = 1)	0.37	0.11	11.31	1	<.001	1.45	[1.17, 1.80]
Sex (Male = 1)	-0.01	0.08	0.01	1	0.916	0.99	[0.84, 1.17]
Geographic (Urban = 1)	-0.08	0.07	1.311	1	0.252	0.92	[0.80, 1.06]

Note: -2 Log likelihood = 6406.707, Nagelkerke R Square = 0.003 The Benjamini-Hochberg False Discovery Rate (Benjamini-Hochberg, 1995) correction was used to protect against multiple comparisons inflation of type 1 error, all findings remain significant.

Table 11
Intellectual Disability Model

Predictor	B	S.E.	Wald	df	Significance	Exp (B)	95 % CI
Race (White = 1)	-0.17	0.13	1.76	1	0.185	0.84	[0.65, 1.09]
Sex (Male = 1)	-0.35	0.11	11.01	1	<.001	0.71	[0.58, 0.87]
Geographic (Urban = 1)	-0.26	0.10	6.90	1	0.009	0.77	[0.64, 0.94]

Note: -2 Log likelihood = 4019.122, Nagelkerke R Square = 0.005, N = 12,231. The Benjamini-Hochberg False Discovery Rate (Benjamini-Hochberg, 1995) correction was used to protect against multiple comparisons inflation of type 1 error, all findings remain significant.

Table 12
Intersectional Analyses

Sub-categories	% within group prior dx	N	Average age of ASD dx	Any previous dx
Urban White female	36.34%	1150	365.52	418
Urban White male	36.55%	3983	369.96	1456
Urban Black male	27.86%	1414	345.41	394
Urban Black female	20.63%	378	321.94	78
Rural White female	37.56%	1094	360.23	411
Rural White male	36.33%	4007	365.16	1456
Rural Black female	51.35%	37	372.78	19
Rural Black male	29.76%	168	334.26	50

Note: Total N: 12,241.

Figure 1

Percent of Autistic Children on Missouri Medicaid with Each Examined Prior Diagnosis by Race and Sex

*Note: * represents a significant difference at p<.05.*

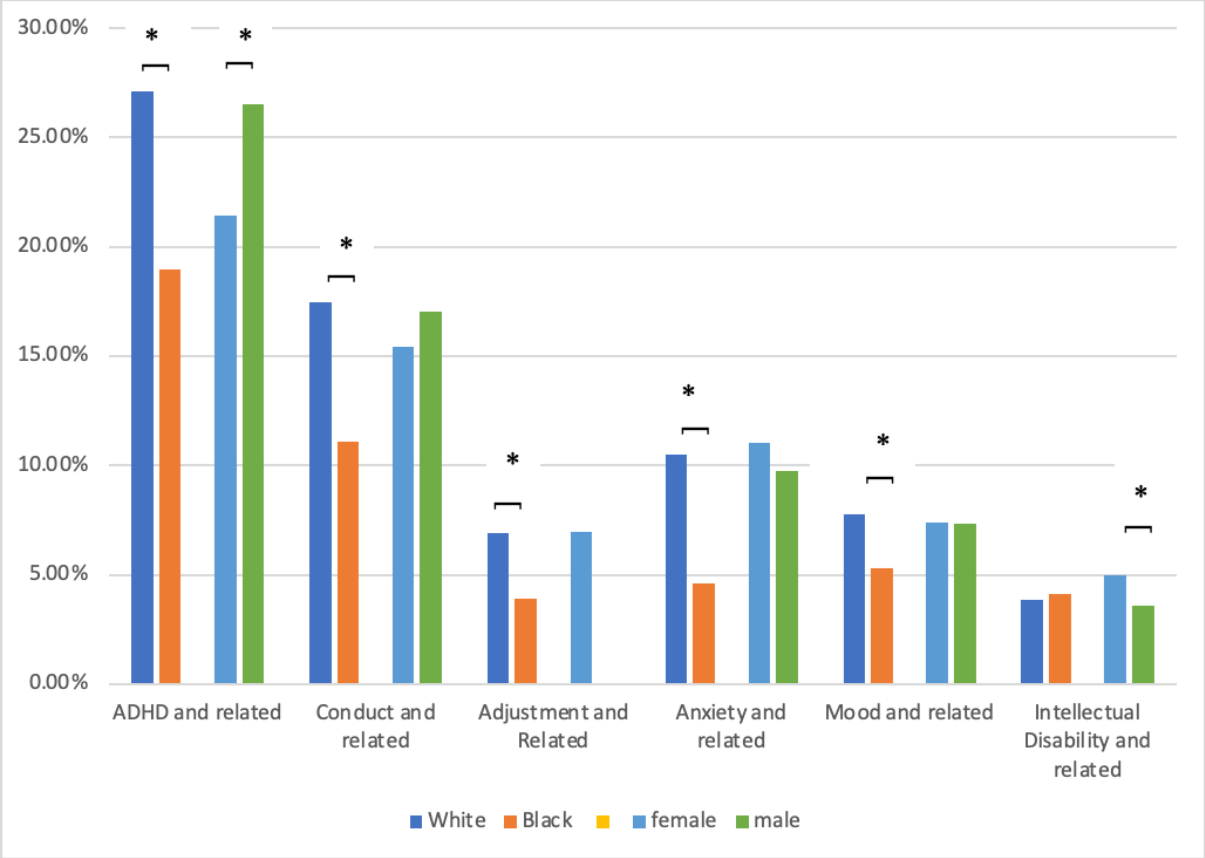
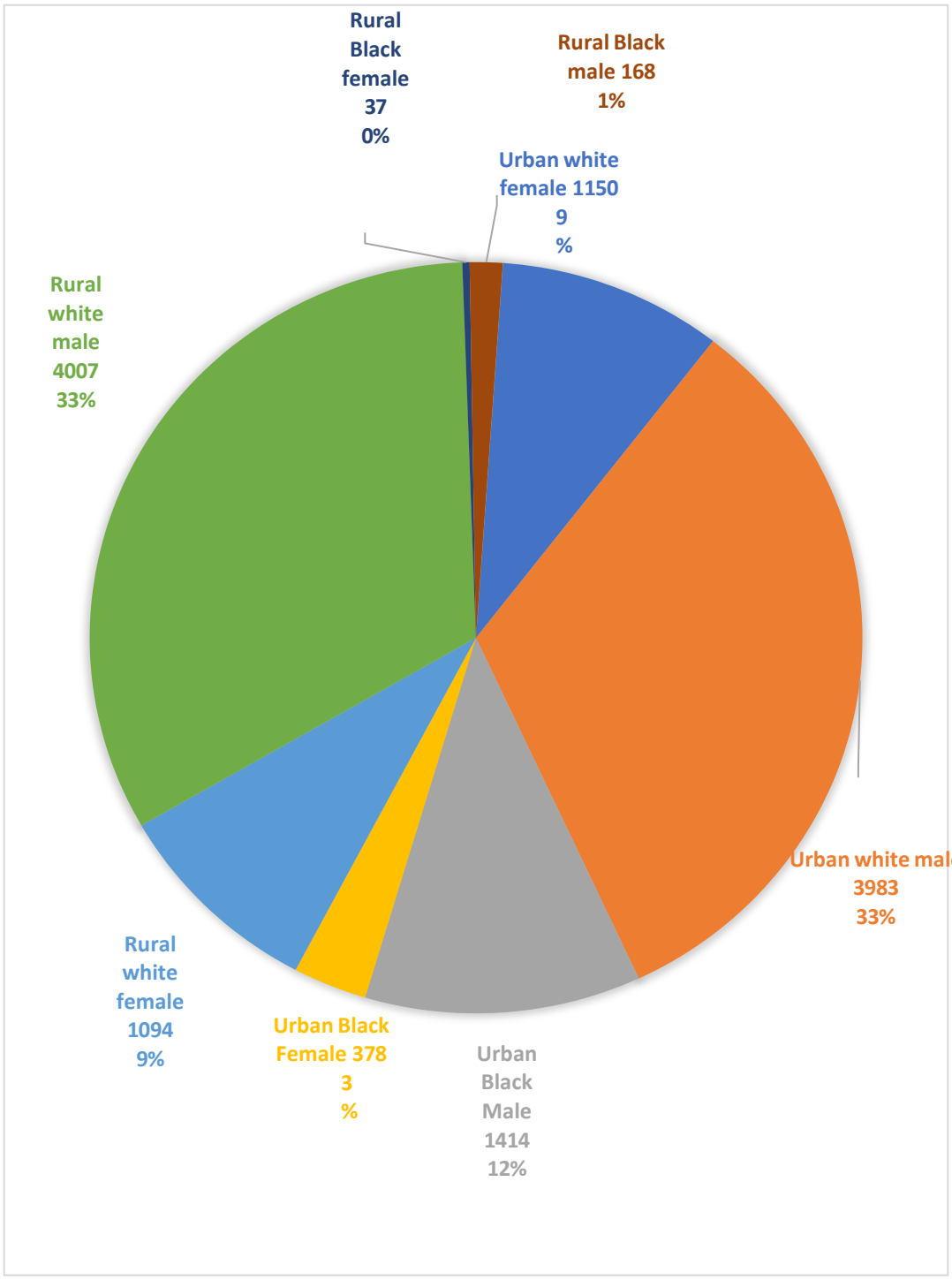


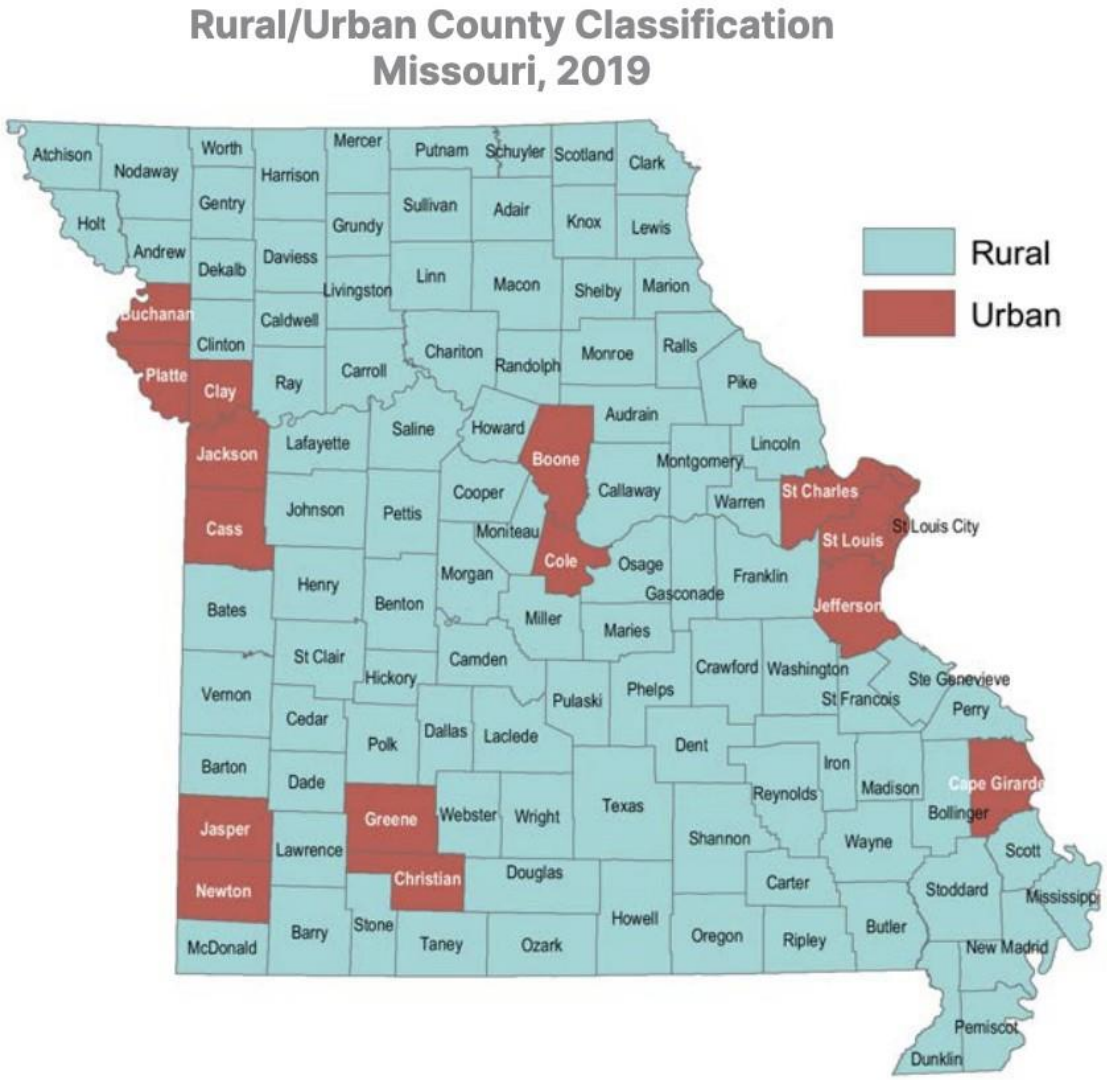
Figure 2

Intersectional Identities of Autistic Missouri Medicaid Children Based on Included Sociodemographic Variables



Appendix A

Urban and rural divisions of Missouri Counties.



Source: Missouri Department of Health and Senior Services. Bureau of Health Care Analysis and Data Dissemination.

Note: Urban Rural map from Office of Rural Health and Primary Care, Bureau of Health care

Analysis and Data Dissemination, & Office of Epidemiology. (2020). Health In Rural Missouri, Biennial Report, 2020-2021. Missouri Department of Health and Senior Services. https://health.mo.gov/living/families/ruralhealth/pdf/biennial2020.pdf