The Health of College Students on the Autism Spectrum as Compared to their Neurotypical Peers

Introduction

Prior research indicates that autism is associated with increased risk of physical and mental health problems among children (e.g., Bauman, 2010; Levy et al., 2010; Schieve et al., 2012) and adults (e.g., Bishop-Fitzpatrick & Rubenstein, 2019; Cashin, Buckley, Trollor, & Lennox, 2018; Hollocks et al., 2019; Rydzewska et al., 2019; see Bishop-Fitzpatrick & Kind, 2017 for a review). With respect to physical health, children on the autism spectrum have high rates of epilepsy, gastrointestinal disorders, metabolic disorders, obesity, and sleep disorders relative to their neurotypical peers (Bauman, 2010; Bishop-Fitzpatrick & Kind, 2017; Levy et al., 2010; Schieve et al., 2010). With respect to mental health, children on the autism spectrum experience elevated rates of anxiety, depression, bipolar disorder, and attention deficit hyperactivity disorder (ADHD; e.g., Joshi et al., 2013; Rosenberg, Kaufman, Law, & Law, 2011; see Hollocks et al., 2019 for a review). These problems follow children into adulthood; adults with autism have relatively high rates of cardiovascular risk factors (e.g., obesity, diabetes, hyperlipidemia), gastrointestinal disorders, hypothyroidism, immune conditions, neurological conditions, sleep disorders, depression, and anxiety (Bishop-Fitzpatrick & Rubenstein, 2019; Croen et al., 2015; Hollocks et al., 2019; Joshi et al., 2013), with some studies finding even higher risks among people with co-occurring intellectual disabilities (Bishop-Fitzpatrick & Rubenstein, 2019; Cashin et al. 2018).

Despite active research interest in the physical and mental health conditions associated with autism among child and adult populations, relatively little is known about the associations during the transition to adulthood. In terms of both physical and mental health, this transitional period represents a critical link between childhood and adulthood. The decisions youth make about

health during the transition influence their physical and mental health for the rest of adult life (Lawrence, Mollborn, & Hummer, 2017). On average, levels of physical activity and healthy eating decline during the transition to adulthood, and alcohol use and risky sexual behavior increase (Institute of Medicine and National Research Council, 2015). Perhaps owing to these lifestyle changes (Lawrence et al., 2017), self-rated health declines during the transition to adulthood as well (Bauldry, Shanahan, Boardman, Miech, & Macmillan, 2012). Understanding how the health of young adults on the autism spectrum differs from their neurotypical peers at this critical life stage offers insight into differences in the long-term health trajectories of these groups.

What little we know suggests that the physical and mental health disadvantages that accompany autism in childhood extend through the transition to adulthood (Weiss et al., 2018). For example, consistent with the results from studies of children and of older adults, young adults on the autism spectrum have high rates of allergies, hypertension, and seizure disorders (Fortuna et al., 2016). They are also less physically active than other young adults (Howlin & Moss, 2012) and, perhaps as a result, are more likely to be obese (Eaves & Ho, 2008). In addition, in contrast to the general population, which sees a decline in depression and anxiety during the transition to adulthood (Galambos, Barker, & Krahn, 2006), youth on the autism spectrum experience increases in depression and anxiety during this life stage (Kuusikko et al., 2008). These studies suggest that health differences based on autism remain steady, or perhaps even accelerate, as youth transition to adulthood.

Existing research on autism and health during young adulthood is limited in three key ways. First, despite studies of the prevalence of specific medical conditions, we know little about the *general health status* of people with autism spectrum disorders at this life stage. By general

health status, we mean people's overall evaluations of their health (i.e., self-rated physical and mental health). General health evaluations are a function of specific medical and psychiatric conditions but also of more general assessments of physical functioning and well-being. Perhaps because of their broad scope, general physical and mental health evaluations predict future physical and psychiatric morbidity and mortality independent of objective health (Idler & Benyamini, 1997; McAlpine, McCreedy, & Alang, 2018), confirming their relevance as indicators of overall health.

To the best of our knowledge, no studies have considered general *mental* health status in samples of persons on the spectrum, though we are aware of two prior studies that provide some insight into general physical health status among youth on the autism spectrum. The National Longitudinal Transition Study 2012 surveyed youth ages 13-21 with an Individualized Education Program or who received disability accommodations. Within that sample, youth with intellectual disabilities, multiple disabilities, and orthopedic impairments were less likely than youth with autism or with other disabilities to have "very good" or "excellent" general health (Lipscomb et al.. 2017). However, because that study did not provide a comparison to the general population, it cannot address the question of whether youth on the autism spectrum have worse health than their neurotypical peers. Partly addressing that limitation, Rydzewska and colleagues (2019) compared general health status ratings for adults ages 25 and above who reported having an autism spectrum disorder to those who did not. The proportion of adults reporting poor health was significantly higher among respondents who reported autism (48.6%) than among those who did not (23.7%), although the difference declined with age. Interpolating to the young adult age group, we would expect to observe significantly lower general health status ratings for young adults on the autism spectrum as compared to their neurotypical peers.

Second, although students on the autism spectrum experience comorbid disabilities (sensory, mobility, learning, ADHD, other mental health disorders) that are also associated with health (e.g., Combs-Orme, Heflinger, & Simpkins, 2002), researchers have not yet analyzed the extent to which their poor health is attributable to comorbid conditions. Understanding the physical and mental health challenges that are unique to autism is essential to designing effective services for students on the spectrum and with associated disabilities.

Third, prior studies have not provided data on the specific experiences of college students on the autism spectrum. Focusing on population of college students offers two analytical benefits. First, it allows us to address the specific needs of a growing subgroup of people on the autism spectrum. High school students on the spectrum increasingly aspire to and enroll in college (Anderson McDonald, Edsall, Smith, & Taylor, 2016; Wagner, Newman, Cameto, Garza, & Levine, 2005; Wehman et al., 2014). To date, we know relatively little about the unique experiences of college students on the spectrum compared to the more general population of adults with autism (Gelbar, Smith, & Reichow, 2014). Second, focusing on college students restricts the range of co-occurring intellectual disabilities among study participants. Intellectual disabilities heighten the risk of poor health among adults on the autism spectrum (Bishop-Fitzpatrick & Rubenstein, 2019), implying that studies of the association of autism with physical and mental health outcomes should control for co-morbid intellectual disabilities. Because students on the spectrum who enroll in college do not have profound intellectual disabilities, focusing on that subpopulation in effect provides that control. By so doing, it also allows us to engage the question of how much the general health challenges of young adults on the spectrum extend to this specific, less intellectually disabled, group.

The ongoing challenges that students on the spectrum face in college environments add urgency to our analysis. Despite increasing rates of enrollment, students on the autism spectrum graduate from college at much lower rates than neurotypical students (e.g., Anderson et al., 2016; Sanford et al., 2011; Wehman et al., 2014). Several explanations have been offered for the academic challenges that college students on the spectrum experience, including poor college preparation, poor executive functioning, low reading proficiency, pragmatic language difficulties, and limited social engagement (e.g. Elias & White, 2018; Gelbar, Shefyck, & Reichow, 2015; Trevisan & Birmingham, 2015). Health problems are another plausible explanation as they are associated with lower rates of college graduation in the general population (DeBerard, Spielmans, & Julka, 2004). If the health problems observed among children, adolescents, and adults on the autism spectrum extend to college students, they may contribute to these students' low rates of graduation.

Despite the increasing presence of students on the spectrum on college campuses, many institutions remain poorly equipped to assist them. While postsecondary educators are aware of the challenges that students on the spectrum face with respect to interpersonal competence, autonomy, and mature interpersonal relationships (Elias, Muskett, & White, 2017), they express uncertainty about how best to support students on the autism spectrum (McKeon, Alpern, & Zager, 2013). Not surprisingly, then, college students on the spectrum report high levels of unmet need, especially in areas other than academic accommodations (Gelbar et al., 2015). Moreover, although colleges and universities may offer health-related educational programs or facilities, they typically do not offer institutional supports to encourage positive physical health behaviors (e.g., healthy eating, physical exercise; Nelson Story, Larson, Neumark-Sztainer, & Lytle, 2008). Nor do they offer programs targeted toward specific populations for whom

traditional and large-group programs may be ill-suited. The absence of such programs may be especially consequential for students on the spectrum some of whom have restricted food preferences and a history of physical inactivity (Cermak, Curtin, & Bandini, 2010; Hamm & Yun, 2019).

We take these limitations as the starting point for an analysis that evaluates the physical and mental health of college students on the autism spectrum as compared to their neurotypical peers, both before and after accounting for co-occurring disabilities. Our analysis incorporates indicators of general physical and mental health as well as four specific conditions with special relevance to college student populations: depression, anxiety, binge drinking, and sleep deprivation. More specifically, we ask two research questions.

What is the association of autism with physical and mental health outcomes among college students? In the past decade, researchers have given increasing attention to the college experiences of students on the autism spectrum but have not yet evaluated the health challenges these students experience. We consider six outcomes: self-rated physical health; self-rated mental health; depressive symptoms; symptoms of anxiety; sleep deprivation; and binge drinking. Based on results in adult samples, we expect college students on the autism spectrum to report poorer physical and mental health than their neurotypical peers, as well as higher levels of sleep deprivation. Although prior research is limited, it suggests that students with disabilities binge drink *less* than other college students (West, Graham, & Temple, 2017). We extend this research to autism specifically.

To what extent is the association of autism with health independent of comorbid disabilities? We consider six other types of disabilities—sensory impairment, mobility impairment, learning disability, ADHD, other mental health disorders, or other disabilities—three of which (learning

disability, ADHD, and mental health disorders) are more common among people with autism (O'Brien & Pearson, 2004; Rosenberg, Kaufmann, Law, & Law, 2011). Based on evidence that autism is less strongly associated with physical health than are other developmental disabilities in young adult samples (Weiss et al., 2018), we expect the association of autism with health to be reduced significantly by the presence of controls for comorbid disabilities.

Methods

Data come from an online survey of college students that was fielded at 14 2-year and 4-year postsecondary institutions in Indiana in spring 2017. The survey was programmed in Qualtrics and implemented by the Center for Survey Research at Indiana University. The Indiana University Institutional Review Board reviewed and approved all study procedures (protocol 1606175874).

Sample Recruitment

All public 2-year and 4-year post-secondary institutions in the state were invited to participate in the study (N=26). In all, 14 institutions participated, including six of eleven regions of the statewide community college system.[1] Participating institutions vary in their selectivity and size, with total undergraduate student populations ranging from approximately 3,000 to 30,000. Each participating institution was asked to contribute two samples of students: (1) all students who were currently registered for disability accommodations based on autism (the "registered" sample) and (2) a probability sample of currently-enrolled, degree-seeking undergraduate students (the "general sample"). All participating institutions agreed to provide a registered sample. Ten institutions also provided a general sample. The general samples allowed us to capture students who had been diagnosed on the autism spectrum but who were not registered for accommodations, and to compare students on the spectrum to their neurotypical peers.

[1] We count regional campuses as separate institutions.

Students were recruited to the study via emails that introduced the study and provided links to the survey. The emails began: “People often say that college is a ‘special time’ in your life. Is that true for you? We are conducting a study of student experiences in coursework, social life, and beyond to learn more about what makes college special for some students and not so special for others.” The invitation assured students that all survey information would be held strictly confidential and that their participation was voluntary.

With one exception, to protect the privacy of students in the registered sample, institutions sent recruitment emails to those students on our behalf. Each email included an anonymized link to the survey. The Center for Survey Research sent invitations directly to students in the general sample with personalized messages and personalized survey links. The initial invitation was followed by two reminder messages, sent roughly 7-10 days later. In the early stages of the survey, participants in the general sample were offered a $5 gift card and entry into a drawing for $500 to complete the survey; participants in the registered sample were offered a $10 gift card and the same drawing entry. In order to increase response rates, the respondent incentives were increased to $10 and $20, respectively, at the second and third invitations. After receiving the survey link, participants reviewed the informed consent document and consented to participate before beginning the survey.

Institutions provided basic demographic information (age, race/ethnicity, gender, domestic v. international status) for their general samples; institutions did not provide the same information for the registered samples. By comparing the demographic characteristics of participants to those of their institutions, we were able to evaluate bias in the sample. Although there is some variation across institutions, women and white respondents tend to be slightly overrepresented among participants in the general sample.

Survey Questionnaire

Participants answered a series of questions related to their college experiences, including prior educational background, motivations for attending college, academic challenges, course-taking and classroom behaviors, feelings of belonging, social relationships, and health. Participants who reported any of a series of conditions (autism, sensory or mobility impairments, learning disabilities, a mental health disorder) answered an additional series of questions on disability accommodations. Participants who reported a diagnosis of autism also answered questions on whether they disclosed their diagnosis to their college and on autism identity. Many questions were drawn from existing national surveys of young adults and college students, including the National Survey of Student Engagement (Kuh, 2009) and the National Longitudinal Study of Adolescent to Adult Health (Harris & Udry, 2018). The draft questionnaire was shared with members of a campus autism support group for their feedback before being finalized. Based on this feedback, the informed consent statement was reorganized to present less information per computer screen, and response options for some questions were simplified.

Response Rate and Sample Size

In total, 3,216 students completed the survey, of whom 78 were in the registered sample. Using AAPOR's Response Rate 1 (the "minimum response rate," American Association for Public Opinion Research 2016), the response rate for the general sample was about 14%, with response rates for individual institutions ranging from 6.32% to 25.45%. The response rate for the registered sample was about 15%, with response rates for individual institutions ranging from 1.10% to 31.71%. The overall cooperation rate was roughly 87%, meaning that 87% of the students who opened the recruitment email and clicked on the survey link went on to complete the survey.

We restrict our analysis to students ages 34 and younger, 88% of our sample, based on evidence that over 90% of full-time or part-time undergraduate students at public institutions fall into that age range (McFarland et al., 2019).[2] This leaves us with a sample of 2,820 students before accounting for missing data. Although we chose the age restriction to capture the typical age range for college students at public institutions, the choice was inconsequential: the pattern of results was the same for youth ages 24 and younger (a range that captures about 60% of postsecondary undergraduate students at public institutions) and for the full sample (ages 18-76).

Measures

Autism/Disability Status. Participants responded to a series of questions about diagnoses they had received, including "an autism spectrum disorder," "a learning disability," "a sensory impairment (vision or hearing)," "a mobility impairment," "a mental health disorder," or "a disability or impairment not listed above." Participants were then asked to report the specific diagnosis they received.

With the exception of autism, participants were defined as having each of these disabilities based on their answers to this question series. Participants were defined as "on the autism spectrum" if they were in the registered sample or if they reported having ever received a diagnosis of an autism spectrum disorder.[3] Although the question series did not include a separate item for ADHD, participants reported ADHD in response to the questions about both

[2] At public institutions, only about 60% of undergraduate students are 24 years of age or younger. Private institutions skew to younger ages. Thus, at public institutions, younger than 35 is considered "typical" college age.

[3] Although we asked respondents the age at which they were diagnosed, we did not ask them whether their diagnosis still holds. Thus, it is possible that some respondents coded as "on the spectrum" no longer carry that diagnosis. To evaluate the association of a current diagnosis on health, we reran the models using a variable that coded respondents as on the spectrum only if they were in the registered sample (N=72). Because students must provide evidence of a current diagnosis to register for accommodations, respondents in the registered sample must have a current diagnosis. This indicator is not perfect: some respondents who carry a current diagnosis do not register for accommodations. Coefficient estimates from the supplementary models were very similar in size and direction to those reported here.

learning disabilities and mental health disorders. Reports of ADHD diagnoses were subsequently coded into a separate category.

Health. The following indicators of health were included in the analysis: self-rated physical health; self-rated mental health; depression; anxiety; self-reports of sleep deprivation; and self-reports of binge drinking. Participants rated their "overall physical health" and "overall mental health" on separate 5-point scales from "poor" to "excellent." For purposes of the analysis, we coded physical and mental health as binary variables for respondents who reported "poor," or "fair" (=1) as compared to "good," "very good," or "excellent" (=0) health. To assess depression, the survey included a subset of items from the Center for Epidemiologic Studies-Depression Scale (Radloff, 1977) that have been shown to be racially-invariant (Perreira, Deeb-Sossa, Harris, & Bollen, 2005) and, to assess generalized anxiety, the Mini-SPIN (Connor, Kobak, Churchill, Katzelnick, & Davidson, 2001). Mean item values were computed for respondents who reported at least half of the items in each scale. Participants also reported how often they feel sleep deprived (4-point scale from "never" to "often," coded as 1= "often" or "sometimes" v. 0 = "never" or rarely") and how often, in a typical week, they "have 5 or more drinks in one setting" (5-point scale from 0 times to 5 or more times). We treat the latter as a rough indicator of binge drinking, and code it as a binary (1="1 time or more" v. 0 = "0 times").[4]

Demographic and enrollment characteristics. Participants responded to questions about several demographic characteristics, including their current age (calculated from birthdate), race/ethnicity (Asian, Black or African American, Hispanic or Latino, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, White, Other), gender identity (man, woman, intersex, transgender, other), sexual identity (heterosexual/straight, gay, lesbian, bisexual, queer,

[4] The definition of binge drinking differs by gender: for men, binge drinking is defined as 5 or more drinks in one setting, as we define it here; for women, binge drinking is defined as 4 or more drinks in one setting.

asexual, questioning or unsure, other), marital status (married, separated, divorced, widowed, never married), and parents' highest level of education (coded here as dichotomy: less than a bachelor's degree v. bachelor's degree or higher). Numerically small racial/ethnic categories were combined into the "other" category; participants with multiple racial identities were coded as such. For gender identity, the intersex, transgender, and other categories were combined. For sexual identity, queer, asexual, and questioning were combined with the "other" category. Students also reported their domestic/international student status, year in school, and full-time/part-time student status. Because many of these characteristics are associated both with autism and with health, we control for them in our analyses.

Several variables had missing values, with the largest number of missing values being for the items for demographics: these questions appeared relatively late in the survey, at a point when some respondents stopped answering questions. Our analyses were restricted to respondents who had valid values on all control variables and on the indicators of autism and other disabilities (N=2,716). To preserve as many cases as possible, separate listwise deletion samples were used for each dependent variable (N=2,707 to 2,716).

Statistical analysis

To evaluate the association of autism with health, we estimated a series of regression models, first including only the indicator for autism status and the control variables and, then, adding indicators for other disability statuses. Logistic regression models were used for physical and mental health, sleep deprivation, and binge drinking. Ordinary least squares regression models were used for the depression and anxiety scales. Robust standard errors were estimated to take into account the clustering of students within institutions.

Results

Descriptive statistics for all analysis variables are shown in Table 1, for the total sample and based on autism status. Eighty-nine respondents were in the registered sample (N=72) or reported a diagnosis of autism (N=17); most had received a diagnosis of Asperger's. In total, 678 respondents reported being diagnosed with a disability other than autism. The most common diagnoses were for mental health disorders (N=408, mostly anxiety and depression) and ADHD (N=209), followed by sensory impairments (N=125, most commonly vision impairment other than blindness or hearing impairment), other disabilities (N=85, a range of chronic illnesses), learning disabilities (N=63, most commonly dyslexia), and mobility impairments (N=26). Students on the autism spectrum reported higher rates of all other disabilities than the total sample except mobility impairments.

Consistent with previous evidence for the comorbidity of autism with mental health conditions (Rosenberg et al., 2011), students on the autism spectrum rated their physical and mental health as significantly worse than neurotypical students and reported higher levels of depression and anxiety; they were less likely to report binge drinking and sleep deprivation. Students on the spectrum and neurotypical students also differed on several of the control variables. Students on the spectrum were less likely than other students to report being Asian, were more likely to report a gender identity of male or other, and were more likely to report a bisexual or other sexual identity. They were also more likely to have a parent who earned a bachelor's degree or higher, were less likely to be an international student, were less likely to be enrolled full-time, and were more likely to be enrolled in a 2-year rather than 4-year institution. These differences in the demographic and enrollment characteristics between students on the spectrum and neurotypical students confirm the importance of including these variables as controls.

Table 2 presents the odds-ratios from the regressions of physical health and mental health on autism, the controls, and other disabilities. Table 3 presents the coefficients from the comparable OLS regressions for depression and anxiety. Table 4 presents the odds-ratios from the models for sleep deprivation and binge drinking. In each table, Model 1 includes autism and indicators of demographic and enrollment characteristics; Model 2 adds the indicators of other disabilities.

The association of autism with physical health was significant in Model 1 and was slightly reduced but remained significant in the presence of controls for other disabilities (Models 1 and 2, Table 2). Before taking other disabilities into account, students on the spectrum were 1.80 times as likely as neurotypical students to report worse physical health. After taking other disabilities into account, students on the spectrum were disadvantaged in health by a factor of 1.58. Among the other disabilities, mental health disorders and other disabilities were most strongly associated with physical health. We estimated supplementary models that added each disability to the model individually to determine which disability had the most influence on the association of autism with physical health. These models confirmed that mental health disorders contributed most to the reduction in the association of autism with physical health.

Similarly, the association of autism with mental health remained strong and significant in the presence of controls for other disabilities. Students on the autism spectrum were over twice as likely as neurotypical students to report worse mental health before taking other disabilities into account (OR = 2.21); after taking other disabilities into account, students on the spectrum were just under twice as likely to report worse mental health (OR = 1.88). Perhaps not surprisingly, students with mental health disorders reported poorer mental health than other students. When considered individually, mental health disorders and ADHD were most

responsible for the reduction in the strength of the association of autism with mental health outcomes.

The models reported in Table 3 refine the results for mental health by predicting symptoms of depression and anxiety from autism, the controls, and other disabilities; the table presents OLS regression coefficients. For both outcomes, the association of autism remains significant after including controls and the other disabilities in the models. Before taking other disabilities into account, students on the spectrum report levels of depressive symptoms that are 1.16 points higher (b = 1.16; about one-third of a standard deviation) than neurotypical students. They report levels of anxiety that are 0.88 points higher (b=0.88; also about one-third of a standard deviation). In the case of depression, the association is reduced in size by about 25% when other disabilities are considered [(1.16-0.88)/1.16], with mental health disorders responsible for most of the reduction. In the case of anxiety, the association remains almost unchanged when other disabilities are considered. Models that added each disability separately revealed that controlling for mental health disorders reduced the association of autism with anxiety symptoms by about 10%. However, controlling learning disabilities and ADHD increased the association of autism with anxiety symptoms, mitigating the reduction.

Turning to the final two outcomes, autism was associated with lower odds of experiencing sleep deprivation (Table 4). Before taking other disabilities into account, students on the spectrum were 0.36 times less likely (1.00-0.64) to report sleep deprivation than their neurotypical peers. The association remained virtually unchanged when controls for other disabilities are added. Autism was also associated with a lower likelihood of binge drinking (OR = 0.35). This association became slightly stronger in the presence of controls for the other disabilities. In particular, because students with autism have relatively high rates of ADHD and

students with ADHD are more likely than other students to binge drink, controlling for ADHD and the other disabilities slightly increased the negative association of autism with binge drinking (OR = 0.32).

As a final step in our analysis, we considered whether the results are sensitive to the cut points we chose for the binary outcome variables. They were for physical health and sleep deprivation. When we coded self-reported physical and mental health as the comparison of "poor," "fair," and "good" to "very good" and "excellent," the differences between students on the spectrum and neurotypical students were smaller and less significant than those reported here. Similarly, when we coded sleep deprivation as the comparison of "often" to all other responses ("sometimes," "rarely," or "never"), the difference between the two groups was not significant. Neither recoding substantially alters our overall conclusions but the results do indicate sensitivity to how health outcomes are coded.

Discussion

In a sample of college students attending a range of institutions, we observed significantly worse health among students with autism on four indicators—self-reported physical health, self-reported mental health, depression, and anxiety. The observed differences in health are especially noteworthy in that they are independent of associated disabilities. In other words, autism in and of itself places college students at risk of poor physical and mental health. At the same time, students with autism reported a lower likelihood of sleep deprivation and lower levels of binge drinking than other students suggesting that, with respect to some health behaviors, they are advantaged relative to their neurotypical peers..

Our results affirm and extend previous research on the health correlates of autism to additional indicators of health and to college students specifically. Our study moves beyond

previous research (e.g., Bishop-Fitzpatrick & Kind, 2017; Hollocks et al., 2019) by providing a direct comparison of physical and mental health among young adults on the spectrum to their neurotypical peers and by incorporating indicators of self-rated health. Self-reported physical and mental health predicts future morbidity and mortality even more strongly than specific health conditions (Idler & Benyamini, 1997; McAlpine et al., 2018). The health disadvantages we observed among college students on the spectrum suggest that they will continue to experience poor health trajectories into the future.

Focusing on college students allowed us to engage the question of whether the health disadvantages associated with autism extend to a relatively advantaged subgroup of the larger autism population. Because intellectual disabilities heighten the risk of poor health among adults on the autism spectrum (Bishop-Fitzpatrick & Rubenstein, 2019), we might have expected to observe a relatively weak association of autism with health in this sample. In contrast, though, even in this select group and even after taking other disabilities into account, we find that autism continues to place young adults at risk of poor health outcomes. Why the health disadvantages of autism remain strong in this subgroup deserves additional attention.

Focusing on college students also encourages consideration of the how the services that colleges and universities provide could be improved. The high levels of depression and anxiety we observed among students with autism are especially concerning for both their general well-being and their success in college. Both types of mental health problems reduce the likelihood of academic success in college populations (e.g., Eisenberg, Golberstein, and Hunt, 2009). As noted, the high levels of depression and anxiety we observed are independent of mental health diagnoses, implying that they are not simply the result of comorbid, diagnosed mental health conditions. Colleges and universities should give special attention to undiagnosed and subclinical

mental health problems as they assess the needs of their students on the spectrum and design programs.

As institutions consider how best to serve students on the spectrum, they also should be mindful of the health advantages those students experience. In our study, students on the spectrum reported less frequent sleep deprivation and binge drinking. Our finding with respect to binge drinking extends evidence regarding the lower risk of binge drinking among students with disabilities to autism (West, Graham, & Temple, 2017). The former result is more surprising given that prior research has established high levels of disrupted sleep and sleep disorders among children and adults with autism (Cortesi, Giannotti, Ivanenko, & Johnson, 2010; Croen et al., 2015). We suspect that our failure to observe an association between autism and sleep deprivation is a function of the selective nature of college student samples and high overall levels of sleep deprivation college students report. As noted, young adults with autism who are enrolled in college differ from their non-enrolled peers in consequential ways, for example, in being less likely to have intellectual impairments or other severely-disabling conditions. In addition, the risk factors for sleep problems among persons on the spectrum—communication difficulties, learning difficulties, disruptive behavior, and rigidity (Schreck, Mulick, & Smith, 2004)—also reduce the probability that young adults are able to enroll or remain in college (McLeod & Kaiser 2004; Wagner et al., 2005).

Three study limitations deserve mention. The restriction of our sample to students who are currently enrolled in college limits the generalizability of our results. Our analysis cannot speak to the health of young adults who never enroll in college or who enroll but drop out. Although the neurotypical students in our sample differ from their non-enrolled counterparts as well, we suspect that enrollment selectivity is even more pronounced for students on the

spectrum. Students on the spectrum are, overall, less likely than neurotypical students to enroll in college (Newman, Wagner, Cameto, & Knokey, 2009), which implies that the students on the spectrum who are able to enroll differ more from their non-enrolled counterparts than neurotypical students do from theirs. If our suspicion is correct, our findings underestimate the differences in early adult health between persons on the autism spectrum and their neurotypical peers.

A second limitation of our study is that the data are based on self-reports. This is not a problem for the self-reported measures of health which, by their nature, depend on individual perceptions of health and illness. However, there could be unknown biases in the reports of disability diagnoses which would affect our estimates of the associations of disabilities with health.

A third limitation of our study is that the measure of binge drinking may underestimate binge drinking among female participants. Our measure of binge drinking is consistent with the definition of binge drinking for men: 5 or more drinks in one setting. For women, however, binge drinking is defined as 4 or more drinks in one setting. We have no reason to believe that our underestimate of binge drinking for women would differ based on autism status so suspect that our results would hold even with a more refined measure, but we cannot be sure.

These limitations are outweighed by several strengths of the study. To the best of our knowledge, this is the largest available sample of college students on the autism spectrum that also includes a neurotypical comparison group. The sample includes students at many different types of institutions and with a range of other disabilities. The measures of general physical and mental health provide comprehensive evaluations of general health status. We were able to control many demographic and enrollment characteristics that are associated with disability

status and with health, bolstering confidence that any observed differences in health are a function of the disabilities themselves.

Conclusions

During the transition to adulthood, youth on the autism spectrum increasingly set their sights on completing a college education. When young adults on the autism spectrum enroll in college, they bring with them not only these aspirations, but also, our results suggest, a higher risk of poor health. In our sample, college students on the autism spectrum had significantly worse health in terms of self-rated physical and mental health, depression, and anxiety, independent of associated disabilities.

Colleges—and especially public and community colleges—work best for students who are willing and able to take the initiative to assemble the resources they need to be successful (Astin, 1999; Roksa, 2016). College students with autism need special assistance to succeed in college, but many are ill-equipped to seek that assistance. The challenges college students on the autism spectrum experience are heightened by the co-occurrence of other disabilities that disrupt their physical and mental health. To effectively serve students on the spectrum, post-secondary institutions must also address their other disabilities and the associated health risks. Our results argue for integrated support services that address the full constellation of disabilities that students on the spectrum present.

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