The mental and physical health profiles of older adults who endorse elevated autistic traits.

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Abstract

Objective: The mental and physical health profile of autistic people has been studied in adolescence and adulthood, with elevated rates of most conditions being reported. However, this has been little studied taking a dimensional approach to autistic traits, and in older age.

Methods: A total of 20,220 adults aged 50-81 years from the PROTECT study reported whether they experienced persistent socio-communicative traits characteristic of autism. Approximately 1%, 276 individuals, were identified as endorsing elevated autistic traits in childhood and currently, henceforth the 'Autism Spectrum Trait' (AST) group. An age and gender matched comparison group was formed of 10,495 individuals who did not endorse any autistic behavioral traits, henceforth the 'Control Older Adults' (COA) group. Differences between AST and COA groups were explored in self-reported psychiatric diagnoses, self-reported symptoms of current depression and anxiety, and self-reported physical health diagnoses. Associations were also examined between autistic traits and health across the whole sample.

Results: The AST group reported significantly elevated rates of psychiatric diagnoses compared to COAs. Additionally, the AST group showed significantly higher self-reported symptoms of current depression and anxiety than COAs. However, few differences were observed in individual physical health conditions, and no differences in total co-occurring physical diagnoses between groups. Similar associations between autistic traits and health were also found taking a dimensional approach across the whole sample.

Discussion: These findings suggest that older adults with elevated autistic traits may be at greater risk of poorer mental, but not physical, health in later life. Future studies should incorporate polygenic scores to elucidate the possible genetic links between propensity to autism/high autistic traits and to psychiatric conditions, and to explore whether those with elevated autistic traits experience particular barriers to mental health care.

Key Words: Autistic Traits, ASD, Mental Health, Physical Health

INTRODUCTION

Autism Spectrum Disorder (ASD) is increasingly seen as lying at the end of a dimension of socio-communicative difficulties, with overlapping genetic influences operating on diagnosed ASD and on sub-clinical autistic traits in the general population (Bralten et al., 2018). Taking this dimensional trait-wise approach increases statistical power by examining individuals with high levels of autistic characteristics who nonetheless fall below the diagnostic threshold for ASD. This technique may be particularly useful for exploring autism-related issues in understudied groups, such as in older age. One reason for autism being under-researched beyond middle adulthood is that the changes to diagnostic criteria over the past 50 years have made it challenging to recruit older autistic adults (Stuart-Hamilton, Griffith, & Totsika, 2010); thus we know relatively little about co-occurring mental and physical health conditions for this aging population.

Several clinical and population-based studies have documented that autistic children and adults experience increased rates of almost all mental health difficulties when compared to neurotypical individuals (Bishop-Fitzpatrick & Rubenstein, 2019; Croen et al., 2015; Hand, Angell, Harris, & Carpenter, 2019; Lever & Geurts, 2016; Lugo-Marín et al., 2019; Rydzewska et al., 2019; Simonoff et al., 2008). An association has also been reported between elevated (but subclinical) autistic traits and mental health problems. Lundström et al. (Sebastian Lundström et al., 2015) first explored this association, in two large Swedish population-based twin cohorts, reporting increasing risk of anxiety, conduct problems, depression, substance/alcohol abuse and ADHD with increasing levels of autistic traits in children and adults. Children with elevated autistic traits have been found to report more emotional problems than those with low autistic traits (Posserud, Hysing, Helland, Gillberg, & Lundervold, 2018; Tick et al., 2016), with depressive symptoms being reported to increase throughout childhood into adolescence (Rai et al., 2018). These emotional problems have

also been found to occur in young adulthood and mid-life, including elevated rates of depression and anxiety (Howlin, Moss, Savage, Bolton, & Rutter, 2015; Rosbrook & Whittingham, 2010). While psychiatric difficulties in later life have been less studied, elevated rates of depression and anxiety symptoms have also been reported by older adults with high versus low autistic traits (Stewart, Charlton, & Wallace, 2018).

Elevated autistic traits have also been reported in groups with other psychiatric diagnoses. Mid-life (Radtke et al., 2019) and older adults (Geurts, Stek, & Comijs, 2016) with chronic depression have been found to report elevated autistic traits compared to those not meeting diagnostic criteria for a depressive disorder. Meta-analyses of studies exploring clinical data from anorexia nervosa patients have identified elevated autistic traits, notably impaired socio-communicative ability and cognitive flexibility (Westwood et al., 2016). Up to 30% of schizophrenia patients demonstrate elevated autistic traits (Barlati, Deste, Gregorelli, & Vita, 2019), and these have also been documented in those with borderline personality disorder (Dell'Osso et al., 2018), and amongst individuals experiencing suicidal thoughts and behaviors (Richards et al., 2019). These studies suggest shared genetic variance between autistic traits and psychiatric conditions more broadly.

Autistic adults show elevated rates of not only psychiatric problems, but also physical health problems compared to non-autistic adults (for review see Cashin, Buckley, Trollor, & Lennox, 2018). Based on analysis of medical insurance records of young and mid-life autistic adults (Croen et al., 2015) and older autistic adults (Hand et al., 2019), increased rates of autoimmune, cardiovascular, gastrointestinal, neurological, and metabolic disorders have been reported when compared to age and gender matched non-autistic adults. Furthermore, an epidemiological study using 2011 census data from Scotland, found that 21% of males and 31% of females (aged 25 years or older) with an autism diagnosis had a physical disability, compared to 9% of the non-autistic population (OR 6.2) (Rydzewska et al., 2018). To the

authors' knowledge, no studies have explored physical health difficulties in relation to sub-clinical autistic traits.

Despite typical aging also having an impact on health, little is known about aging and ASD (or autistic traits more broadly). Currently, the population of older adults across the world is steadily increasing. As ASD has a prevalence rate of around 1% across the lifespan (Lai, Lombardo, & Baron-Cohen, 2014), there are approximately 240,000 autistic adults aged over 50 years old in the UK, 1.1 million in the USA, and over 18 million worldwide (United Nations, 2019). Despite this, few studies have explored the physical and mental health profile of autistic populations in older adulthood (Happé & Charlton, 2011; Howlin & Taylor, 2015; Mukaetova-Ladinska, Perry, Baron, & Povey, 2012; Stuart-Hamilton et al., 2010). The few studies exploring health in older autistic adults suggest that rates of physical (but not mental) conditions and general health difficulties increase in older age (Croen et al., 2015; Hand et al., 2019; Rydzewska et al., 2019). The Scottish epidemiological study (Rydzewska et al., 2019, 2018) found double the rate of physical disability in autistic males and females aged 65 years or older (42% and 48% respectively), compared to those in the 25-35 years age bracket (14% and 25%). Rates in both age groups were far higher for autistic than non-autistic adults (c. 1.6% at 25-35 years, 20% for 65+), although the change with age was proportionally larger in the non-autistic group. However, it is currently unknown whether physical or mental health problems are elevated in adults growing older with sub-clinical autistic traits.

The current study investigates the health profile of adults aged 50 years and older who endorsed persistent elevated socio-communicative autistic traits, compared to a control group who did not report any childhood or current autistic traits. Associations between autistic traits and health will also be examined dimensionally across all participants. It is predicted that in older adults elevated autistic traits will be associated with (1) more self-reported psychiatric

diagnoses, (2) more elevated and above clinical cut-off self-reported symptoms of psychiatric difficulties currently, and (3) more self-reported physical diagnoses. These results could contribute to our understanding of aging with autistic traits and highlight potential differences in support and care needs of older adults on the wide autism spectrum.

METHODS

Study Design and Participants

This study uses cross-sectional baseline data from the PROTECT study (www.protectstudy.org.uk). Inclusion criteria for the PROTECT study are: aged over 50 years, resident in the UK, with good working understanding of English, and able to use a computer with internet access. Participants who have an established diagnosis of dementia are excluded. Participants register online and are required to review the study information sheet and to provide consent via an approved online platform. The PROTECT study received ethical approval from the UK London Bridge National Research Ethics Committee (Ref: 13/LO/1578).

From a total sample of 20,220 participants (female n = 14,946, 73.9%), 276 (1.4%) met our cut-off criteria for the Autism Spectrum Traits (AST) group, see Measures section below for inclusion criteria. To create a Control Older Adults (COA) group, from the remaining 19,944 participants, 4,243 participants were excluded for endorsing any autism spectrum traits. To match the AST and COA groups on mean age/range and gender ratio, a further 5,206 participants were excluded using random participant selection methods, resulting in 10,495 participants in the COA group. See Table 1 for demographic characteristics.

To ensure the age- and gender-matched COA group, who endorsed no autistic traits, were not atypical or unrepresentative of the whole PROTECT sample, analyses were repeated comparing the AST group to all other PROTECT participants (n=19,944). A similar pattern of results was observed, therefore, the results reported below are from AST and matched COA groups described above.

TABLE 1 / DEMOGRAPHICS TABLE HERE

Measures

Autistic traits – Constraints on the number of items in the PROTECT battery of questionnaires required the construction of a very short, 5-item measure to assess childhood and current socio-communicative traits characteristic of autism. Using a yes/no format, the participant was asked if as a child they had "struggled compared to [their] peers (socially or at school) with: (1) knowing how to get along with other children; (2) understanding other kids' jokes, sarcasm or deception". Further questions asked if the participant "currently find[s] it more difficult than other people to: (1) make and keep friends; (2) understand other people's perspectives; (3) recognize if someone means something different from what they are saying". Socio-communicative autistic traits were measured as both total number of items endorsed and categorized as above or below a cut-off for high traits. A stringent cut-off was used for categorizing individuals, with those included in the AST group endorsing both the childhood traits plus at least two of the three current traits (total scores = 4 - 5/5), while those included in COA group did not endorse any past or current traits.

To validate this bespoke measure, an additional study was conducted to examine associations between the PROTECT Autistic Traits measure and the Autism Quotient (AQ-10; Allison, Auyeung, & Baron-Cohen, 2012), and Ritvo Autism and Asperger's Diagnostic Screen (RAADS-14; Eriksson, Andersen, & Bejerot, 2013). In the separate validation sample (autistic individuals with a diagnosis n=101; non-autistic individuals n=133; see supplementary Table 1 for full demographics), moderate to strong positive associations were observed between the PROTECT measure and the AQ-10 (autistic r=.51, p<.001; non-autistic r=.66, p<.001), and the RAADS-14 (autistic r=.56, p<.001; non-autistic r=.73, p<.001). On the PROTECT measure 82.2% of the autistic group and 6.0% of the non-autistic group passed the cut-off described above. This overall sensitivity and specificity was as good as for the established measures; on the AQ-10 77.2% of autistic and 18.0% of non-autistic group passed cut-off, and on RAADS-14, 97.0% of autistic and 33.1% of non-autistic group passed cut-off (see supplementary Table 2 for more details). Good to excellent internal consistency were demonstrated in the validation sample for the PROTECT measure (Cronbach's a=.82), AQ-10 (Cronbach's a=.80), and RAADS-14 (Cronbach's a=.93).

Demographic information – PROTECT participants completed an online demographic information questionnaire, including age, gender, marital status, education history, and employment status.

Self-report medical history – Participants reported whether they have ever received a diagnosis of a variety of psychiatric and physical conditions.

Self-report questionnaire measures – Recent depression was measured using the PHQ-9 (Kroenke, Spitzer, & Williams, 2001), a nine-item questionnaire with a 4-point scale which ask the participant to report whether they have been bothered by a range of problems over the past two weeks. Using a cut-off score of ≥10, the PHQ-9 has a sensitivity of 88% and a specificity of 88% for major depressive disorder.

Recent anxiety was measured using the GAD-7 (Spitzer, Kroenke, Williams, & Löwe, 2006), a seven-item questionnaire with a 4-point scale which asks the participant to report whether they have been bothered by a range of problems over the past two weeks. Using a cut-off score of ≥10, the GAD-7 has a sensitivity of 89% and a specificity of 82% for generalized anxiety disorder.

Statistical Analyses

All statistical analyses were performed using SPSS (version 25.0; IBM Corp., 2017). Differences between AST and COA in demographic variables were analyzed using $\chi 2$ and analysis of variance (ANOVA). $\chi 2$ was used to evaluate differences in self-reported mental and physical health diagnoses. ANOVA was used to evaluate differences in self-reported symptoms of current depression and anxiety, with $\chi 2$ being used to evaluate differences in the prevalence of above cut-off symptoms.

Among the whole PROTECT sample, point biserial correlations were used to evaluate associations between total autistic traits endorsed (scores = 0 – 5) and self-reported mental and physical health diagnoses. Spearman and point biserial correlations were used to evaluate associations between total autistic traits endorsed and self-reported symptoms of current depression and anxiety.

Multiple comparisons were controlled for using the False Discovery Rate (FDR; Benjamini & Hochberg, 1995), with an α of 0.05 being used. FDR was applied to all *p*-values, with adjusted α-values being assigned based on the *p*-value rank.

RESULTS

Demographics

Table 1 shows demographic characteristics by group and gender. Age, gender ratio, education history and employment status did not differ between the AST and COA groups. Differences between the AST and COA groups were observed in marital status: the AST adults were more likely than COA to be separated or to have never had a partner.

Gender differences were observed in marital status in AST and COA, and in education history and employment status in COA. For marital status, COA and AST females were more often widowed, divorced, separated or single, while males were more often married. For education history, COA males more often reported having undergraduate or postgraduate degrees, while females more often reported having school to 18 qualifications. For employment status, COA females were more often employed, while males were more often retired. See supplementary Table 3.

The only significant interaction of group (AST vs. COA) with gender was observed for age. AST males and females were on average closer in age than COA; age mean (SD) male AST = 64.28 (7.34), female AST = 62.34 (6.30), male COA = 65.80 (7.04), female COA = 60.94 (5.93), $F(1,10766)=12.80$, $p<.001$.

Among the whole PROTECT sample, a weak negative association was found between socio-communicative autistic traits and age (r=-.017, p=.015). See supplementary Figure 1 for distribution of socio-communicative autistic traits and supplementary Figure 2 for distribution of age.

Self-report psychiatric diagnoses

Table 2 shows the frequencies of self-reported psychiatric diagnoses and total number of co-occurring psychiatric conditions by group. The AST group reported significantly higher rates of all psychiatric diagnoses than the COA group, apart from schizophrenia.

Overall, only 35 individuals in the PROTECT cohort reported having an ASD diagnosis, 21 (60%) were included in the AST group. Of the remaining 14 adults reporting an ASD diagnosis, six (17%) just missed inclusion in the AST group by endorsing only 3 versus 4/5 items, and the remaining eight (23%) endorsed two or fewer items; none of these individuals were included in the COA group.

Numbers of co-occurring conditions

The AST group reported a significantly higher total number of co-occurring psychiatric diagnoses than those in the COA group, with 67.8% of the AST group reporting one or more psychiatric diagnosis (vs 31.3% in COA) and 17.4% reporting three or more psychiatric diagnoses (vs 2.3% in COA). Age was found to be negatively associated with the total number of co-occurring psychiatric conditions in both the AST (r=-.11, p<.001) and the COA groups (r=-.09, p<.001).

Associations among the whole PROTECT sample

Among the whole PROTECT sample, socio-communicative autistic traits were positively associated with self-reported diagnoses of all psychiatric conditions, excluding schizophrenia (which was very rarely reported). Socio-communicative autistic traits were also positively associated with the total number of psychiatric condition diagnoses. The same pattern of results was observed when controlling for age, correcting for multiple comparisons. See Table 2.

Gender differences in psychiatric conditions

Females in the COA group reported more diagnoses of depressive and anxiety disorders and eating disorders when compared to COA males. However, the only significant gender difference in the AST group was for anorexia, with AST females reporting more diagnoses than AST males. See supplementary Table 4.

COA females also reported a higher total number of co-occurring psychiatric conditions than COA males, while no gender difference was found in the AST group.

TABLE 2 / PSYCHIATRIC HEALTH CONDITIONS TABLE HERE

Self-report psychiatric symptoms

Table 3 shows the self-report questionnaire summary data, including numbers passing cut-offs, by group. The AST group reported significantly more symptoms of recent/current

depression and anxiety than the COA group. Using questionnaire cut-off scores to identify those with probable clinical symptoms, more individuals in the AST group were above cut-off levels for recent/current depression and anxiety, compared with the COA group.

Associations among the whole sample

Among the whole PROTECT sample, socio-communicative autistic traits were positively associated with self-reported symptoms of current depression and anxiety. Socio-communicative autistic traits were also positively associated with meeting above cut-off levels for recent/current depression and anxiety. The same pattern of results was observed when controlling for age, correcting for multiple comparisons.

Gender differences in psychiatric symptoms

Females in the COA group reported significantly more symptoms of current depression and anxiety compared to COA males, and more passed clinical cut-offs, while AST males and females did not differ. No interactions of group (AST vs. COA) with gender were observed. See supplementary Table 5.

TABLE 3/ SELF-REPORT QUESTIONNAIRE TABLE HERE

Self-report physical health diagnoses

Table 4 shows the frequencies of self-reported physical diagnoses and total number of co-occurring physical conditions by group. Few differences were observed between AST and

COA groups in reported physical health diagnoses. The AST group reported significantly higher rates of mild cognitive impairment and arthritic conditions only.

Numbers of co-occurring conditions

No group differences were observed between AST and COA in total number of co-occurring physical health condition diagnoses. Age was positively associated with the total number of co-occurring physical health conditions in both the AST (r=.22, p<.001) and the COA groups (r=.26, p<.001).

Associations among the whole PROTECT sample

Among the whole PROTECT sample, socio-communicative autistic traits were positively associated with self-reported diagnoses of diabetes, mild cognitive impairment, and arthritic conditions. No other associations were observed with individual diagnoses. Socio-communicative autistic traits were positively associated with the total number of physical health condition diagnoses. The same pattern of results was observed when controlling for age, correcting for multiple comparisons. See Table 3.

Gender differences in physical conditions

Males in AST and COA groups reported more diagnoses of high blood pressure than females. COA males also reported more diagnoses of other cardiovascular, metabolic and neurological conditions than COA females. COA females reported more diagnoses of endocrine conditions than COA males. No further gender differences were observed in the AST group. See supplementary Table 5.

COA males had a higher total number of co-occurring physical health conditions than COA females; $\chi 2=361.56$, $p<.001$. The somewhat higher total number of co-occurring physical health conditions in AST females vs males did not reach significance, $\chi 2=7.37$, $p=.061$.

TABLE 4 / PHYSICAL HEALTH CONDITIONS TABLE HERE

DISCUSSION

This study documents for the first time the mental and physical health profile of older adults with elevated socio-communicative autistic traits. As predicted, and in keeping with the autism literature, those with elevated socio-communicative autistic traits reported significantly more diagnoses of psychiatric conditions, and higher symptom levels for current depression and anxiety, compared to an age- and gender-matched control group (selected for low autistic traits). Positive associations were also found between socio-communicative autistic traits and psychiatric health conditions among the whole PROTECT sample. By contrast, few differences were reported in physical health diagnoses, and there was no group difference in the number of co-occurring physical conditions. Furthermore, few associations were found dimensionally between autistic traits and physical health conditions; however, a weak positive association was found between socio-communicative autistic traits and the total number of physical health conditions reported. Overall a similar pattern of results was found for the group comparisons and the correlational analysis. Therefore, our results suggest that older adults with elevated autistic traits may be more susceptible to poorer mental, but not physical, health in later life.

In the current study, elevated rates of almost all psychiatric diagnoses were observed in older adults with high vs low autistic traits; a pattern consistent with the literature on mental health in autistic adults (Croen et al., 2015; Hand et al., 2019; Lever & Geurts, 2016) and those with high autistic traits (Kanne, Christ, & Reiersen, 2009; S. Lundström et al., 2011). For depression and anxiety diagnoses, a three to four-fold increase was found, comparable to the rates previously described in autistic adults across the adult life course (Croen et al., 2015; Hand et al., 2019), and in the few previous studies of older adults with high autistic traits (Geurts et al., 2016; Stewart et al., 2018). From self-rated current/recent symptoms, too, rates of anxiety and depression were elevated in the high autistic traits group; more than 20% passed clinical cut-off for depression and more than 10% for anxiety. It is notable that more than a quarter of those self-reporting clinical levels of depressive symptoms, did not report having had a diagnosis of depression. Depression and anxiety have been both identified as risk factors for both poorer physical health and early mortality in non-autistic (Janszky, Ahnve, Lundberg, & Hemmingsson, 2010; Schulz et al., 2000) and autistic adults (Hirvikoski et al., 2016), including an increased likelihood of suicidal thoughts and behaviors (Cassidy, Bradley, Shaw, & Baron-Cohen, 2018; Fiske, Wetherell, & Gatz, 2009).

Elevated rates of rarer conditions like eating disorders were also observed, representing a fivefold risk increase for those with elevated autistic traits. These results are consistent with previous studies that have established links between anorexia and ASD, and autistic traits more broadly, in adolescent and young adult populations (see Westwood et al., (2016) for recent systematic review and meta-analysis). Elevated rates of personality disorders were also observed for those with elevated autistic traits. The symptomatic overlap between Borderline Personality Disorder (BPD) and ASD has been widely discussed, with those with BPD reporting elevated autistic traits compared to those without BPD (Dell'Osso et al., 2018; Dudas et al., 2017). Additionally, both anorexia and BPD have been identified as

conditions which diagnostically 'overshadow' ASD, resulting in underdiagnosis of ASD, perhaps particularly in females (Mandy & Tchanturia, 2015).

However, one conditions that deviated from the rates described in the previous literature is schizophrenia. Elevated rates of schizophrenia (up to a twofold increase in risk) have previously been reported for autistic adults (Croen et al., 2015) and in those with elevated autistic traits (Barlati et al., 2019). Among the general population, schizophrenia has a lifetime prevalence rate of c. 4%; however, in the current study (and in the PROTECT cohort more broadly), very few individuals reported a diagnosis of schizophrenia (n=3, <0.1%). This could be due, in part, to the early mortality rates documented among those with schizophrenia (Olfson, Gerhard, Huang, Crystal, & Stroup, 2015). Also, those with severe and persistent conditions (such as schizophrenia) may be unlikely to participate in voluntary longitudinal studies such as PROTECT, which includes lengthy questionnaire and cognitive assessments online (Golomb et al., 2012).

The findings from the current study suggest that not only are those with elevated autistic traits more susceptible to most psychiatric conditions, they are also more likely to experience a higher number of such comorbidities compared to matched older adults with low autistic traits. Whether this reflects shared genetic influences on autistic traits and psychiatric conditions (Pettersson et al., 2019), or phenotypic effects (e.g. reduced social skills leading to social isolation or stress, raising the risk of mental ill-health) cannot be established by the present research design. However, since poor mental health is a risk factor for poorer long-term outcomes, this should be addressed to mitigate future risk.

Interestingly, the same pattern of results was not observed for physical conditions. No significant differences in diagnosis rates were observed between high and low autistic trait groups across most physical diagnoses, including cardiovascular, metabolic, or endocrine conditions. Furthermore, no group differences were observed in total number of co-occurring

physical conditions – although this did correlate positively with age in both groups, as would be expected (Bishop-Fitzpatrick & Rubenstein, 2019; Croen et al., 2015; Rydzewska et al., 2019). To the authors' knowledge, no other studies have collectively explored the prevalence rates of physical conditions among those with elevated autistic traits of any age range.

While our findings are not consistent with the ASD literature, where higher rates of most physical conditions are reported (Cashin et al., 2018; Hand et al., 2019), arthritic conditions and mild cognitive impairment (MCI) were reported to be diagnosed more often in our adults with elevated autistic traits compared to the control group. Regarding arthritis, at least one previous study has reported an association between arthritis in either mother or father and elevated likelihood of autism in offspring (Rom et al., 2018), in a very large Danish cohort study, interpreted as suggesting a genetic link between the two conditions.

To the authors' knowledge, no study has documented prevalence rates of MCI in older autistic/trait populations before. MCI has been previously described as a prodromal period before dementia (Britt et al., 2011), and one study has reported that autistic adults are at a sixfold increased risk for dementia compared to non-autistic adults (Croen et al., 2015). It is important to note that a diagnosis of any dementia is an exclusion criterion for recruitment into the PROTECT study; future time points in PROTECT's longitudinal follow-up will provide further information about cognitive decline, MCI and dementia.

Why might the current, high autistic trait group show poorer mental but not physical health? One possibility is that our questions aimed at tapping autistic-like social-communication difficulties are in fact endorsed by individuals with a wide range of mental health problems. In this regard it is worth noting that for inclusion in the AST group we required endorsement of social-communication difficulties in both childhood and currently, and that this identified just 1.4% of the PROTECT sample, and had a low false-positive rate in our separate validation study. As over 20% of the COA group reported a diagnosis of

depression, and more than 30% reported at least one psychiatric diagnosis, yet by definition none endorsed any of our socio-communicative autistic trait questions, this perhaps provides some reassurance that our autistic trait questions are not merely measuring general psychopathology.

An alternative explanation might be shared genetic influences on autistic traits/autism and a range of psychiatric conditions. Caspi and Moffitt (2018) have argued for a 'p' (psychopathology) factor general to all psychiatric conditions, explaining high rates of multi- and diverse-morbidity in those with any psychiatric diagnosis. Recent findings indicate that autism may be one of eight genetically overlapping psychiatric and neurodevelopmental conditions, perhaps explaining elevated rates of psychiatric conditions in autistic/trait populations (Cross-Disorder Group of the Psychiatric Genomics Consortium, 2019).

A third alternative is that living with longstanding socio-communicative difficulties may cause stress, increase the risk of adverse life events (e.g., bullying), or reduce levels of social support and increase isolation, all of which are known to have negative consequences for mental health in the general population (Lereya, Copeland, Costello, & Wolke, 2015). Longitudinal studies and modeling of possible mediating factors, as well as genetically sensitive designs, will be needed to move beyond the present association to test putative causal links between high autistic traits and poor mental health. Such designs will also be needed to identify why autistic adults, but not adults high in autistic social-communication traits, show poorer physical health. Lifestyle factors, reduced educational and employment opportunities and hence low SES, and other issues such as intellectual/language impairment, may be affecting autistic adults but not the present sample of high autistic trait adult participants in PROTECT.

It is important to consider limitations when contextualizing the results of the current study. A strength of PROTECT is its use of an online platform which allows large scale recruitment from a wide geographical spread across the UK. However, use of self-report alone is a limitation, and collecting multiple informant measures would be important in future work. Furthermore, older adults who engage in medical research are typically those that are physically well and mentally able, which may lead to sampling biases, survival effects, and poor generalizability of findings (Golomb et al., 2012). The current study examines a large sample of adults aged 50-81; however, as changes to health occur throughout the life course, future studies need to include adults aged over 80 years in order to examine the influence of autistic traits on health in later life. Moreover, the PROTECT sample is predominately female and well-educated, which may further limit the generalizability of our findings. Additionally, the design of this study was cross-sectional and we cannot infer causation in the association between self-reported socio-communicative autistic traits and poorer mental health. Finally, the criteria used to identify the AST group was a bespoke set of brief questions rather than a standardized measure. It is possible that participants experience/d or report poor socio-communicative functioning for a range of reasons, some unrelated to autistic traits, for example, the AST group do report elevated rates of current depression which may influence their self-perception of their social functioning. Additionally, this bespoke measure focused on socio-communicative traits and did not include items related to restricted and repetitive behaviors and interests. However, this bespoke measure did have good sensitivity and specificity for identifying those with an autism diagnosis. Further work with well-validated ASD trait measures, and ideally in person assessments, would be valuable. Whilst these factors may limit the overall generalizability of the findings, the results still provide important new information about the health profile in a large population of older adults and

are a first step towards greater understanding of ageing for those with poor socio-communicative functioning.

In conclusion, our study exploring the health profile of older adults suggests that those who self-report elevated autistic social-communication traits in childhood and adulthood also report more psychiatric, but not physical, diagnoses compared to those without autistic traits. This risk to mental health also extends to self-reported current depression and anxiety symptoms, which are risk factors for crises including suicidality. The findings of the current study highlight the need for adequate mental health support for those on the autism spectrum, including those with elevated traits who may not have a diagnosis or meet current criteria, to ensure that they receive appropriate support to prevent psychiatric problems and crises.

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about the PROTECT cohort data, analytic methods, or materials used in this study, please contact the corresponding author. The SPSS syntax and output are available on OSF (*https://mfr.osf.io/render?url=https://osf.io/x5nb2/?direct%26mode=render%26action=download%26mode=render).*

Conflicts of Interest: None

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Table 1. Demographic characteristics of the COA and AST groups.

		Control Older Adults (n = 10,495)		AS Traits (n = 276)		Group difference	Effect Size
Age	*M (SD)*	62.42	(6.67)	62.97	(6.74)	F(1,10769) = 1.83, *p* = .176	0.08 [-0.04 - 0.01]
	95% CI	62.29 - 62.55		62.17 - 63.77			
	Range	50 - 81		50 - 81			
Gender	*male : female*	3200 : 7295		90 : 186		$\chi2$ = .57, *p* = .451	0.05 [0-.09 - 0.19]
	%	30.5% : 69.5%		32.6% : 67.4%			
Marital Status	*Married*	7516	(71.8%)	171	(62.0%)	$\chi2$ = 22.78, *p* < .001***	0.27 [0.15 - 0.39]
	Widowed	476	(4.5%)	8	(2.9%)		
	Separated	177	(1.7%)	5	(1.8%)		
	Divorced	991	(9.5%)	37	(13.4%)		
	Civil Partnership	56	(0.5%)	1	(0.4%)		
	Co-habiting	684	(6.5%)	28	(10.1%)		
	Single	570	(5.4%)	26	(9.4%)		
Education history	*School to 16*	1445	(13.8%)	43	(15.6%)	$\chi2$ = 2.97, *p* = .395	0.02 [-0.10 - 0.14]
	School to 18	3263	(31.2%)	73	(26.4%)		
	Undergraduate	3566	(34.1%)	99	(35.9%)		
	Postgraduate	2196	(21.0%)	61	(22.1%)		
Current employment status	*Employed*	5809	(55.5%)	140	(50.7%)	$\chi2$ = 4.72, *p* = .094	0.12 [0.00 - 0.23]
	Retired	4331	(41.4%)	122	(44.2%)		
	Unemployed	330	(3.2%)	14	(5.1%)		

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Table 2. Prevalence of self-reported diagnoses of mental health conditions of the COA and AST groups.

		Control Older Adults (n = 10,495)		AS Traits (n = 276)		Group Difference	Effect Size	Odds Ratio	Whole Sample Association ǂ (n = 20,229)
Psychiatric conditions	*Major depressive disorder*	2411	(23.0%)	153	(55.4%)	$\chi2 = 156.24$, $p < .001$***	0.82 [0.68 - 0.95]	4.41 [3.46 - 5.62]	$r = .171$, $p < .001$***
	Generalized anxiety disorder	1294	(12.4%)	86	(31.2%)	$\chi2 = 85.35$, $p < .001$***	0.67 [0.52 - 0.81]	3.37 [2.60 - 4.34]	$r = .123$, $p < .001$***
	Social anxiety	80	(0.8%)	21	(7.6%)	$\chi2 = 135.70$, $p < .001$***	1.35 [1.09 - 1.62]	11.68 [7.23 - 18.88]	$r = .116$, $p < .001$***
	Mania	50	(0.5%)	7	(2.5%)	$\chi2 = 21.67$, $p < .001$***	0.92 [0.48 - 1.36]	5.33 [2.39 - 11.85]	$r = .046$, $p < .001$***
	Agoraphobia	29	(0.3%)	6	(2.2%)	$\chi2 = 29.89$, $p < .001$***	1.11 [0.62 - 1.60]	7.75 [3.20 - 18.78]	$r = .045$, $p < .001$***
	Panic Attacks	444	(4.2%)	35	(12.7%)	$\chi2 = 45.19$, $p < .001$***	0.65 [0.45 - .85]	3.28 [2.27 - 4.73]	$r = .080$, $p < .001$***
	OCD	28	(0.3%)	6	(2.2%)	$\chi2 = 31.08$, $p < .001$***	1.14 [0.65 - 1.63]	8.02 [3.30 - 19.47]	$r = .056$, $p < .001$***
	Anorexia nervosa	73	(0.7%)	9	(3.3%)	$\chi2 = 23.43$, $p < .001$***	0.85 [0.47 - 1.26]	4.74 [2.35 - 9.58]	$r = .032$, $p < .001$***
	Bulimia nervosa	41	(0.4%)	6	(2.2%)	$\chi2 = 19.68$, $p < .001$***	0.94 [0.46 - 1.42]	5.53 [2.33 - 13.12]	$r = .035$, $p < .001$***
	Binge eating	39	(0.4%)	5	(1.8%)	$\chi2 = 13.70$, $p < .001$***	0.86 [0.35 - 1.38]	4.82 [1.88 - 12.31]	$r = .044$, $p < .001$***
	Schizophrenia	2	(0.0%)	0	(0.0%)	$\chi2 = .05$, $p = .819$	0.00	1.00 [0.99 - 1.00]	$r = .001$, $p = .176$
	Other psychotic illness	16	(0.2%)	3	(1.1%)	$\chi2 = 13.37$, $p < .001$***	1.05 [0.37 - 1.73]	6.77 [1.97 - 23.25]	$r = .027$, $p < .001$***
	Personality disorder	6	(0.1%)	5	(1.8%)	$\chi2 = 81.14$, $p < .001$***	1.83 [1.19 - 2.46]	27.64 [8.72 - 87.65]	$r = .069$, $p < .001$***
	Autism Spectrum Disorders	0	-	21	(7.6%)	$\chi2 = 800.01$, $p < .001$***	3.73 [2.61 - 4.83]	864.21 [115.80 - 6449.43]	$r = .148$, $p < .001$***
	ADD/ADHD	1	(0.0%)	2	(0.7%)	$\chi2 = 49.39$, $p < .001$***	2.01 [0.92 - 3.09]	38.29 [5.37 - 272.86]	$r = .049$, $p < .001$***
Number of psychiatric condition diagnoses	*No diagnoses*	7208	(68.7%)	89	(32.2%)	$\chi2 = 368.67$, $p < .001$***	1.12 [0.99 - 1.23]	-	$r = .221$, $p < .001$***
	1	2362	(22.5%)	81	(29.3%)				
	2	684	(6.5%)	58	(21.0%)				
	3 or more	241	(2.3%)	48	(17.4%)				

Note: ǂ Whole Sample analyses examines AS Traits continuously (scores = 0 – 5). * $p < .05$, ** $p < .01$, *** $p < .001$

Table 3. Self-report questionnaire means and cut-off frequencies of the COA and AST groups.

		Control Older Adults (n = 10,495)	AS Traits (n = 276)	Group Difference	Effect Size	Odds Ratio	Whole Sample Association ǂ (n = 20,220)
Depression *(max score = 27)*	*Mean (SD)*	2.26 (2.80)	6.18 (5.09)	F(1,10767) = 495.81, $p < .001$***	1.36 [1.23 - 1.47]	-	$r = .258$, $p < .001$***
	95% CI	2.20 - 2.31	5.58 - 6.78				
Anxiety *(max score = 21)*	*Mean (SD)*	1.29 (2.32)	4.32 (4.57)	F(1,10766) = 424.98, $p < .001$***	1.26 [1.14 - 1.37]	-	$r = .231$, $p < .001$***
	95% CI	1.24 - 1.33	3.78 - 4.86				
Depression *(cut off =>10)*	*Frequency (%)*	310 (3.0%)	61 (22.1%)	$\chi 2 = 296.36$, $p < .001$***	1.23 [1.06 - 1.39]	9.32 [6.86 - 12.65]	-
Anxiety *(cut off =>10)*	*Frequency (%)*	143 (1.4%)	33 (12.0%)	$\chi 2 = 187.69$, $p < .001$***	1.26 [1.03 - 1.48]	9.82 [6.59 - 14.65]	-

Note: Depression measured using PHQ-9; Anxiety measured using GAD-7.
ǂ Whole Sample analyses examines AS Traits continuously (scores = 0 – 5). * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4. Prevalence of self-reported diagnoses of physical health conditions of the COA and AST groups.

		Control Older Adults (n = 10,495)		AS Traits (n = 276)		Group Difference	Effect Size	Odds Ratio	Whole Sample Association ǂ (n = 20,220)
Physical conditions	*High Blood Pressure*	2410	(23.1%)	65	(23.6%)	$\chi2 = .04$, $p = .849$	0.02 [-0.14 - 0.17]	1.02 [0.77 - 1.36]	$r = .001$, $p = .157$
	Stroke	135	(1.3%)	4	(1.5%)	$\chi2 = .05$, $p = .819$	.07 [-0.48 - 0.61]	1.12 [0.41 - 3.06]	$r = .002$, $p = .805$
	Heart Disease	437	(4.2%)	14	(5.1%)	$\chi2 = .53$, $p = .467$	0.11 [-0.19 - 0.41]	1.22 [0.71 - 2.11]	$r = .007$, $p = .347$
	High Cholesterol	425	(4.1%)	17	(6.2%)	$\chi2 = 2.98$, $p = .084$	0.25 [-0.03 - 0.52]	1.52 [0.94 - 2.56]	$r = .010$, $p = .164$
	Diabetes	356	(3.4%)	14	(5.1%)	$\chi2 = 2.40$, $p = .134$	0.23 [-0.07 - 0.53]	1.51 [0.87 - 2.62]	$r = .029$, $p < .001$***
	Mild Cognitive Impairment	21	(0.2%)	4	(1.5%)	$\chi2 = 18.02$, $p < .001$***	1.09 [0.50 - 1.69]	7.30 [2.49 - 21.42]	$r = .040$, $p < .001$***
	Parkinson's Disease	31	(0.3%)	2	(0.7%)	$\chi2 = 1.60$, $p = .205$	0.49 [-0.29 - 1.28]	2.45 [0.58 - 10.30]	$r = .003$, $p = .721$
	Hypothyroidism	137	(1.3%)	4	(1.5%)	$\chi2 = .04$, $p = .842$	0.06 [-0.49 - 0.61]	1.1 [0.41 - 3.01]	$r = .009$, $p = .200$
	Hyperthyroidism	33	(0.3%)	2	(0.7%)	$\chi2 = 1.38$, $p = .240$	0.46 [-0.33 - 1.25]	2.30 [0.55 - 9.65]	$r = .009$, $p = .226$
	Arthritic conditions	348	(3.3%)	19	(6.9%)	$\chi2 = 10.28$, $p < .001$***	0.42 [0.16 - 0.68]	2.14 [1.33 - 3.46]	$r = .025$, $p < .001$***
Number of physical condition diagnoses	*No diagnoses*	7086	(68.1%)	169	(61.5%)	$\chi2 = 5.71$, $p = .126$	0.14 [0.02 - 0.26]	-	$r = .028$, $p < .001$***
	1	2522	(24.2%)	78	(28.4%)				
	2	640	(6.1%)	22	(8.0%)				
	3 or more	164	(1.6%)	6	(2.2%)				

Note: ǂ Whole Sample analyses examines AS Traits continuously (scores = 0 – 5). * $p < .05$, ** $p < .01$, *** $p < .001$