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DOI:

[10.1007/s40519-019-00695-8](https://doi.org/10.1007/s40519-019-00695-8)

Document Version

Peer reviewed version

[Link to publication record in King's Research Portal](#)

Citation for published version (APA):

Sedgewick, F. R., Leppanen, J., & Tchanturia, K. (2019). Autistic adult outcomes on weight and Body Mass Index: a large-scale online study. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*. <https://doi.org/10.1007/s40519-019-00695-8>

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1 Autistic adult outcomes on weight and Body Mass Index: a large-scale online study

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7 **Abstract:**

8 *Purpose:* There has been a wealth of work on the weight outcomes of autistic children and young people,
9 generally finding that they are more likely to be overweight or obese than their non-autistic counterparts. There
10 has not been the same focussed study of the weight outcomes of autistic adults, however. This study therefore
11 sought to examine the relationship between weight outcome and being autistic in adults.

12 *Methods:* Data was collected as part of an online study looking at eating, autism, and relationships. 665 people
13 gave demographic and mental health information, and group differences and robust regressions were conducted.

14 *Results:* Autistic adults were more likely to be in non-Healthy weight categories than their non-autistic
15 counterparts, i.e. more likely to be Underweight, Overweight, or Obese. There were no interactions between
16 autism status and mental health impacting BMI, although both anxiety and depression predicted higher BMI in
17 the sample overall.

18 *Conclusions:* We conclude that while some weight patterns from childhood and adolescence continue into
19 adulthood for autistic individuals, this is not necessarily a straightforward picture, and would benefit from
20 further in-depth and qualitative study to understand the processes at play. The lack of interactions between
21 mental health and autism, however, should provide professionals with confidence in supporting healthy weight
22 management among autistic people.

23 **Level of evidence:** Level Three – cohort study

24 **Keywords:** autism, adult outcomes, obesity, eating, weight, mental health

25 **Acknowledgements:** All authors would like to acknowledge the MRC-MRF Fund (MR/R004595/1) and Swiss
26 Anorexia (58/16) for making this research possible. In addition, KT would like to acknowledge Prof Tracey

- 27 Wade and the Norman Munn Distinguished Visiting Scholar Award 2017/2018 from Flinders University South
- 28 Australia. There are no conflicts of interest to declare for any author.

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Introduction

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When discussing the weight outcomes of autistic people, there is a wealth of work showing that children and young people on the spectrum are more likely to be overweight or obese than their non-autistic peers [1,2]. There are a wide range of reasons for being overweight ,but some of the most common factors – consuming more calories than you burn, low levels of physical activity – may particularly affect autistic people [3]. What has not previously been thoroughly explored, however, is whether these patterns extend into adulthood, or their relationships with factors known to influence weight outcomes in non-autistic people.

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Autistic children and young people often have very different diets to non-autistic children and young people, consuming a more limited range of foods [4], although this pattern is not universal [5]. Those foods which are often preferred by autistic children and young people tend to have a higher calorie count or have lower nutritional value [6]. Although it is common for children and young people to enjoy hobbies such as videogames, autistic children and young people engage in less physical activity than their non-autistic peers [7], tending to spend their time with their autistic and non-autistic friends in more sedentary activities [8].

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To our knowledge, there are to date no studies which frame their work specifically as studying weight outcomes in autistic adults, but there is work which has included this data in exploring health outcomes generally. This work finds autistic adults are more likely to be overweight/obese than non-autistic adults, along with also being more likely to have a wide range of health complaints [9,10]. Most adult outcome work has focussed on cognitive and social outcomes [11–13], but health outcome work generally shows autistic adults have more difficulties. Work in non-autistic populations has shown that people with multiple health challenges are more likely to be in the overweight/obese categories [14,15], and this is likely to also be the case for autistic adults.

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Alongside physical health, mental health conditions have also been shown to be linked to higher BMI (Body Mass Index) [16,17] in non-autistic individuals. Autistic people are more likely to experience poor mental health than their non-autistic counterparts, with higher levels of anxiety [18,19] and depression [20,21] being particularly common. It is therefore possible that this interaction between mental health issues and increased BMI is also the case for autistic adults, but this has not been previously investigated.

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One mental health condition which is by definition associated with low rather than high BMI is anorexia nervosa (AN), and connections between autism and AN have been suggested and explored since the

57

58 1980s (Gillberg, 1985). This exploration has normally taken the form of conceptualising AN as a ‘female form’
59 of autism [23], with similarities in cognitive profiles – set-shifting difficulties [24], detail-focussed processing
60 [25,26], and theory of mind challenges [27] – and in social difficulties [28,29]. These studies have, however,
61 exclusively used female participants, as women are more likely to develop AN [30], compared to autism being
62 more commonly diagnosed in males due to well-recognised diagnostic biases [31]. Furthermore, research
63 looking at the overlap between the two conditions has very much focussed on the presence and level of autistic
64 traits in AN populations, with some studies finding up to 23% of women receiving in-patient treatment for AN
65 meet clinical criteria for autism [32,33]. This means that to date there is no published research on how likely
66 autistic people are to meet the criteria for AN of having a BMI below 18.5 [34].

67 This study therefore sought to examine all weight category outcomes of autistic and non-autistic adults,
68 and the potential impact of mental health on these outcomes. Our hypotheses were:

- 69 1) Autistic people would on average have a higher BMI than non-autistic people, and would be more
70 likely to be in the higher weight categories,
- 71 2) People with more mental health difficulties would have a higher BMI than those without mental health
72 difficulties,
- 73 3) There would be an interaction between autism status and mental health resulting in higher BMI
74 outcomes

75 Method

76 Participants

77 Six hundred and sixty-five people between the ages of 18 and 81 were included in the analysis, after
78 the exclusion of 276 participants who self-reported having an eating disorder diagnosis. Of these 665, 335
79 (50.38%) reported that they were autistic, and 330 (49.62%) reported no autism diagnosis. Gender, ethnicity,
80 employment status and other reported diagnoses among the two groups can be seen in Table 1.

81 INSERT TABLE ONE ABOUT HERE

82 Participants were recruited online through social media (Twitter, Facebook) and through online
83 advertising on the King's College website and email circulars. Ethical approval was obtained from the King's
84 Psychiatry, Nursing and Midwifery Research Ethics Committee (LRS-17/18-5292). All participants read a full
85 information page before taking part in the study, and were informed that completing the study would be taken as

86 consent for the use of their data. Participants also completed a written informed consent page before starting the
87 survey. All procedures were conducted in accordance with the latest version of the Declaration of Helsinki.

88 **Measures**

89 *Demographics:* Participants completed a demographics questionnaire, including their age, height,
90 weight, ethnicity and employment status.

91 *AQ:* The Autism Quotient-28 item version [35] is a 28-item self-report screening questionnaire
92 assessing the presence and level of autism symptomatology an individual experiences. Answers are given on a
93 Likert scale from 'Very accurate' to 'Very inaccurate' and are then scored 1 or 0 depending on the direction of
94 the question. Higher scores reflect more autistic symptomatology.

95 *EDE-Q:* The Eating Disorder Examination Self-Report Questionnaire [36] is a 36-item self-report
96 questionnaire assessing eating disorder psychopathology over the past 28 days. Participants score the frequency
97 of their behaviours or thoughts from '0 days' to 'Every day'. Higher scores reflect greater eating disorder
98 symptomatology.

99 *HADS:* The Hospital Anxiety and Depression Scale [37] is a 14-item self-report questionnaire
100 assessing levels of both anxiety and depression over the past two weeks. Answers are scored from 0 (not
101 anxious/depressed) to 3 (very anxious/depressed) on each item for a maximum score of 42. Higher scores reflect
102 higher anxiety and depression levels.

103 **General Procedure**

104 Participants all completed the study online, at their own pace and in a place of their preference. The
105 data was collected as part of a larger study. Participants completed demographic information, the AQ, the EDE-
106 Q, and the HADS online.

107 **Data Analysis**

108 All data analyses were conducted with R [38]. Group differences in demographic and clinical
109 characteristics were explored with t-tests. Weight category outcomes according to autism status were
110 investigated using ordinal logistic regression [39]. Impact of self-reported mental health and autism status on
111 BMI outcomes were investigated using robust regression [40]. Separate robust regression models were built to
112 examine the impact of self-reported anxiety (HADS anxiety), depression (HADS depression), and eating

113 disorder symptomatology (EDEQ total) along with autism status on BMI. Separate Spearman's correlation
114 analyses were conducted to examine associations between AQ-28 scores and BMI within the two groups.
115 Significance level was set at $p < 0.05$.

116 **Results**

117 **Demographics**

118 Participants were matched on age, $t(664) = -1.62, p = 0.11$. They were not matched on AQ score, with
119 those who reported being autistic scoring significantly higher than those who reported being non-autistic, $t(664)$
120 $= -31.22, p < 0.001$.

121 **Weight Outcomes**

122 The numbers of autistic and non-autistic people in each weight category can be seen in Table 2.
123 Autistic people had a higher average BMI than non-autistic people, $t(664) = -4.03, p < 0.001$. Within the autistic
124 group, higher AQ scores were correlated with lower BMI, $r = -2.51, p = 0.01$. Within the non-autistic group,
125 there was no correlation between AQ score and BMI, $r = 1.43, p = 0.15$.

126 **INSERT TABLE TWO ABOUT HERE**

127 A categorical outcome regression showed that being autistic had a significant impact on likely weight
128 category outcome. Taking Healthy weight as the baseline, autistic people were more likely to be either
129 Underweight ($t = -14.20, p < 0.001$), Overweight ($t = 3.26, p < 0.001$), or in obesity range ($t = 11.72, p < 0.001$)
130 than non-autistic people. Being autistic was linked to a 58.84% greater chance of being in the Overweight/Obese
131 weight categories than Healthy weight category.

132 **Mental health and BMI**

133 Scores on mental health and clinical measures can be seen in Table 3. Autistic people scored more
134 highly than non-autistic people on both the anxiety, $t(664) = -12.35, p < 0.001$, and depression subscales of the
135 HADS, $t(664) = -10.85, p < 0.001$. There were no significant differences between the groups on the EDE-Q,
136 $t(664) = -1.14, p = 0.25$.

137 **INSERT TABLE 3 ABOUT HERE**

166 characterised by low body weight and the pursuit of extreme thinness [34], and autism or autistic traits
167 [32,33,41]. This research has shown that up to 23% of women with severe and enduring anorexia, i.e. those who
168 maintain very low BMI for many years, have clinically significant levels of autism traits [32]. This association
169 between autism and anorexia has been linked to similar cognitive profiles in the two conditions [27,42–44]. It
170 may therefore be that those autistic people, especially autistic women, who develop an eating disorder are more
171 likely to fall into the lowest BMI category anyway and therefore find it hardest to change their behaviour pattern
172 to achieve a Healthy weight regardless of ongoing ED. There is also some evidence that children with
173 developmental disabilities are more likely to be in the Under- as well as Over-weight categories [45], a pattern
174 which may also be maintained into adulthood.

175 This interpretation is supported by the finding that within the autistic group, higher AQ score was
176 correlated with lower BMI, suggesting that more severely autistic people are more likely to have restricted
177 calorie intake. Wider literature proposes a range of possible reasons for this, particularly around sensory
178 sensitivities. That autistic people are often hyper- or hypo-sensitive to touch, taste, smell and light is well-
179 documented and was included as a diagnostic criterion in the new DSM-V [34]. These sensitivities may
180 contribute to the restricted dietary range often seen in autistic children [4], and potentially result in the same in
181 autistic adults, as people seek to avoid unpleasant or overstimulating foods. This in turn potentially leads to
182 more acute malnutrition and low BMI amongst those with more sensory challenges associated with higher levels
183 of autism symptomatology.

184 These sensory sensitivities may also play a role in the higher numbers of autistic adults who were in the
185 Overweight/Obese categories as well as those in the Underweight category. Just as some autistic people may be
186 underweight due to sensory avoidance of unpleasant or overwhelming stimuli, some autistic people may be
187 overweight/obese due to sensory seeking of foods which are pleasant to them. Considering work which has
188 shown that, regardless of autism status, people find more emotional satisfaction from foods associated with their
189 childhoods [46,47] and that autistic children often have diets containing relatively high calorie foods [6], it is
190 reasonable to assume that autistic adults who sensory seek through food tend to go for those same high calorie
191 items, contributing to weight gain.

192 It was somewhat surprising that BMI outcome was not impacted by the interaction between autism and
193 mental health. Individuals with mental health issues are often found to have higher BMI than those without
194 mental health issues [16,17], as are autistic people [10]. Considering that autistic people are more likely to have

195 mental health issues than non-autistic people [18], a pattern which was also present in this study, it would be
196 reasonable to predict that autistic people with mental health issues would have higher BMI scores than non-
197 autistic people with mental health issues or autistic people without mental health issues. That this is not the case,
198 however, is promising in that it suggests there are not a set of unique processes occurring for autistic people
199 with mental health issues regarding their weight outcomes, and therefore weight interventions which already
200 exist can be implemented with confidence. **It is also the case that anxiety levels in our non-autistic sample were**
201 **higher than the expected population norm, sitting at 7.55 in our sample compared to 4.4 – 5.0 in normative data**
202 **[37]. This may be because the majority of participants were female, and women are known to experience higher**
203 **levels of anxiety than men [48].**

204 While this is generally a strong study due to the large sample size, there are some limitations to the
205 research. First, the data comes entirely from self-report, which raises the possibility of inaccurate answers,
206 especially regarding weight. It is common for people to be unclear as to their weight in a way that isn't for
207 their height, and so it may be that there are some people who either under- or over-reported their weight. Despite
208 this, the broad range of BMI scores in both the autistic and non-autistic samples suggest that the overall sample
209 is representative even if individual scores are somewhat off. Second, the groups were not matched on
210 demographic variables such as gender or employment status. This is to be expected, however, considering work
211 showing that autistic people are more likely to be gender non-conforming than non-autistic people [49–51] and
212 that they can struggle to maintain full-time employment [52,53], and therefore these differences are
213 representative of the population. Third, this study lacks any qualitative data, so we are unable to discuss what
214 experiences and drivers people felt contributed to their weight in their own words. Future work exploring this
215 topic would be valuable, as people cannot be supported in living healthier lives if we do not know what causes
216 unhealthy behaviours in the first place. Fourth, this work captures people's weights at just one point in time,
217 rather than being longitudinal, and does not track the many factors which are known to promote weight gain
218 over time. **Finally, there are potential selection biases in online recruitment, such as the reliance on the literacy**
219 **and written communication abilities of participants which may mean our findings are not representative of those**
220 **autistic people who have difficulties with these media. It is also possible that our participants were individuals**
221 **who have an interest in the topics of autism and weight, although the wide range of BMI scores and the**
222 **preponderance of those in the Normal weight category suggest this is not necessarily a key bias present in the**
223 **sample.**

224 In conclusion, our data is the first large-scale study which shows that autistic adults are more likely to
225 be in all weight categories considered ‘unhealthy’, i.e. Underweight, Overweight, and Obese, than they are to be
226 in the Healthy weight category. This is in line with a wealth of work which has examined the weight outcomes
227 of autistic children and adolescents and extends our understanding of health across the lifespan for autistic
228 people. **In this study there were no impacts on BMI from the interactions between self-reported mental health
229 and autism status, suggesting that autistic people would likely benefit from the same interventions as non-
230 autistic people without the assumption that they will inherently have mental health challenges.** Future work
231 should include qualitative explorations of the factors and experiences which autistic adults themselves feel
232 contribute to their weight status in order to understand how to best support them regarding healthier choices,
233 along with understanding whether autistic people want this kind of support at all.

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237 **Declaration of Interest:** There are no conflicts of interest to declare.

238 **Funding:** All authors would like to acknowledge the MRC-MRF Fund (MR/R004595/1) and the Swiss
239 Anorexia Foundation (58-16) for making this research possible. KT would like to acknowledge Prof Tracey
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423
424 Table 1. *Demographic characteristics of the sample by group (autistic, non-autistic).*

| | Autistic (n = 335) | Non-autistic (n = 330) |
|--------------------------|--------------------|------------------------|
| Age | | |
| Range | 18.12 – 71.42 | 18.29 – 81.29 |
| M (SD) | 34.06 (10.86) | 32.67 (11.25) |
| Gender | | |
| Male | 53 (15.82%) | 53 (16.06%) |
| Female | 195 (58.21%) | 266 (80.61%) |
| Non-binary | 86 (25.67%) | 12 (3.63%) |
| Ethnicity | | |
| White | 246 (73.43%) | 262 (79.39%) |
| Asian | 8 (2.38%) | 24 (7.27%) |
| Black | 3 (0.90%) | 3 (0.91%) |
| Latinx | 3 (0.90%) | 1 (0.30%) |
| Mixed | 14 (4.18%) | 9 (2.73%) |
| No Answer | 59 (17.61%) | 31 (9.39%) |
| Employment Status | | |
| Full-time | 89 (26.57%) | 177 (53.63%) |
| Part-time | 40 (11.94%) | 27 (8.18%) |
| Student | 60 (17.91%) | 91 (27.57%) |
| Self-employed | 39 (11.64%) | 14 (4.24%) |

| | | |
|-----------------------------|--------------|-------------|
| Unemployed | 73 (21.79%) | 12 (3.63%) |
| Retired | 8 (2.38%) | 4 (1.21%) |
| Other | 23 (6.87%) | 5 (1.52%) |
| Eating-related Diagnoses | | |
| Diabetes | 21 (6.27%) | 4 (1.21%) |
| Coeliac Disease | 3 (0.89%) | 1 (0.30%) |
| Crohn's Disease | 2 (0.60%) | 1 (0.30%) |
| Ehlers-Danlos Syndrome | 2 (0.60%) | 0 (0.00%) |
| Food Intolerances/Allergies | 104 (31.04%) | 48 (14.54%) |
| Irritable Bowel Syndrome | 16 (4.77%) | 8 (2.42%) |
| AQ score | | |
| Range | 4 – 28 | 0 – 25 |
| M (SD) | 20.98 (3.83) | 8.93 (5.68) |

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430 *Table 2. BMI and weight category outcomes by group (autistic, non-autistic).*

| | Autistic (n = 335) | Non-autistic (n = 330) |
|-----------------|--------------------|------------------------|
| BMI | | |
| Range | 14.56 – 72.31 | 15.06 – 63.82 |
| M (SD) | 28.01 (8.36)*** | 25.66 (6.49) |
| Weight category | | |
| Underweight | 18 (5.37%)*** | 9 (2.73%) |
| Healthy weight | 126 (37.61%) | 189 (57.28%) |
| Overweight | 86 (25.67%)*** | 71 (21.52%) |
| Obese | 104 (31.04%)*** | 61 (18.48%) |

431 N.B. * denotes significance at the .05 level, ** denotes significance at the .01 level, *** denotes significance at
432 the .001 level

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