# Examining Neurodiversity and Inclusion in Neuroscience Research Networks: A Case Study of the AIMS-2-TRIALS Autism Research Consortium.

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**Abstract**

The growing demand of better representation of people from marginalised communities within the scientific workforce has recently started to include neurodiversity, especially in projects and consortia investigating neurodivergence. In line with this aim, this study explores the diversity of the research workforce in the context of a European autism neuroscience research consortium (AIMS-2-TRIALS). By investigating potential power imbalances between researchers of different backgrounds and at different career levels, we aim to investigate the impact of such imbalances on career and mental health. A survey was administered to AIMS-2-TRIALS researchers (including students, early, mid, and advanced career levels), obtaining 124 complete respondents. While autistic researchers were present in this sample (4% formally diagnosed, 19.23% self-identified), they were under-represented in senior and clinical roles. Neuro-identity emerged as the primary predictor of mental health conditions such as anxiety and depression. Also, while researchers in the sample were mostly women (74%), income was consistently lower in women. These findings emphasise the need to consider underrepresentation of intersecting marginalised identities within consortia like AIMS-2-TRIALS, and to redistribute roles and resources. The recognition of mental health and socio-economic challenges faced by neurodivergent and female researchers in this field constitute a barrier to career progression that calls for recognition and intervention.

## Introduction

Discrimination and the mental health crisis are driving forces of the lack of diversity and inclusivity within scientific workforces (Evans et al., 2018; Wellcome Foundation, 2020). Women, people of colour and/or disabled people face disproportionate barriers to access and retention within scientific careers (Campbell-Montalvo et al., 2020; Dewsbury & Brame, 2019; Johri et al., 2021), with unique challenges faced by scientists at the intersection of multiple identities (Pownall et al., 2021). The underrepresentation of neurodivergent researchers in the scientific community, especially within autism research, has also been highlighted for its serious consequences in terms of exclusion of diverse perspectives that limits the understanding of the

needs of the investigated population (Botha et al., 2022; Shaw et al., 2023). This limitation contributes to the widening gap between science and real-world applications, as well as self-perpetuating within the workforce and is therefore particularly relevant for the inclusion of neurodivergent researchers in studies of neurodevelopmental conditions.

Researchers encompassing multiple of these identities (e.g., autistic, low-income women) may face significant societal pressure. Overlapping demands from work and family may mediate forced choices with loss of salary and quality of life – e.g., working part-time or multiple jobs to meet childcare costs (Harrop et al., 2021; Jiang, 2021). At institutions, students and employees under this profile may also provide time commitment to unrecognised labour on committees for diversity and inclusion (Bird et al., 2004). These multifaceted obstacles may indirectly subtract time and funding with lost professional development and publications (Casad et al., 2021; Harrop et al., 2021; Johri et al., 2021; Roberson, 2020). The publication rate and impact may also be influenced by editorial and peer-review procedures of high impact journals, that often overwhelmingly consist of white, male senior researchers (Rice et al., 2022) and/or may feel biased against disclosed autistic authors (Botha, 2021). However, rejection and having to resort to lower impact journal may subtly affect neurodivergent researchers even when undisclosed or with double-blind peer-review due to difficulties with conforming to the strict rules of academic writing ('tell us what's important, not what you know', Jones, 2023, p. 826). Addressing underrepresentation and its causes is critical to overcoming the significant challenges posed to contemporary science by limited cross-neurotype, cross-gender, and cross-cultural information exchange. Without testimony from diverse perspectives, the understanding of complex phenomena, such as the factors affecting the recognition and support of autistic people in societies, may remain incomplete.

AIMS-2-TRIALS, a multinational research consortium dedicated to the study of autism from a biological perspective using multiple methods that require multi-disciplinary expertise (e.g., clinical trials, neuroscience, behavioural and cognitive science), presents a unique opportunity to investigate diversity. Spanning across 14 countries, the consortium facilitates collaboration among researchers, aligning protocols, sharing data, and producing joint publications. Notably, the consortium includes autistic representatives (A-Reps), including autistic people, parents, carers, and advocates. A-Reps actively participate in science communication and training, collaborate on priority-setting, study design and implementation, form part of working groups that advise on essential aspects of research, (e.g., ethics), and co-author publications. However, it remains unclear whether autistic researchers - whose perspectives may closely align with research participants and the wider autism community - are represented at all, and in positions that allow adequate influencing of the research process (e.g., research assistant collecting data vs principal investigator). It is possible that autistic researchers may positively influence public interest and trust in the scientific process in this field, that may facilitate recruitment, retention of participants and collaboration between communities and researchers. Lack of connection between research and communities led to significant consequences as the cancellation of studies (Sanderson, 2021). To function as connecting layers, of course, neurodivergent researchers need to be hired and occupy influential roles within the research consortium: the current study sets out to verify whether neurodivergent researchers are employed in the consortium, and at what level.

The primary objective of this paper is an in-depth demographic analysis of the researchers working for AIMS-2-TRIALS, to identify potential disparities among researchers, and explore the impact of neurotype, gender, and socio-economic background on career level and mental health. These variables were selected because previous research indicated that these factors challenge access and progression within research positions (Botha, 2021; Botha & Cage, 2022; Harrop et al., 2021). We hypothesize that the consortium does not fully reflect the diversity observed in participant samples and that certain groups of people face underrepresentation and socio-economic challenges.

# Methods

## Participants

The participants are researchers (including students, early- and mid-career, and senior) and staff (e.g., admin and project management) of the AIMS-2-TRIALS consortium. The inclusion criterion was to be involved in an active project with one of the 35 contributing institutions forming AIMS-2-TRIALS (for a complete list, see *AIMS-2-TRIALS - Autism Research For Europe* , 2018).

## Tools

This study used an in-house built questionnaire including multiple choice and open-ended questions built on the secure platform, REDcap. The questions included in the questionnaire were developed by four of the authors (TDB, GLE, MD and EJHJ), in consultation with the AIMS-2-TRIALS Communication team. The questionnaire included 47 questions. Depending on the question, participant response options included: ticking a box, typing, ordering categories, or dragging a marker on a slider. Every question included a "Prefer not to say" response option and could also be left blank. A list of the questions is provided in Table S 1 of the Supplementary Material.

## Procedure

The ethical approval was granted by the Departmental Ethics Committee of the Department of Psychological Sciences at Birkbeck College University of London. The Communication Team of AIMS-2-TRIALS sent researchers/staff members of AIMS-2-TRIALS an email invitation to participate with a link to access the questionnaire in January 2022. The email included complete information about the study aims and modalities and a link redirecting to the questionnaire online platform and the study information sheet. After reading the information sheet, the participant could progress and access the consent form. After confirming their consent, the participant could progress to the first questionnaire item.

## Measures and Statistical Analysis

In the text, we report averages and standard deviations or maximum and minimum and median, depending on what type of metrics fits interpretability better (e.g., median for number of bedrooms) for continuous variables. For categorical variables, we report percentages for every level of response, as well as sample sizes in Table 2. For all continuous variables, we report sample size, minimum, maximum, median, interquartile range, mean, standard deviation, standard error, and confidence interval in Table 3.

We investigated the relationship between professional category and diversity by utilising chi-square tests. Chi-square tests determine whether there is an association between pairs of categorical variables. As categorical variables, we selected professional category, gender, being autistic, personal link to autism, and the number of household children. The levels of each of these variables corresponded to the available responses in the questionnaire (see Table S 1 of the SM). To increase the group-levels samples sizes and avoid low frequencies that can bias the chi-square tests, we decided to collapse together some of the levels of professional category based on role and career pathway (i.e., admin, clinician, and researcher). Further, we separated the researcher category into two, based on whether the position officially entails managing other employees and/or students (Research Assistants / Postdoctoral Researchers / Research Fellows / Researchers / PhD Students - not managing other employees and/or students -, and Lecturers / Readers / Professors / Directors - managing other employees and/or students), for a total of 4 levels. Please note that these categories are not ordinally ordered and may not reflect the number of years in academia; this decision was justified by differences between countries in the contractual status of early and mid-career researchers and in the number of years before obtaining tenure. We report the chi-square statistics, p-values, and the differences between observed and

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expected frequencies for each professional category combination to identify significant associations between variables.

To explore the relationship between income, mental health, and various socio-economic variables, we employed multiple regression analysis. For the dependent variables of annual income (converted to euros; continuous) and lifetime diagnosis of mental health conditions (binary, 0 / 1), we utilised two separate repressions to accommodate the different format of the dependent variables (linear for the continuous dependent variable, and generalised linear with binomial logit link for the binary dependent variable). We included the independent variables neuro-identity, gender, age, living arrangement, number of bedrooms, number of household children, number of non-household adults financially supported, and subregion of residence (Southern Europe, Northern Europe, Belgium, Switzerland, North America, Southern Africa, Eastern Africa). To increase the group-level sample sizes and avoid low frequencies, we generated the categorical variable neuro-type by combining responses to the questions "Are you autistic?" and "Do you have another developmental condition?". To further increase the group-level sample size and avoid low frequencies that can overfit regression models, within this variable we collapsed the response levels other than "No" into one level – Neurodivergent – that therefore includes diagnosed and self-identified respondents. For income, we report the estimate, standard error, t-value, and p-value from the linear regression analysis. For lifetime mental health diagnosis, we report the estimate, standard error, z-value, and p-value from the generalised linear regression analysis.

# Results

## Descriptive Statistics

### Demographic Composition

For complete reports of each subcategory, see Table 2 and Table 3.

The average age was 38.74 years (SD - 12.09, range 20 - 70). Most respondents were based in the United Kingdom (38.71%), followed by Spain (12.10%), with the most common nationalities being British (17.39%), followed by Dutch (10.43%) and Spanish (10.43%). Respondents ranged from 13 different countries of residence in Europe, North America, and Southern Africa, with 22 different nationalities from Northern, Southern, Western and Eastern Europe, North and Central America, the Caribbean, Northern, Eastern and Southern Africa, and Eastern and Southern Asia (see Table 2).

### Gender and Ethnicity

The most represented gender was female (74.19%); most respondents were cis gender (97.58%) with preferred pronouns she or he (98.38%, combined). Most respondents were white (79.13%), followed by mixed/multiple ethnic groups (6.96%), Asian (6.09%), not listed (3.48%) and black (0.87%).

### Neurodiversity

8.04% of respondents (10) declared that they received a formal diagnosis of autism or are undergoing the diagnostic process; 15.32% (19) responded that they think they are or might be autistic, but never entered the diagnostic process, and 76.61% responded that they are not. 60% of the formally diagnosed participants declared they had disclosed to their line manager, 20% preferred not to respond, and 20% did not disclose. All the respondents who think they are or might be autistic but do not have a diagnosis left this question blank. 16.13% responded that they have a formal diagnosis of another neurodevelopmental condition 9 e.g. ADHD, dyslexia, dyspraxia), while 9.68% responded that they are not sure. Regarding personal links to autism, people responded that they have (19.35%) or might have (16.13%) someone autistic in their family, including partner and children, have (51.61%) or might have (16.13%) autistic friends, have (37.10%) or might have (8.06%) a family member with another neurodevelopmental condition.

**Living Arrangement**

The majority of respondents lived with a partner (65.04%), with 52.03% owning their house, and 44.72% renting, with the most common type of house being a flat (56.91%). The median number of bedrooms was 3 (range 1 - 10), and the median number of children living with the respondents was 0 (range 0 - 3).

**Income and Employment**

The median annual income was 40000 EUR (range 3400 - 174000). The most common job title was post-doctoral researcher (25.62%), followed by research assistant/nurse/technician (15.70%) and PhD Student (10.74%). When ranking job-related tasks, statistical analysis, data science and coordination received the highest rankings (median = 3), followed by data management and recruitment and testing (median = 4), working with the autistic community, teaching, and clinical work (median = 5). There were gender differences in task roles with men ranking higher for statistics, programming and data management, and women ranking highest for testing, coordination, and data management (see Table 1).

Table : ranking of job tasks by gender

| rank | men | women |
|------|-----|-------|
| 1 | statistics | participant testing |
| 2 | programming | coordination |
| 3 | data management | data management |
| 4 | coordination | statistics |
| 5 | writing | clinic |
| 6 | wet laboratory | writing |
| 7 | participant testing | community |
| 8 | teaching | teaching |
| 9 | community | programming |
| 10 | clinic | wet laboratory |

The majority of respondents had never been unemployed in the last 5 years, but some declared they had been unemployed for 3 months (15.15%) or 6 months (9.09%). 38.79% were paying for student debt, 6.90% declared over the previous year they had difficulties managing essential expenses (e.g., food, bills) and 16.12% had chosen not to use health care services (e.g., dentist, paid prescriptions) because of the cost.

**Health**

36.52% had a physical chronic illness; for 59.52% of them, their condition affected work and daily activities. 34.78% received a formal diagnosis of a mental health condition (e.g., anxiety, depression) in their lifetime; for 62.50% of them, this condition affected their work and daily activities. 70.43% responded that a loved one had been diagnosed with a mental health condition. The median number of sick days taken in the last year was 2 (range 0 - 160).

**Expectations**

The last section of the questionnaire asked the participants to indicate what percentage they expected in terms of diversity expectations within the consortium. The median percentage of researchers from high socio-economic backgrounds according to respondents' expectations was 75% (IQR = 19.00), 25% (IQR = 19.25) for the percentage of non-white researchers, and 60% (IQR = 34.50) for the percentage of researchers based outside of an English-speaking country.

Table : sample sizes and percentages for each of the response levels. Missing values are excluded so the totals may differ between questions.

| Question / Answers |
| --- |
| What is your country of residence? |
| Belgium |
| France |
| Germany |
| Italy |
| Netherlands |
| Portugal |
| Prefer not to say |
| South Africa |
| Spain |
| Sweden |
| Switzerland |
| United Kingdom |
| United States |
| What gender do you identify as? |
| Man |
| Non-binary |
| Woman |
| Are you transgender? |
| No |
| Yes |
| What pronouns do you prefer that others use when talking to you? Tick all that applies |
| He/him |
| She/her |
| They/them |
| Prefer not to say |
| Are you autistic? |
| I think I am or might be, but I never entered the diagnostic process |
| No |
| There is a high chance that I am, and I am undergoing the diagnostic process |
| Yes, I received a formal autism diagnosis |
| Did you disclose this information to your Principal Investigator or manager? |
| Yes |
| Is someone in your family including partner and children autistic? |
| Maybe / I am not sure |
| No |
| Yes |
| Do you have any autistic friends? |
| Maybe / I am not sure |
| No |
| Yes |
| Do you have another neurodevelopmental condition, e.g. ADHD, dyslexia, dyspraxia? |
| Maybe / I am not sure |
| No |
| Yes |
| Does someone in your family including partner and children have another neurodevelopmental condition, e.g. ADHD, dyslex |
| Maybe / I am not sure |
| No |
| Yes |
| Have you met an autistic person at least twice beyond a first acquaintance in the past 2 years? This may be in person or re |

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| Question / Answers |
| --- |
| Maybe / I am not sure |
| No |
| Yes |
| What is your living arrangement? |
| I live in a flat share |
| I live on my own with/without children |
| I live with a partner with/without children |
| Other |
| What best describes the kind of house or flat you live in? |
| Owned property |
| Private rental |
| Social housing |
| What kind of house or flat do you live in? |
| Detached house |
| Flat/Apartment |
| Prefer not to say |
| Semi-detached house |
| Shared accomodation (e.g, hostel, student residence/dorm...) |
| Terraced house |
| Are you employed in education in receipt of any benefits? Tick all that applies |
| Employed |
| In education |
| In receipt of benefits |
| Please select the closest value to your annual income |
| 10,000 |
| 20,000 |
| 30,000 |
| 40,000 |
| 50,000 |
| 60,000 |
| 70,000 |
| 90,000 |
| >100,000 |
| Prefer not to say |
| Please, specify your currency |
| CHF |
| EUR |
| GBP |
| SEK |
| USD |
| ZAR |
| What is your job title? |
| Lecturer |
| Medical doctor/clinician |
| PhD student |
| Postdoctoral researcher |
| Prefer not to say |
| Professor |
| Project manager/admin |
| Reader |

| Question / Answers |
| --- |
| Research assistant/nurse/technician |
| Research fellow |
| Senior Researcher |
| If you have been unemployed how many months have you been unemployed approximately over the last 5 years? |
| 0 |
| 2 |
| 3 |
| 6 |
| Are you paying for your own student debt? |
| No |
| Prefer not to say |
| Yes |
| In the past 12 months have you had any difficulty managing current expenses for food rents bills etc? |
| No |
| Yes, more than once |
| Yes, once |
| In the past 12 months have you chosen not to use health care services including dentist, doctor's visit or prescription collect |
| No |
| Yes, more than once |
| Yes, once |
| Do you have any physical chronic illness symptoms after an accident, disability or other long term health problem? |
| No |
| Yes |
| Do these problems affect your work or other daily activities? |
| No |
| Yes |
| Have you ever experienced mental health conditions and received a formal diagnosis, such as of anxiety and depression in yo |
| No |
| Prefer not to say |
| Yes |
| Do these problems affect your work or other daily activities? |
| No |
| Yes |
| Have any of your loved ones ever experienced mental health conditions and received a formal diagnosis, such as of anxiety a |
| No |
| Yes |
| What is your nationality? |
| American |
| Belgian |
| British |
| Czech |
| Dutch |
| English |
| French |
| German |
| Irish |
| Italian |
| Portuguese |
| Prefer not to answer |
| South African |

| Question / Answers |
| --- |
| Spanish |
| Swedish |
| What is your first language? |
| Czech |
| Dutch |
| English |
| French |
| German |
| Italian |
| Portuguese |
| Prefer not to say |
| Spanish |
| Swedish |
| Are you fluent in English? |
| Yes |
| No |
| What is your ethnic group? |
| Asian |
| Mixed/multiple ethnic groups |
| Other |
| Prefer not to say |
| White |
| What is your country of birth? |
| Belgium |
| Czech Republic |
| France |
| Germany |
| I don't know |
| Ireland |
| Italy |
| Netherlands |
| Portugal |
| Prefer not to say |
| South Africa |
| Spain |
| United Kingdom |
| United States |
| What is your country of birth of your mother main caregiver? |
| Belgium |
| France |
| Germany |
| Ireland |
| Italy |
| Netherlands |
| Poland |
| Portugal |
| Prefer not to say |
| South Africa |
| Spain |
| Sweden |

| Question / Answers |
| --- |
| United Kingdom |
| United States |
| What is your country of birth of your father/co-parent? |
| Belgium |
| Czech Republic |
| France |
| Germany |
| Ireland |
| Italy |
| Netherlands |
| Portugal |
| Prefer not to say |
| South Africa |
| Spain |
| Sweden |
| United Kingdom |
| United States |

Table : descriptive statistics of the continuous responses.

| Question | N | Min | Max | Median | I |
| --- | --- | --- | --- | --- | --- |
| What is your age? | 115 | 20 | 70 | 35 | 1 |
| How many bedrooms do you have in your home? | 119 | 1 | 10 | 3 | 2 |
| How many children under 18 live in your home? | 121 | 0 | 3 | 0 | 1 |
| How many children under 18 do you financially support who do not live in your home? | 117 | 0 | 2 | 0 | 0 |
| How many adults live in your house including you ? | 120 | 0 | 9 | 2 | 0 |
| How many adults do you financially support who do not live in your home? | 120 | 0 | 2 | 0 | 0 |
| How any sick days have you taken in the last year | 101 | 0 | 160 | 2 | 5 |
| Expectations: Proportion of respondents from high socio economic backgrounds | 105 | 18 | 100 | 75 | 1 |
| Expectations: Proportion of respondents from non white ethnic background | 104 | 4 | 100 | 24.5 | 1 |
| Expectations: Proportion of respondents based outside of an English speaking country | 103 | 8 | 100 | 60 | 3 |
| Average Annual Income (EUR) | 115 | 3400 | 174000 | 40000 | 2 |

## Association between Professional Categories and Diversity (Chi-Square Tests)

There was a significant association between professional category and gender (Chi-Square = 16.97, DF = 4, p-value = 0.001), and being autistic (Chi-Square = 25.44, DF = 12, p-value = 0.01)[11]The combined proportion of non-binary researchers and researchers whose identity was not listed was < 5 and had to be dropped from the test.. The association was not significant between professional category and having an autistic family member (Chi-Square = 10.54, DF = 8, p-value = 0.23), and number of household children (Chi-Square = 18.91, DF = 12, p-value = 0.09).

In terms of direction of these associations, the difference between observed and expected frequencies was > 1 for women among Research Assistants / Postdoctoral Researchers / Research Fellows / Researchers / PhD Students (5.90) and men among Lecturers / Readers / Professors / Directors (7.36) – indicating that men are overrepresented in the Lecturer / Reader / Professor / Director category, while women are over-represented in the Research Assistants / Postdoctoral Researchers / Research Fellows / Researchers / PhD Students category. This difference was also > 1 for respondents who self-diagnosed autism, who were over-

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represented in the Research Assistants / Postdoctoral Researchers / Research Fellows / Researchers / PhD Students category (1.98) and under-represented in the Lecturer / Reader / Professor / Director category. Additionally, respondents who declared they are not autistic were over-represented in the Clinician (1.50) and Lecturer / Reader / Professor / Director categories (4.00), while under-represented in the Research Assistants / Postdoctoral Researchers / Research Fellows / Researchers / PhD Students category (see Table 4).

Table : difference between observed and expected frequencies for each level of the categorical variables significantly associated with professional categories (gender, autism diagnosis). A difference $< / > 1$ indicated under- / over-representation of that level.

| Professional Category | Gender Man | Gender Woman | Autism Diagnosis I think I am or might be, but I never entered the diagnostic |
|---|---|---|---|
| Admin | -0.93 | 0.93 | 0.44 |
| Clinician | -0.81 | 0.81 | -0.66 |
| Early Career Researcher | -5.90 | 5.90 | 1.98 |
| Lecturer / Reader / Professor / Director | 7.36 | -7.36 | -2.33 |
| Other | 0.29 | -0.29 | 0.58 |

## Relationship between Socio-Economic Variables and Diversity Representation

Results from the linear multiple regression (Table 5) revealed that annual income was significantly increased by age (Coef. = 1321.18, SE = 297.87, T-Value = 4.44, P-value < 0.001). Female gender was associated with lower annual income compared to male gender (Coef. = -19591.04, SE = 6312.85, T-Value = -3.10, P-value < 0.001), even when controlling for age, that had a positive effect overall. The model showed good fit to the data, with a proportion of variance explained compared to baseline (based on between participants variability of annual income, no predictors) of 0.85. The model did not violate the assumption of normality, homogeneity and heteroscedasticity of residuals, and independence of predictors (see Table S 2 and Figure S 1-2-3 of the SM).

Table : linear regression results for the predictors of Income. Significant predictors are marked with *

| Variable | Estimate | Standard Error | T-Value | P-Value |
|---|---|---|---|---|
| (Intercept) | -38331.21 | 31377.84 | -1.22 | 0.23 |
| Neuro-identity (ND) | -1253.62 | 6067.64 | 0.21 | 0.84 |
| Age | 1321.18 | 297.87 | 4.44 | <0.001* |
| Gender (Woman) | -19591.04 | 6312.85 | -3.10 | <0.001* |
| Residence: North America | 52221.49 | 30179.80 | 1.73 | 0.09 |
| Residence: Northern Europe | 29830.35 | 25819.23 | 1.16 | 0.25 |
| Residence: Southern Africa | -24572.72 | 27394.42 | -0.90 | 0.37 |
| Residence: Southern Europe | 13509.74 | 26444.45 | 0.51 | 0.61 |
| Residence: Western Europe | 20613.36 | 26033.35 | 0.79 | 0.43 |
| Living Arrangement (on my own with/without children) | 16257.02 | 10948.42 | 1.48 | 0.14 |
| Living Arrangement (with a partner with/without children) | 14545.78 | 9506.23 | 1.53 | 0.13 |
| Living Arrangement (with parents) | 8721.84 | 31578.61 | 0.28 | 0.78 |
| Living Arrangement (other) | -2346.42 | 20025.92 | -0.12 | 0.91 |
| Housing (Private rental) | 8521.35 | 6475.99 | 1.32 | 0.19 |
| Housing (Social housing) | 12131.34 | 19153.77 | 0.63 | 0.53 |
| Number of Bedrooms | 3329.14 | 2062.98 | 1.61 | 0.11 |
| Number of Household Children | 1445.88 | 4200.54 | 0.34 | 0.73 |
| Non-household adults financially supported | 3333.47 | 5061.45 | 0.66 | 0.51 |

The results of the generalised logistic regression (Table 6) showed that the odds ratio of lifetime mental health diagnosis was significantly increased by being neurodivergent (diagnosed or self-identified, including autism and other neurodevelopmental conditions) compared to neurotypical (Coef. = 1.93, SE = 0.63, T-Value = 3.05, P-value = 0.002). The model showed good fit to the data, with a proportion of variance explained compared to baseline (based on between participants variability of lifetime mental health diagnosis, no predictors) of 0.86. The model did not violate the assumption of linearity and independence of predictors, and acceptable homoscedasticity of residuals (see Table S 3 and Figure S 4-5-6 of the SM)).

Table : generalised logistic regression results for lifetime diagnosis of mental health condition. Significant predictors are marked with *

| Variable | Estimate | Standard Error | Z-Value | P-Value |
| --- | --- | --- | --- | --- |
| (Intercept) | 14.17 | 3.95 | 0.003 | 0.99 |
| Neuro-identity (ND) | 1.93 | 6.32 | -3.05 | 0.002* |
| Age | 0.002 | 3.17 | 0.07 | 0.93 |
| Gender (Woman) | 1.46 | 7.58 | 1.93 | 0.05 |
| Residence: North America | -31.90 | 4.83 | -0.006 | 0.99 |
| Residence: Northern Europe | -16.66 | 3.95 | -0.004 | 0.99 |
| Residence: Southern Africa | -17.32 | 3.95 | -0.004 | 0.99 |
| Residence: Southern Europe | -17.05 | 3.95 | -0.004 | 0.99 |
| Residence: Western Europe | -16.25 | 3.95 | -0.004 | 0.99 |
| Living Arrangement (on my own with/without children) | 1.320 | 1.19 | 1.10 | 0.27 |
| Living Arrangement (with a partner with/without children) | 0.97 | 1.05 | 0.92 | 0.35 |
| Living Arrangement (with parents) | 35.24 | 4.66 | 0.007 | 0.99 |
| Living Arrangement (other) | 17.03 | 3.95 | 0.004 | 0.99 |
| Housing (Private rental) | 0.70 | 6.52 | 1.07 | 0.28 |
| Housing (Social housing) | -17.46 | 2.46 | -0.007 | 0.99 |
| Number of Bedrooms | 0.14 | 2.26 | 0.65 | 0.51 |
| Number of Household Children | 0.13 | 3.96 | 0.33 | 0.73 |

| | | | |
|---|---|---|---|
| Non-household adults financially supported | 0.31 | 5.19 | 0.59 | 0.54 |

## Discussion

This study aimed to examine the composition of a research consortium focused on quantitative autism research, the AIMS-2-TRIALS consortium. Disparities in the representation of neurodivergent and female researchers were identified across its professional categories. The descriptive statistics highlight socio-economic challenges such as student debt, temporary unemployment – that might be explained by widespread furloughing at Universities during the COVID pandemic –, and mental and physical health conditions – that affected over 30% of respondents. Surprisingly enough, given that mental and physical health conditions affected the everyday life of at least 15% of the respondents, the number of reported sick leave days was very low, which might reflect the detrimental academic culture around taking sick leave (Jung, 2017). Finally, the regression analyses revealed that mental health conditions were exacerbated among those diagnosed or self-identified with autism and other neurodevelopmental conditions, and that female researchers earned less despite controlling for age.

Our investigation into neurodivergent researchers within the consortium yielded significant insights. Firstly, diagnosed and self-identified neurodivergent individuals were over-represented among Research Assistants / Postdoctoral Researchers / Research Fellows / Researchers / PhD Students. This findings could be explained with the younger ages of people occupying such positions (average age of Research Assistants / Postdoctoral Researchers / Research Fellows / Researchers / PhD Students in this sample = 33.17 years), and thus reflect lower rates of diagnosis and/or hampered self-identification in more senior researchers (average age of Lecturers / Readers / Professors / Directors = 51.33 years) that may be due to a cultural prevalence of the deficit-based model (Shaw et al., 2023). However, neurodivergent people were also under-represented among clinicians, whose average age was younger than Lecturers / Readers / Professors / Directors (40.33 years). Therefore, this distribution could partly show challenges in accessing senior and clinical positions for neurodivergent people in this consortium. These roles are often characterised by high exposure to the public, administrative demands, blurred role boundaries and emphasis on neurotypical social communication preferences (such as attending meetings to build and maintain internal and external contacts and develop productive relationships, regular contact and liaison with collaborators and students, and outreach activities). Neurodivergent people may be primed to expect receiving negative feedback during such situations due to the Double Empathy Problem (Milton et al., 2022), therefore such expectations can lead to frustration, discouragement, and avoidance (Davies et al., 2023). Relatedly, the fear of increased expectations of masking – i.e., impression management employed to suppress autistic behaviour to fit in (Ai et al., 2022) – in leadership positions may hamper career advancement of neurodivergent researchers (Roberson et al., 2021). Simple adjustments, such as improving the clarity of job descriptions, offering alternative criteria that may fit neurodivergent socialisation styles, and alternative recruitment methods (e.g., practical evaluation and skill assessments; Davies et al., 2023), may encourage more neurodivergent people to pursue leadership positions at top-tier institutions, bringing to the table significant contributions to innovation, cost-effectiveness, and problem-solving (LeFevre-Levy et al., 2023).

Second, we found a notable prevalence of mental health issues – that may include stress, anxiety, and burnout – in this sample, and within the neurodivergent subgroup in particular. Mental health issues not only impact quality of life, but also result in loss of training, funding, and attrition to the field (Harrop et al., 2021). While mentorship, flexibility, and job stability have been recognized as important factors in addressing the research mental health crisis (Casad et al., 2021; Harrop et al., 2021), additional measures are needed for neurodivergent researchers. Specifically, a significant risk is posed by autistic burnout, a phenomenon driven by excessive expectations and discriminatory views that pressure individuals into extreme masking and assimilation (Botha et al., 2022). This condition has causes and features that distinguish it from the

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burnout experienced by neurotypical people in challenging work environments (Raymaker et al., 2020), but still under investigated and poorly understood (Mantzalas et al., 2022). To prevent its detrimental consequences, such as exhaustion and loss of skills, it is crucial to provide mental health support and reasonable accommodations for sensory and social breaks (Raymaker et al., 2020). Establishing peer support systems for neurodivergent professionals has already created positive change within scientific organisations (e.g., Autistic Doctors International; Shaw et al., 2023), and would be a valuable addition to research consortia and institutions such as AIMS-2-TRIALS.

Collateral and intersecting findings of this work are the lack of ethnic diversity and the gender pay gap in this sample. Ethnic and Gender imbalances are well-documented in the broader field of Science, Technology, Engineering, and Mathematics (Fry et al., 2021), and discussing these aspects here is crucial, as neurodivergent people of under-represented ethnic background and of discriminated genders are going to be the most affected by contributing factors (Abubakare, 2022). Even though we cannot analyse the causes of these patterns as this questionnaire did not investigate retroactively access and retention, previous evidence suggests that such inequalities are influenced by barriers to higher education for non-white people (Khan et al., 2019) and job segregation for women (Brynin & Güveli, 2012). Studies across the higher education sector have highlighted prejudice and discrimination in selection procedures, even when targeted policies are in place (Mendoza-Denton et al., 2017).

Addressing ethnic disparities requires the targeting of environmental barriers within contributing universities and companies. Examples of measures that have been shown to promote persistence and success among underrepresented students in STEM fields are clear policies for publication (Mendoza-Denton et al., 2017), and opportunities for peer discussion and socialisation (Whittaker & Montgomery, 2012). In terms of gender distribution, the current sample was in majority female, a finding that is better explained by the tendency of women in STEM to cluster around health-related subjects (Fry et al., 2021), rather than response bias, as women have been found to be as likely to respond to online surveys as men (Andrews, 2005; Harrop et al., 2021). Regarding the gender pay gap, it is evident that factors such as geographical and family-related reasons (Jiang, 2021) cannot fully explain the observed disparities within the sample, given that most respondents were international, and a significant proportion had no children. Other factors, such as application bias towards lower-status jobs (Campero, 2021), lower initial pay, and cultural beliefs (Sterling et al., 2020), may play a significant role in perpetuating the gender pay gap and influencing perceptions of women in certain tasks that contribute to career development and promotion. This explanation is strengthened by the findings that women's and men's ranking of statistics and programming as a task was vastly different – with men ranking them 1st and 2nd and women ranking them 4th and 8th –, while other typical researchers' tasks, such as writing, data management, and teaching, were not ranked differently. Statistics and programming became highly gendered fields dominated by men in the last 30 years due to cultural influences – e.g., gendered exposition to technology during childhood and adolescence (Lawson et al., 2015; McHale et al., 2009) –, growing prestige and formalisation of the topics, and the stereotyping of its workers (Yansen & Zukerfeld, 2014). These complex cultural biases not only lead to differences in career progression, but also pre-selection of job opportunities, for example of women applying less for prestigious and technical jobs due to lower perceived self-efficacy (Sterling et al., 2020). To avoid propagating gender segregation, institutions and employers should take this into consideration when advertising positions and career development opportunities, for example reducing the emphasis on confidence (Sterling et al., 2020), diversifying tasks so that jobs are not restricted to testing or statistics and programming (Yansen & Zukerfeld, 2014), and account for the disproportionate number of women starting their careers in lower-status roles (Campero, 2021). Additionally, reserved mentorship, workshops and training for women and minorities have proved beneficial (Rittmayer & Beier, 2009).

## Limitations

This work presents two limitations in terms of the evaluation of the representativeness of its sample. First, we report < 1% black researchers within this consortium, however, we may not be able to compare it with

a European percentage. The percentage of non-white Europeans is not well documented due to inconsistent data collection practises across European countries, and an ongoing debate on how to take a census of ethnic groups in Europe (Farkas, 2017). In 2017, an estimated 8 million (1%) black people lived in Europe (Farkas, 2017). This percentage may have been higher then due to problems with census, and even more now due to population growth and migration. Nonetheless, in our sample the percentage is lower than this estimated 2017 figure. Moreover, there is evidence of discrimination on the workplace and in education in Europe based on skin colour (European Union Agency for Fundamental Rights, 2018). Therefore, we believe this percentage is worth highlighting.

We did our best to obtain an accurate and representative sample, however, due to the lack of a comprehensive and up-to-date source of information about the population of study (i.e., the AIMS-2-TRIALS researchers), we cannot report the exact sample size of all the researchers involved in AIMS-2-TRIALS at present. According to the AIMS-2-TRIALS website, that was last updated in 2018, there were 239 active contributors employed by 35 Universities / research organisations / public bodies / non-profit groups at the time. The respondents were recruited via the newsletter of the AIMS-TRIALS Communication Teams (that counts more than 300 subscribers but is also open to externals) sent out in January 2022, but explicitly invited to complete the questionnaire researchers who were current active contributors of an AIMS-2-TRIALS project. It is possible that many of the initial contributors were no longer active and therefore were not eligible for completing this questionnaire. This possibility is confirmed by the number of attendants at the 2023 AIMS-2-TRIALS General Assembly (106). This number does not totally represent the active research in the consortium either, as people tend to select nominees to attend depending on their budgets, availabilities, other commitments at any given time. Therefore, we believe that the current active members may be between the initial 239 and the 106 attending the General Assembly. This context calls for caution while interpreting the results, and not overgeneralize these findings. There are potential sources of bias that may have influenced those who responded and/or remained to contribute to AIMS-2-TRIALS until 2022, when the questionnaire was circulated.

Nonetheless, while the sample might not be representative of the entire population, the findings certainly provide insights into the characteristics of researchers who were recent active contributors within the consortium. Furthermore, the significance of this work also stands for encouraging better data collection mechanisms, a follow-up investigation of the reasons for leaving AIMS-2-TRIALS, and more comprehensive and updated records that could benefit future investigations.

## Conclusions

Our findings clearly show significant and complex disparities between researchers who were recent active contributors of a multi-national autism research consortium. These disparities most certainly influence the quality of life of these researchers, and their research outputs. While the low frequencies of certain subcategories did not allow to investigate interactions between neurotype, gender and ethnic background, data from multiple consortia could help developing intersectional quantitative analysis in the future, detecting factors influencing access and career progression. Qualitative follow-ups on the lived experience of neurodivergent researchers that, even if not in leadership positions, attained a PhD and made a career in academia, could also inform about resilience and protective factors from unfavourable outcomes such as dropout from education in autism and neurodevelopmental conditions. From the point of view of consortia and institutions, these findings invite to reflect on how they can help neurodivergent people and their family members to feel more comfortable in disclosing and protect these people from discrimination and stigma during their studies and in the workplace if they disclose. Researchers' backgrounds and lived experiences could also help guiding the development of consortium-specific work packages and decision-making processes: by incorporating their perspectives, consortia and institutions can potentially enhance the quality of findings and ensure a more comprehensive understanding of research outcomes. Ultimately, incorporating the perspectives of researchers from non-traditional backgrounds & marginalised identities can also aide in effective communication to the lay public, and to groups who might be most impacted by or interested in the research.

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# Acknowledgements

# Conflicts of Interest

All authors report no potential conflicts of interest.

# Data Availability

We will make the data available upon request in accordance with the AIMS-2-TRIALS guidelines.

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