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Five-factor personality traits and functional somatic disorder: A systematic review and meta-analysis

Thomas Tandrup Lamm [a,b,*], Victoria Von Schrottenberg [c], Anneline Rauch [a], Bo Bach [d,e], Heidi Frølund Pedersen [a,b], Mette Trøllund Rask [a], Eva Ørnbøl [a,b], Kaare Bro Wellnitz [a,b], Lisbeth Frostholm [a,b]

[a] Research Clinic for Functional Disorders and Psychosomatics, Aarhus University Hospital, Palle Juul-Jensens Boulevard 11, 8200 Aarhus N, Aarhus, Denmark
[b] Department of Clinical Medicine, Aarhus University, Palle Juul-Jensens Boulevard 11, 8200 Aarhus N, Aarhus, Denmark
[c] Institute of General Practice and Health Services Research, TUM School of Medicine and Health, Technical University of Munich, Orleansstraße 47, 81667 Munich, Germany
[d] Center for Personality Disorder Research, Region Zealand, Fælledvej 6, 4200, Slagelse, Denmark
[e] Department of Psychology, University of Copenhagen, Øster Farimagsgade 2A, 1353 København K, Denmark

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ABSTRACT

Introduction: Functional Somatic Disorders (FSD) is an umbrella term for various conditions characterized by persistent and troublesome physical symptoms, that are not better explained by other psychiatric or somatic conditions. Personality traits may play a crucial role in FSD, but the link is not fully understood. This study presents a systematic review and meta-analysis examines the relationship between the Five-Factor Model (FFM) of personality traits and FSD.

Methods: The review was based on the PRISMA statement, and drew data from systematic searches in PsycInfo, PubMed, and Embase. To be eligible for inclusion, studies had to include eligible FSD groups and control groups and to assess FFM traits. Data were analyzed using random effects models. Sub-group and sensitivity analyses as well as meta-regression were used to explore the heterogeneity and robustness of findings.

Results: In total 6841 records were screened and 52 included. FSD cases scored higher on neuroticism ($k = 46$, Hedge's $g = 0.72$, [95 % CI, 0.61: 0.83]) and lower on extraversion ($k = 31$, $g = -0.41$, [−0.55:-0.28]) and agreeableness ($k = 15$, $g = -0.22$, [−0.36:-0.09]) than healthy/unspecified controls. FSD cases scored higher on neuroticism ($k = 9$, $g = 0.26$ [0.08:0.44]) and agreeableness ($k = 4$, $g = 0.43$ [0.28:0.59]) than somatic controls, but did not differ on extraversion ($k = 6$, $g = -0.17$ [−0.45:0.11]). No significant differences were found for conscientiousness and openness. For psychiatric controls, meta-analysis was only possible for neuroticism ($k = 3$,= −0.61, [−1.98:0.77]). Findings displayed significant heterogeneity but no publication bias.

Conclusions: This review reveals significant associations between FFM traits and FSD, providing insight into the etiology, classification, and management of FSD.

1. Introduction

Functional Somatic Disorder (FSD) is a recently proposed classification for conditions characterized by persistent and impairing physical symptoms that are not better explained by other psychiatric or somatic diagnoses (Burton et al., 2020). FSD was introduced to address the overlap between diagnostic categories within the field (Budtz-Lilly et al., 2015; Burton et al., 2020). For instance, although Fibromyalgia, Chronic Fatigue Syndrome, and Irritable Bowel Syndrome are widely used and distinct constructs, their symptom presentations overlap significantly (Fink, Toft, Hansen, Ørnbøl, & Olesen, 2007; Petersen et al., 2020; Schröder & Fink, 2011; Wessely, Nimnuan, & Sharpe, 1999; Witthöft, Hiller, Loch, & Jasper, 2013). The FSD classification aims to simplify the classification of these and other similar conditions (e.g. Somatization

* Corresponding author at: Research Clinic for Functional Disorders and Psychosomatics, Aarhus University Hospital, Palle Juul-Jensens Boulevard 11, 8200 Aarhus N, Aarhus, Denmark.

E-mail addresses: THLAMM@rm.dk (T.T. Lamm), Victoria.vonSchrottenberg@mri.tum.de (V. Von Schrottenberg), ANRAUC@rm.dk (A. Rauch), bbpn@regionsjaelland.dk (B. Bach), heidpers@rm.dk (H.F. Pedersen), MERASK@rm.dk (M.T. Rask), eva.oernboel@aarhus.rm.dk (E. Ørnbøl), kaare.bro@rm.dk (K.B. Wellnitz), lisbeth.frostholm@aarhus.rm.dk (L. Frostholm).

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Disorder (SzD) and Somatic Symptom Disorder) in order to facilitate improved communication, clinical management, and research within the field, which has historically been fragmented by the use of a variety of different operationalizations.

A recent meta-analysis showed that FSD affect about 8 % of the population (Rometsch et al., 2024), but the severity of cases may vary significantly (Burton et al., 2020). FSD is associated with a significant increase in the use of various medical and healthcare services (e.g. primary care visits, hospital admissions, and medicine usage) (D'Onghia et al., 2022; Konnopka et al., 2012; Tack et al., 2019) and social services (e.g. disability pension and sick leave) (Momsen, Nielsen, Nielsen, Rugulies, & Jensen, 2016; Rask et al., 2015; Tack et al., 2019).

The high prevalence rate and significant societal burden of FSD has led to urgent calls to improve the understanding and management of FSD (Henningsen, Zipfel, Sattel, & Creed, 2018). Among other things, this entails expanding and refining understandings of the etiology and mechanisms of FSD (Burton et al., 2020). An amassing literature is beginning to cast light on important factors that predispose to or affect FSD (e.g. infectious diseases, pain catastrophizing); however, much more research is needed, especially with a focus on the role of psychological factors (Kleinstäuber et al., 2023).

Personality traits, which can be defined as an individual's habitual way of thinking, feeling, and behaving across time and situation, are psychological factors that are commonly thought to predispose for and maintain FSD (Bogaerts et al., 2015; Bourke, Langford, & White, 2015; Deary, Chalder, & Sharpe, 2007; Henningsen et al., 2018; Rimbaut, Van Gutte, Van Brabander, & Vanden Bossche, 2016; Waller & Scheidt, 2006). In the 1980s, the Five-Factor Model (FFM) of personality traits (i.e., neuroticism, extraversion, openness, agreeableness, and conscientiousness) emerged as a consensual framework for conducting research within the field of personality (Coker, Samuel, & Widiger, 2002; Markon, Krueger, & Watson, 2005; O'Connor, 2017; Widiger & Simonsen, 2005), which has led to a surge of interest in personality research (John, Naumann, & Soto, 2008; Widiger, 2017). The FFM has significantly contributed towards reconceptualizing modern personality disorder diagnoses in accordance with a dimensional trait model (e.g. ICD-11) (Swales, 2022; Tyrer, Mulder, Kim, & Crawford, 2019), as it has been shown to represent both adaptive and maladaptive personality traits (Coker et al., 2002; Markon et al., 2005; Widiger & Simonsen, 2005).

A sizeable literature now demonstrates that most FFM traits are consistently associated with mental health conditions, including mood, anxiety, and personality disorders (Gomez & Corr, 2014; Jeronimus, Kotov, Riese, & Ormel, 2016; Kotov, Gamez, Schmidt, & Watson, 2010; Saulsman & Page, 2004). Meta-analyses have also indicated an association between high neuroticism and low conscientiousness in relation to several somatic diseases (e.g. migraine, cardiovascular disease, Alzheimer's, Parkinson's, and diabetes) (Garramone et al., 2020; Jokela et al., 2014; Jokela, Pulkki-Råback, Elovainio, & Kivimäki, 2014; Low, Harrison, & Lackersteen, 2013; Santangelo et al., 2018; Terracciano et al., 2014). Furthermore, FFM traits – especially neuroticism – seem to be associated with the tendency to experience somatic symptoms (e.g. cognitive complaints, fatigue, headache, and pain) (Aschwanden et al., 2020; Atanassova, Madariaga, Oosterman, & Brazil, 2024; Stephan, Sutin, Luchetti, Canada, & Terracciano, 2021, 2022). Although FFM traits appear to play a pervasive role in relation to a person's mental and somatic health, only a few reviews have examined the association between FSD and personality traits. The main finding from these reviews is that functional somatic syndromes, including Fibromyalgia (FM), Chronic fatigue Syndrome (CFS) and Irritable bowel Syndrome (IBS), are associated with elevated neuroticism (Conversano et al., 2018; Macina, Bendel, Walter, & Wrege, 2021; Malin & Littlejohn, 2012b; Muscatello, Bruno, Mento, Pandolfo, & Zoccali, 2016; van Geelen, Sinnema, Hermans, & Kuis, 2007; Vesal, Asgari, Roohafza, & Adibi Sedeh, 2024). Findings on the remaining personality traits have been more inconsistent, which might be due to varying trait operationalizations, leading to very few effect sizes that can be meaningfully compared (Conversano et al., 2018; Macina et al., 2021; Muscatello et al., 2016).

Reviews that have examined maladaptive trait manifestations, have only been conducted within the context of personality disorder, and have generally indicated elevated rates of personality disorder in patients with FM, CFS, SzD and Somatoform Disorder (SfD) (Bornstein & Gold, 2008; Penfold, St Denis, & Mazhar, 2016; Schmaling & Fales, 2018). No reviews to date have specifically examined dimensional measures developed to assess the maladaptive manifestation of FFM traits (e.g. PID-5) (Krueger, Derringer, Markon, Watson, & Skodol, 2012).

Thus, despite the prominent position of the FFM within personality research, no current review has explicitly attempted to comprehensively synthesize findings from studies that have investigated the association between FFM traits and FSD.

Furthermore, existing reviews are limited by the fact that they have focused on a singular operationalization of FSD (e.g. FM or SzD), thereby neglecting to provide a comprehensive coverage of the FSD construct and limiting the numbers of included studies (Attademo & Bernardini, 2018; Bornstein & Gold, 2008; Conversano et al., 2018; Macina et al., 2021; Malin & Littlejohn, 2012b; Muscatello et al., 2016; van Geelen et al., 2007).

Finally, to our knowledge, there are only three meta-analyses on the association between FSD and personality, of which only one have focused on the associations between FSD and FFM traits (Vesal et al., 2024), while the other two have examined categorical personality disorder (Bornstein & Gold, 2008; Schmaling & Fales, 2018). All remaining reviews are narrative reviews (Attademo & Bernardini, 2018; Conversano et al., 2018; Malin & Littlejohn, 2012b; Muscatello et al., 2016; van Geelen et al., 2007), which introduces a risk of bias in the reported findings as few of these reviews describe their strategy comprehensively, and those that do, fail to live up to the PRISMA reporting standards (e.g. lacking PRISMA charts, quality assessment, and parallel screening) (Page et al., 2021).

These limitations call for a new systematic review that includes several different operationalizations of FSD and use the FFM as an integrative framework to assess both adaptive and maladaptive personality traits. The aim of the current study is to conduct a systematic review and meta-analysis of how FFM traits are associated with FSD.

2. Materials and methods

To address the aims of the current study, a systematic review and meta-analysis was conducted according to the PRISMA guidelines (Page et al., 2021). The study was pre-registered in PROSPERO[1] (CRD42024478759) prior to the start of the search procedure. The protocol can be shared upon reasonable request to the main author.

2.1. Eligibility criteria

All studies were assessed for eligibility based on the following criteria:

2.1.1. Inclusion criteria

To be included in the review, studies had to meet five inclusion criteria. Studies had to: (1) include a study group characterized by one of the eligible FSD operationalizations (see below) with a categorical case definition set via: a) a clinical interview, b) self-report of a FSD diagnosis, or c) a psychometric cut-off on a self-report instrument validated to screen for FSD; (2) include a control group consisting of either a)

[1] The initial PROSPERO registration included pre-specified hypotheses regarding the anticipated associations between FFM traits and FSD. However, during the editorial process, the authors opted to omit these hypotheses from the manuscript as they were deemed to contribute limited additional value. The original hypotheses remain available in the PROSPERO pre-registration.

healthy/unspecified individuals, b) individuals suffering from a somatic disorder, or c) individuals suffering from a psychiatric disorder; (3) apply dimensional measures of FFM traits across study groups; (4) include an adult (18 years or older) participant population; (5) be retrievable as full-text via online databases or via contact with authors.

A pre-specified list of eligible FSD operationalizations were used for inclusion in criterion 1. This list included major diagnostic FSD operationalizations from the DSM-IV (*Somatization Disorder, Undifferentiated Somatoform Disorder, Pain Disorder, Persistent Somatoform Pain Disorder*); DSM-5 (*Somatic Symptom Disorder*); and ICD-10 (*Fibromyalgia, Irritable Bowel Syndrome, Chronic Fatigue Syndrome/Myalgic Encephalomyelitis, Neurasthenia*) (APA, 1995, 2013; WHO, 2004). Furthermore, it included *Functional Disorder/Functional Somatic Disorder* as well as the *Bodily Distress Syndrome* diagnosis as this was a major inspiration for the FSD construct (Budtz-Lilly et al., 2015; Fink et al., 2007). It was decided that Functional Neurological Disorders (FND), including Conversion Disorder, as well as dimensional operationalizations of FSD (e.g. Persistent Physical Symptoms) should not be included in the inclusion criteria for this review, as these were regarded as a sufficiently wide and heterogeneous constructs to warrant their own systematic reviews. SfD were not eligible for inclusion because SfD is a heterogeneous group of diagnoses that include diagnostic categories that do not fit within the classification of FSD (e.g. Hypochondriasis and Body Dysmorphic Disorder) as defined by Burton et al. (2020) (Mayou, Kirmayer, Simon, Kroenke, & Sharpe, 2005).

To ensure that all included FFM trait measures mentioned in criterion 3 represented the same fundamental constructs (i.e., the FFM traits) and were homogenous enough to pool, the Personality Measure Catalogue (PMC) was developed (See appendix A). The PMC consists of a list of FFM measures that were selected prior to the screening of studies based on scoping searches of the literature, which specified all eligible FFM measures and specified how their factors were coded to represent the FFM trait domains. It has previously been shown that the FFM can be used as a framework that integrates both adaptive (e.g. NEO-PI-R) and maladaptive (e.g. PID-5) trait expressions (Coker et al., 2002; Markon et al., 2005; Widiger & Simonsen, 2005). The PMC was therefore designed to include measures of both adaptive and maladaptive expressions of the FFM traits.

2.1.2. Exclusion criteria

The exclusion criteria of studies were: (1) the study does not present novel empirical data, (2) the study it is not available in an English translation, (3) the study has been published before 1990, and (4) relevant data are not accessible via the published study or contact with authors. Relevant data points were defined as raw data that could be used for the calculation of effect sizes (e.g. N, M, SD per Trait, per group), test statistics (e.g. *t*-value, F-value, *p*-value, degrees of freedom) or effect sizes (e.g. standardized mean difference, Cohen's *d*).

2.2. Information sources and search strategy

Studies were identified based on systematic searches in the following three databases: PsycINFO, PubMed, and Embase. These databases were chosen because they cover the most important medical and psychological research within the field. Initial searches and retrieval of records from all databases were conducted on January 12, 2024. An updated search was conducted on May 22, 2024 using the same search strategy as the initial search.

The search string was based on the string used in Kleinstäuber et al. (2023). This string covers the most important functional somatic syndromes (IBS, FMS, IBS) as well as other more general FSD operationalizations which are not organ/system-specific (e.g. Medically Unexplained Symptoms and SfD). The list of terms in the search string was wider than the list of eligible FSD operationalizations to ensure the inclusion of all relevant studies. Nevertheless, only the conditions listed in Section 2.1.1 could be included.

A series of personality-related terms were added to the search string. Terms were selected by combining generic terms for personality and terms from the FFM (Costa Jr. & McCrae, 1995; McCrae & John, 1992). The final search string was constructed as such: *[all FSD terms] AND [all personality terms] AND [filters/limits]*. The string was uniquely adapted for each database, including filters and MeSH terms. All search strings can be found in appendix B.

In searches, the filter "published: 01-01-1990 to 12-01-2024" was applied, consistent with the exclusion criteria (Section 2.1.2). The filter "NOT conference abstracts" was also applied for Embase, as conference abstracts were not eligible for inclusion. For the updated search, the following filter was applied "published: 12-01-2024 to 22-06-2024".

2.3. Study selection and data collection

For the entire data selection process, the Covidence web app was used (VHI, 2024). After preregistration on PROSPERO, searches in all databases were conducted. Deduplication was conducted using Covidence.

Titles and abstracts were screened by two independent researchers in parallel, via Covidence by four independent authors (TTL, VS, AR, HFP). Full-text screening, data extraction, and quality rating were conducted in parallel by three independent authors (TTL, VS, AR). Inconsistencies were resolved via discussions among the reviewers, and disagreements were resolved by a third party (LF). Questions of a principal nature (e.g. interpreting the protocol, dealing with edge cases) were discussed in the author group.

Full-text papers were retrieved for screening via the university libraries at Aarhus University and Munich Technical University. If records could not be retrieved, a university librarian at Aarhus University assisted with the retrieval of studies. If this did not result in retrieval, the record was excluded.

Data extraction was conducted using a form in Covidence (For data items, see appendix C). If relevant data could not be retrieved from a study, authors were contacted via mail. If an e-mail address could not be identified or authors neither replied to the initial request nor two subsequent reminders (sent within a span of 30 days), the study was excluded. The same search procedure was used throughout the initial and updated search.

2.4. Quality assessment

A modified version of the Newcastle-Ottawa Scale for Case-control Studies (NOS) (Stang, 2010; Wells et al., 2014) was used for the quality assessment (See appendix D). The NOS has frequently been used to assess methodological quality in systematic reviews, including several reviews similar to the current (Afari et al., 2014; Fischer et al., 2023; Ludwig et al., 2018; Martinez-Calderon, Jensen, Morales-Asencio, & Luque-Suarez, 2019; Strawbridge, Sartor, Scott, & Cleare, 2019).

The NOS was modified to fit the needs of the current review more precisely. The NOS section 'Selection' regarding the validity of selection of cases and controls was modified using items from Joustra, Minovic, Janssens, Bakker, and Rosmalen (2017), as these items related specifically to FSD. The items under 'Exposure' from the NOS were replaced by items from Bucher, Suzuki, and Samuel (2019), as these related specifically to the FFM.[2] The item under 'Exposure' in the NOS, which is related to non-response rates, was excluded based on scoping searches, as it was indicated that this information was generally not provided by

[2] Of the four items described in Bucher et al. (2019), one item (Criterion b), which is related to the reporting of internal consistency statistics of trait measures, was dropped by the authors during the editorial process. The reason is that most included studies used short trait measures, where internal consistency is not a reliable indicator, and that this item overlapped with the item regarding number of items in the personality measures.

any of the included studies. The item under 'Comparability' from the NOS, which relates to adjustment for covariates, was excluded, as the current review is entirely based on unadjusted effect sizes.

Depending on the item, studies could be awarded either 0, 1, or 2 points or 0 or 2 points, where a higher point score indicated higher study quality. While the point system used by the NOS makes it compelling to represent overall study quality by summing all items into a single metric, it has been argued that the weighting of these items is arbitrary, which makes pooling biased (Stang, 2010). To give an overall impression of study quality, a total quality score was instead calculated by counting on how many of the 7 items a given study received a 'high' score (i.e., a score of 2). The quality score had a range of 0–7, with 7 indicating the highest possible quality. Quality assessment was conducted by two raters in parallel using a rating form in Covidence.

2.5. Data synthesis

Data were synthesized quantitatively. For each FFM trait, all pooled analyses were conducted separately for each control group type (healthy/unspecified, psychiatric, somatic). This was based on the fact that empirical studies have firmly established that having a somatic or mental disorder has a strong state effect on FFM traits (Jokela, Hakulinen, Singh-Manoux, & Kivimäki, 2014; Karsten et al., 2012; Kotov et al., 2010; Malouff & Thorsteinsson, 2005; Ormel, Oldehinkel, & Vollebergh, 2004). Thus, combining effect sizes from studies that use healthy controls with controls that have somatic or mental disorders would introduce unnecessary heterogeneity in the pooled effect size.

The first category, which includes healthy/unspecified controls, was initially intended to only include healthy controls. During the review process it, however, became clear that several studies could neither be placed in the healthy, somatic, nor psychiatric category. In most cases, these were studies that used either convenience samples or general population samples, where the patients' health status was either not specified or mixed. It was therefore decided to expand the 'healthy controls' category into 'healthy/unspecified controls'. A new 'unspecified controls' category was not formed as this would result in too many analytical groups with too few studies, leading to an overwhelming amount of analyses, many of which would have too few studies to be informative. Furthermore, upon inspection, the studies with unspecified controls and healthy controls seemed to have a sufficiently large overlap in characteristics to be combined.

Effect sizes were calculated for each FFM trait based on extracted data (e.g. N, mean of trait, and SD of trait score) for each FSD group by control group comparison. As effects were expected to vary between studies, random-effects models were chosen for all analyses. Effect sizes were converted into Hedge's *g* and inverse variance weighted. In cases where necessary raw data were available, attempts were made to transform other data points into the necessary raw data (e.g. calculating SD from 95 % CIs). If this did not provide meaningful effect sizes, attempts were made to use other relevant reported parameters to create a meaningful effect size. If none of the above resulted in an eligible effect size, authors were contacted. A criterion of three or more effect sizes was required to conduct meta-analysis for any FSD by control group comparison. This was the case for all main, subgroup, and sensitivity analyses.

To explore heterogeneity, Q-tests were conducted and I^2 calculated for each pooled analysis. A prediction interval was calculated for all pooled analyses to further examine the dispersion of effect sizes in accordance with suggestions by Borenstein (2022).

For studies with several FSD by control group comparisons, all subgroups were entered as individual FSD group by control group comparisons with one effect size each. If several independent comparisons were made with the same FSD subgroup, the amount of participants in this FSD subgroup was counter-weighted across comparisons by dividing the number of participants in the FSD group with the amount of comparisons made.

Subgroup analyses were conducted separately for each trait and control group type based on three predefined moderator variables: 1) FSD operationalization (CFS, FMS, IBS, SzD); 2) method of determining FSD (clinical interview, self-reported diagnosis, psychometric cut-off); and 3) type of personality trait instrument (Big Five, Eysenck, Maladaptive).

To explore whether the year of publication influenced effect size, random-effects univariate meta-regression analyses were conducted separately for each FFM trait. Year was entered as the independent variable and effect size as the dependent variable. It was assumed that type of control group (e.g. healthy/unspecified, somatic, psychiatric) would not influence the effect of publication year on the effect sizes, and therefore one single meta-regression was conducted per trait. For studies with multiple control groups, the effect sizes for each control group was entered as a separate data point. As all meta-regression analyses were univariate, a z-test was used to examine the significance of the independent variable, estimated at an alpha level of 0.05. Plots of the regression models were inspected to identify outliers. If outliers were identified, a separate model was calculated without the outlying effect size. Results from models that had been stripped of outliers were only reported if they significantly changed the result of the model.

Publication bias was assessed based on inspection of funnel plots and by calculating an Egger's test for each funnel plot. Funnel plots were generated separately for each trait. As both meta-regression and Egger's test are regression-based tests, they were only conducted if there were 10 or more available studies for a given comparison (Borenstein, 2009).

Sensitivity analyses were conducted to test the robustness of findings to decisions made during the review process. Sensitivity analyses were decided upon after conducting all other analyses and were chosen based on notes taken during the review process. The first sensitivity analysis entailed removing two studies where there had been doubt about how to code the control group as either somatic or psychiatric (Besharat, Behpajooh, Poursharifi, & Zarani, 2011; Hariharan, Ramakrishnan, & Mathrubootham, 1993). The second sensitivity analysis was related to a single study (Datta, Basu, & Bandyopadhyay, 2011), where the definition of FSD was a mix of different FSD operationalizations, and where there had been discussion in the author group as to whether it fulfilled inclusion criterion 1. The third sensitivity analysis was related to three studies that reported data in an ambiguous manner, which had led to discussions as to whether they could be included (Farnam, Somi, Sarami, Farhang, & Yasrebinia, 2007; Johnson, DeLuca, & Natelson, 1996; Zighelboim, Talley, Phillips, Harmsen, & Zinsmeister, 1995). The results of sensitivity analyses were interpreted by comparing the result of the sensitivity analyses with the result of the main analyses to see if effect sizes or heterogeneity were notably different.

All analyses were conducted using the Comprehensive Meta Analysis Version 4 software package (Borenstein, Hedges, Higgins, & Rothstein, 2022).

3. Results

The review was conducted in January–March 2024 with an updated search in May 2024. Throughout the searches, titles and abstracts were screened for 6841 records, of which 201 were included for full-text screening. This resulted in a total of 52 studies included for analysis (see Table 1). For the updated search, 149 records were screened, but no new studies were included. A total of 18 authors were contacted due to missing data, of which five provided data. The PRISMA in Fig. 1 describes the results of the inclusion process for the initial and updated searches. See appendix E for a PRISMA chart that describe results from the initial search.

3.1. Descriptive information

Descriptive information for all studies can be found in Table 1. The total sample size was 23,852, of which 7626 were FSD cases. The most

Table 1
Descriptive characteristics of included studies.

Study	Year	Country	Design	FSD recruitment set.	FSD assessment	FSD operationalization	FSD criteria	Total N	FSD N	Personality Trait Measure	Traits Measured	Type of control	Quality score
Cao et al.	2005	China	Case-control	Clinical psychiatric	Clin. Int.	Neurasthenia	*NR/U*	60	30	EPQ	N,E	HC	2
Da Silva et al.	2017	Portugal	Case-control	Clinical somatic	Clin. Int.	FMS	ACR crit. (1990)	256	129	NEO-PI-R	N,E,O,A,C	HC	4
Federman et al.	2019	Israel	Case-control	Clinical somatic	Clin. Int.	FMS	ACR crit. (1990)	50	25	NEO-FFI	E	HC	1
Montoro & del Paso	2015	Spain	Case-control	Patient associations	Clin. Int.	FMS	ACR crit. (1990)	157	92	EPQ-R	N,E	HC	3
Datta et al.	2011	India	Case-control	Clinical psychiatric	Clin. Int.	Pain Disorder; SD; Conversion Disorder	*NR/U*	90	30	NEO-FFI	N,E,O,A,C	HC, Som	2
Chen et al.	2011	Canada	Case-control	Clinical somatic	Clin. Int.	IBS	Rome III	26	10	NEO-PI	N	HC	3
Zighelboim et al.	1995	USA	RCT	Clinical somatic	Clin. Int.	IBS	Rome I	22	12	EPI	N,E	HC	2
Whitehead et al.	1990	USA	Case-control	Not Reported	Clin. Int.	IBS	Adapted Manning Crit.	59	16	NEO-PI	N	HC	2
Hariharan et al.	1993	India	Case-control	Clinical somatic	Clin. Int.	SD	DSM-III-R	65	33	EPI	N,E	Psy	3
Fiedler et al.	2000	USA	Case-control	Clinical somatic	Clin. Int.	CFS	*NR/U*	68	23	NEO-PI	N	HC	1
Gwee et al.	1999	UK	Prospective	Clinical somatic	Clin. Int.	IBS	Rome I	94	22	EPI	N	HC	2
Park et al.	2018	USA	Case-control	Convenience	Clin. Int.	IBS	Rome III	256	154	Mini IPIP	N,E	HC	3
Gwee et al.	1996	UK	Prospective	Clinical somatic	Clin. Int.	IBS	BSQ	75	22	EPI	N,E	HC	1
Krupa et al.	2023	Poland	Case-control	Clinical somatic	Clin. Int.	FMS	ACR crit. (2016)	90	60	TIPI	N,E,O,A,C	HC	4
Yap et al.	2023	Indonesia	Cross sectional	Convenience	Psychometric	SD	PHQ-15	410	175	BFI	N,E,O,A,C	HC	3
Li et al.	2016	China	Case-control	Clinical somatic	Clin. Int.	IBS	Rome III	59	35	EPQ	N,E	HC	0
Arun et al.	1993	India	Case-control	Clinical somatic	Clin. Int.	IBS	*NR/U*	60	30	PEN[a]	N,E	HC	0
Hazlett-Stevens et al.	2003	USA	Cross sectional	Convenience	Psychometric	IBS	Rome II	399	47	EPQ	N	HC	2
Kingma et al.	2013	Netherland	Cross sectional	Population cohort	Psychometric	FSD	CIDI	1026	77	EPQ	N	HC	4
Steinsvik et al.	2020	Norway	Case-control	Clinical somatic	Clin. Int.	IBS	Rome II, Rome III; ICD-10	105	75	EPQ-R	N	HC	3
Davydov et al.	2021	Spain	Case-control	Patient associations	Clin. Int.	FMS	ACR crit. (1990)	170	110	EPQ-R	N,E	HC	2
Nater et al.	2010	USA	Cross sectional	Population cohort	Clin. Int.	CFS	Fukuda Crit.	237	113	NEO-FFI	N,E,O,A,C	HC, HC	3
Farnam et al.	2007	Iran	Case-control	Clinical somatic	Clin. Int.	IBS	Rome II	150	150	NEO-FFI	N,E,O,A,C	HC	2
Torres et al.	2013	Spain	Case-control	Clinical somatic	Clin. Int.	FMS	ACR crit. (1990)	482	225	NEO-FFI	N,E,O,A,C	Som, Som	6
Johnson et al.	1996	USA	Case-control	Clinical somatic	Clin. Int.	CFS	*NR/U*	114	35	NEO-I	N	HC, Som, Psy	2
Buckley et al.	1999	UK	Case-control	Mixed	Clin. Int.	CFS	Fukuda Crit.	65	30	NEO-FFI	N,E,O,A,C	HC	3
Deary et al.	2010	UK	Case-control	Clinical psychosomatic	Clin. Int.	CFS	Fukuda Crit., Oxford Crit.	57	27	NEO-PI-R	N,E,O,A,C	HC	3
Besharat et al.	2011	Iran	Case-control	Clinical NOS	Clin. Int.	CFS	Fukuda Crit.	149	77	NEO-FFI	N,E,O,A,C	HC	5
Blomhoff et al.	2000	Norway	Case-control	Mixed	Clin. Int.	IBS	Rome I	60	40	EPQ	N	HC	1
Malin et al.	2012a	Australia	Prospective	Mixed	Patient self-report	FMS	ACR crit. (1990)	52	25	BFI	N,E,O,A,C	HC	1
Riccio et al.	1992	UK	Case-control	Clinical somatic	Clin. Int.	ME	*NR/U*	18	9	EPQ	N,E	HC	2
Tosic-Golubovic et al.	2010	Serbia	Case-control	Clinical somatic	Clin. Int.	IBS	Rome II	90	30	EPI	N,E	HC, Psy	2
Boyce et al.	2000	Australia	Case-control	Population cohort	Psychometric	IBS	Rome II	5024	2512	EPQ	N,E	HC	3
Naliboff et al.	2008	USA	Case-control	Convenience	Clin. Int.	IBS	Rome II	64	42	EPQ	N	HC	3
Whitehead et al.	1996	USA	Case-control	Convenience	Psychometric	IBS	Manning Crit.	205	83	NEO-PI	N	HC	3
Hollifield et al.	1999	USA	Cross sectional	General practitoner	Psychometric	SD	SQ (p)	185	61	NEO-FFI	N,E,O,A,C	HC	3
Verne et al.	2001	USA	Case-control	Not reported	Clin. Int.	IBS	Rome II	29	12	NEO-FFI	N	HC	2

(*continued on next page*)

Table 1 (*continued*)

Study	Year	Country	Design	FSD recruitment set.	FSD assessment	FSD operationalization	FSD criteria	Total N	FSD N	Personality Trait Measure	Traits Measured	Type of control	Quality score
Petersen et al.	2023	Denmark	Cross sectional	Population cohort	Psychometric	FSD	BDS-25	9477	1530	NEO-PI-R sf	N	HC	4
Komasi et al.	2023	Iran	Cross sectional	Mixed	Clin. Int.	SSD	DSM-5 crit	1264	257	PID-5	N,E,A,C	HC	6
Zautra et al.	2005	USA	Prospective	Convenience	Psychometric	FMS	FMS SSI-r	126	87	BFI	N,E	Som	2
Malt et al.	2002	Norway	Case-control	Clinical somatic	Clin. Int.	FMS	ACR crit. (1990)	90	42	EPQ	N	HC	1
Silva et al.	2022	Brazil	Case-control	Clinical somatic	Clin. Int.	FMS	ACR crit. (1990)	80	40	FPB	N,E,O,A,C	HC	3
Zhao et al.	2020	China	Case-control	Clinical psychiatric	Clin. Int.	SD	DSM-IV crit.	53	25	EPQ	N,E	HC	3
Whitehead et al.	1992	USA	Prospective	Convenience	Clin. Int.	IBS	*NR/U*	271	39	NEO-PI	N,E,O,A,C	HC	2
Tayama et al.	2012	Japan	Cross sectional	Convenience	Psychometric	IBS	Rome II	557	143	MPI	N,E	HC	3
Jones et al.	2013	Australia	Case-control	Population cohort	Clin. Int.	IBS	Rome I	307	207	EPQ	N	HC	3
Tkalčic et al.	2010	Croatia	Case-control	Clinical somatic	Clin. Int.	IBS	Rome III	99	56	BFI	N,E	Som	3
Taillefer et al.	2003	Canada	Case-control	Mixed	Clin. Int.	CFS	Holmes Crit.	85	45	NEO-FFI	N	Som	3
Rey et al.	2009	Spain	Case-control	Clinical somatic	Clin. Int.	IBS	*NR/U*	188	94	NEO-PI	N,E,O,A,C	HC	3
Bucourt et al.	2017	France	Case-control	Clinical somatic	Clin. Int.	FMS	ACR crit. (1990), FIRST crit.	163	48	BFI	N,E,O,A,C	Som	3
Poeschla et al.	2013	USA	Cross sectional	Population cohort	Psychometric	CFS	Fukuda Crit.	459	308	NEO-FFI	N,E	HC	5
Tkalčic et al.	2014	Croatia	Case-control	Clinical somatic	Clin. Int.	IBS	Rome III	55	27	BFI	N	HC	3

This table displays descriptive information for all studies included within the current meta-analysis. **Abbreviations**: HC, healthy control/unspecified; Som, Somatic; Psy, Psychiatric; N, Neuroticism; A, Agreeableness; C, Conscientiousness; E, Extraversion; O, Openness; FMS, Fibromyalgia Syndrome; CFS, Chronic Fatigue Syndrome; IBS, Irritable Bowel Syndrome; SD, Somatization Disorder; SSD, Somatic Symptom Disorder; FSD, Functional Somatic Disorder; ME, Myalgic Encephalomyelitis; BFI, Big Five Inventory; EPQ(−R), Eysenck Personality Questionnaire (Revised); EPI, Eysenck Personality Inventory; NEO-PI, NEO Personality Inventory; PID-5, Personality Inventory for DSM-5; MPI, Maudsley Personality Inventory; NEO-FFI, NEO Five Factor inventory; NEO-PI-R(sf), NEO Personality Inventory-Revised (Short form); mIPIP, Mini International Personality Item Pool; TIPI, Ten Item Personality Inventory; PEN, Psychoticism, Extraversion, Neuroticism Inventory; FPB, factorial Personality Battery; ACR, American College of Rheumatologists; PHQ-15, Patients Health Questionnaire-15; DSM-III-R, Diagnostic and Statistical Manual III; BSQ, Bowel Syndrome Questionnaire; CIDI, Composite International Diagnostic Interview; SQ, Symptom Questionnaire; SOM-7, Screening for Somatic Symptom Disorders; FMS SSI-r, Modified version of the FMS Self-report Screening Instrument; FIRST, Fibromyalgia Rapid Screening Tool; CDC, Center for disease control Criteria; Clin. Int., Clinical Interview, NR/U, Not reported/unclear.

Note:

a, This personality measure (Psychoticism, Extraversion, Neuroticism Inventory, PEN) is not included in the Personality Measure Catalogue (PMC), though upon inspection of the nature of the measure it appears that it is a renamed Hindi translated and adapted version of the Eysenck Personality Inventory. As the EPI is in the PMC the PEN was included in the current study following discussion among the authors.

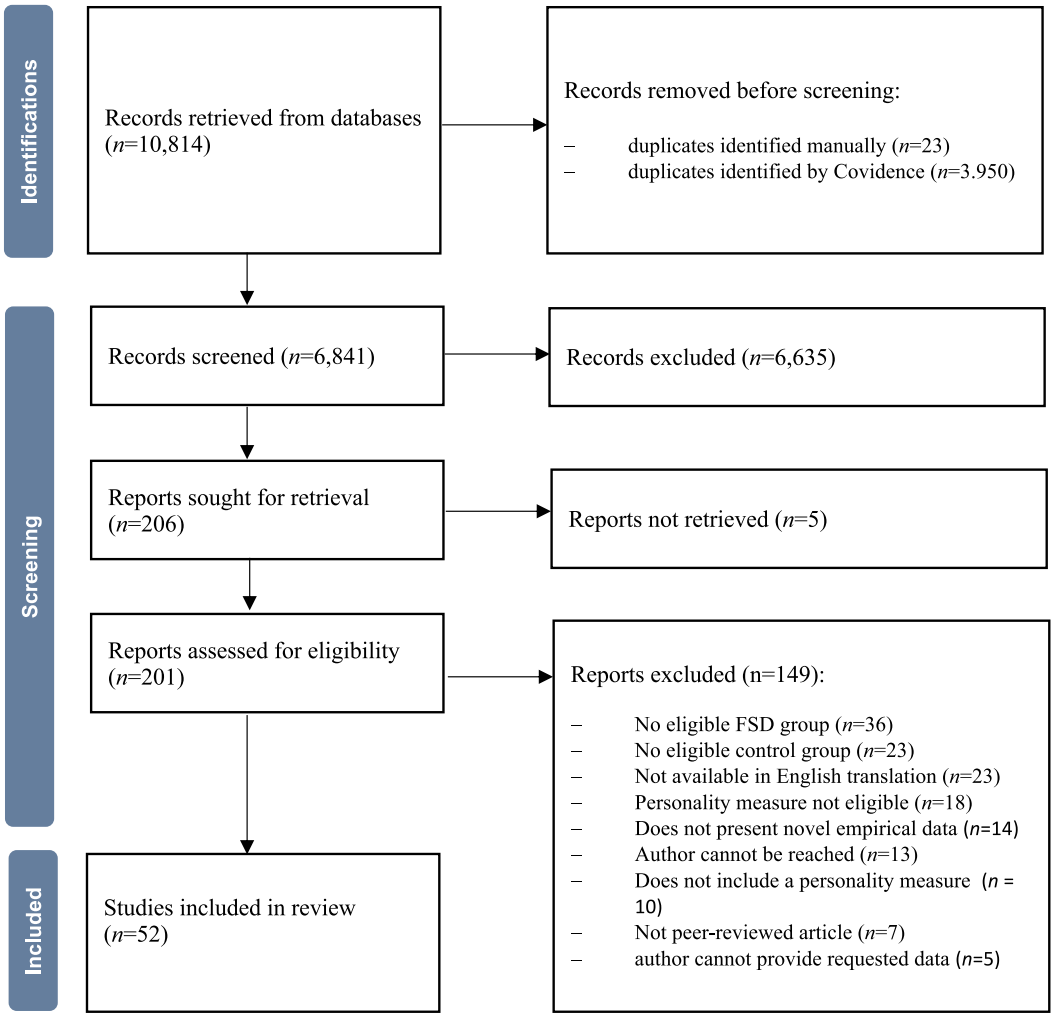

Fig. 1. PRISMA chart of the inclusion of studies.
This PRISMA chart displays the combined results from the initial search in January 2024 and the updated search in May 2024. **Abbreviations**: FSD, Functional Somatic Disorder.

frequent research design was case-control (71 % of studies). Studies stemmed from a variety of nationalities across several continents, most frequently from Anglophone countries.

A total of nine different operationalizations were used to define FSD, of which 80 % were covered by the functional somatic syndrome diagnoses (CFS, IBS, FMS). Individuals suffering from FSD were most frequently recruited from clinical somatic settings (44 % of studies) and via clinical interview (78 % of studies).

A total of 48 comparisons between FSD cases and healthy/unspecified controls were found. For somatic controls, eight comparisons were found. For psychiatric controls, three comparisons were found. Only five studies included multiple control groups. Somatic controls suffered from various rheumatic (arthropathies, dorsopathies, osteopathies, chrondropathy, ostheoarthritis, rheumatoid arthritis, spondyloarthritis, Sjogren's syndrome); neurological (migraine, multiple sclerosis, drug-resistant epilepsy); and gastrointestinal conditions (ulcerative colitis, Crohn's disease, lactose malabsorption). Psychiatric controls suffered from depression or were non-specified psychiatric patients.

A total of 15 unique personality trait measures were used across the 52 studies, most frequent of which were the NEO-FFI (21 % of studies) and the EPQ (21 % of studies). In 30 studies, the measure was coded as a Big Five measure, in 21 studies it was coded as an Eysenck measure, and in one study it was coded as an maladaptive personality trait measure (the PID-5).

3.2. *Quality assessment*

Across studies, a mean quality score of 2.65 (SD = 1.25) was found (See Table 1 for the quality scores of each study). The range for the modified NOS was 0–7, and the mean quality score thus indicated that most studies did not meet even half of the quality criteria. A summary of the percentwise point allocation for each item as well as descriptions of the item contents is shown in Fig. 2. The quality score for each item can be found in appendix F.

3.3. *Meta-analytic findings*

Pooled effect sizes are shown in Table 2. Forest plots for all the FFM traits are shown in Fig. 3–7.

3.3.1. *Neuroticism*

For neuroticism, a large positive effect was found for healthy/unspecified controls, and a small positive effect for somatic controls, indicating that FSD cases score significantly higher on neuroticism than these two groups (Fig. 3). Some degree of heterogeneity was observed for the healthy/unspecified comparisons, but confidence intervals (CIs) and prediction intervals (PIs) were quite narrow with neither crossing zero, indicating a reasonably precise effect. Somatic controls likewise had a narrow PI, but this did cross zero. For psychiatric controls, a large

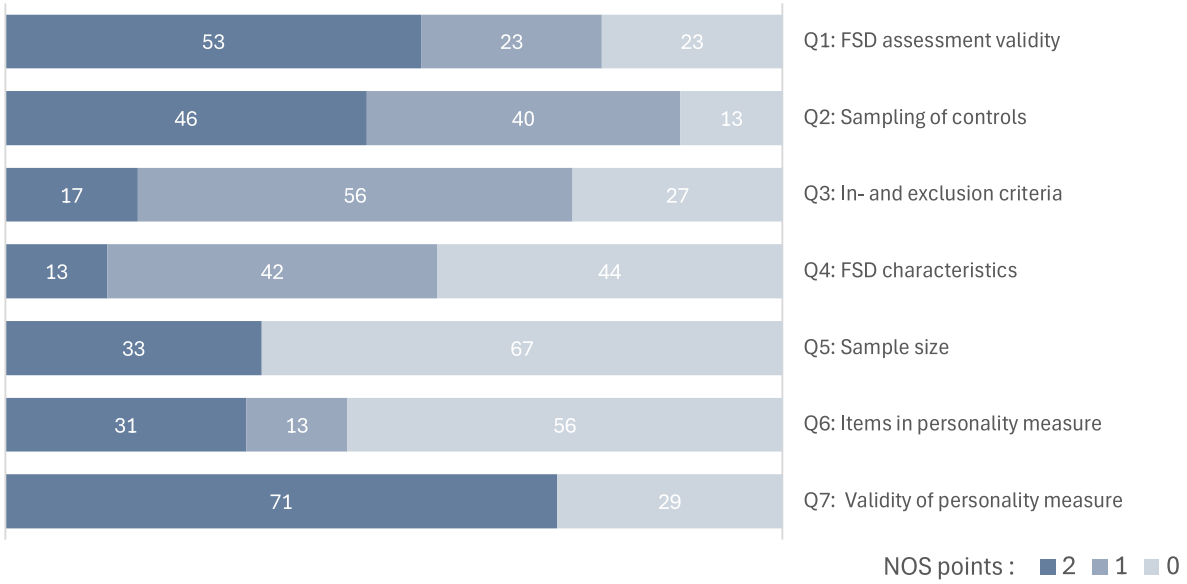

Fig. 2. Percent-wise point allocation for each item on The Newcastle Ottawa Scale.
This figure displays the total allocation of points on the eight items of the Newcastle Ottawa Scale in percentage points. To see the full NOS used for quality assessment, see appendix D. The answer categories of each item is described here:
Q1: 2 = Assessment done by a physician according to international criteria: 1 = Assessment done by a physician, criteria unclear; 0 = Self-report or not clearly stated.
Q2: 2 = Same control population as cases: 1 = Selected population such as hospital staff or students; 0 = Not clearly stated.
Q3: 2 = Medication use, somatic morbidity, psychiatric morbidity, 3 stated: 1 = Medication use, somatic morbidity, psychiatric morbidity 1–2 stated; 0 = None stated or not clearly stated.
Q4: 2 = Duration of disease and severity of disorder is stated: 1 = only duration or only severity is stated; 0 = none stated.
Q5: 2 ≥ = 64 per group; 0 ≤64 per group.
Q6: 2 = Personality measure consisted of at least 10 items per trait: 1 = Personality measure consisted of less than 10 items per trait; 0 = Not reported.
Q7: 2 = Yes, the study used a validated personality measure: 0 = The study did not report on the validity of the personality measure used.

Table 2
Results from meta-analyses comparing Functional Somatic Disorder with control groups across all Five-Factor Model personality traits.

Trait	Control group	k	N (FSD)	N (Control)	g	95 % CI	p	PI	Q (Df)	p	I^2
N	Healthy/unspecified	46	4631	17,287	0.72	[0.61: 0.83]	<0.01	[0.09: 1.35]	272.11 (45)	<0.01	83.46
	Somatic	9	494	569	0.26	[0.08: 0.44]	<0.01	[−0.20: 0.72]	14.20 (8)	0.08	43.65
	Psychiatric	3	59	86	−0.61	[−1.98: 0.77]	0.39	[−17.84: 16.63]	27.71 (2)	<0.01	92.78
E	Healthy/unspecified	31	2409	7495	−0.41	[−0.55: −0.28]	<0.01	[−1.10: 0.27]	169.33 (30)	<0.01	82.28
	Somatic	6	430	484	−0.17	[−0.45: 0.11]	0.23	[−1.06: 0.72]	19.12 (5)	<0.01	73.86
O	Healthy/unspecified	14	1035	2898	−0.07	[−0.20: 0.06]	0.29	[−0.45: 0.32]	27.68 (13)	0.01	53.03
	Somatic	4	287	402	0.18	[−0.10: 0.46]	0.21	[−0.95: 1.31]	8.46 (3)	0.04	64.52
A	Healthy/unspecified	15	1292	3905	−0.22	[−0.36: −0.09]	<0.01	[−0.69: 0.24]	42.92 (14)	<0.01	67.38
	Somatic	4	287	402	0.43	[0.28: 0.59]	<0.01	*a*	2.11 (3)	0.55	0
C	Healthy/unspecified	15	1292	3905	−0.2	[−0.43: 0.03]	0.09	[−1.12: 0.72]	131.25 (14)	<0.01	89.33
	Somatic	4	287	402	0.01	[−0.28: 0.30]	0.95	[−1.21: 1.23]	9.45 (3)	0.02	68.24

This table displays the main findings from all meta-analyses conducted within the current review. **Note**: The first column from the left labeled 'p' refers to the significance testing of the effect size (g), while the second column labeled 'p' refers to the Q test which tests for heterogeneity. **Abbreviations**: N, Neuroticism; A, Agreeableness; C, Conscientiousness; E, Extraversion; O, Openness; k, number of studies; g, Hedge's g; CI, confidence interval; p, significance level reported as *p* value; PI, Prediction Interval; Q(Df), Q-statistic and degrees of freedom.
Note:
a = the prediction interval could not be calculated because the variance within this particular comparison was too low.

negative effect was found, albeit non-significant, indicating that FSD cases had a lower score on neuroticism. This comparison was only based on three effect sizes with large CIs and PIs.

3.3.2. *Extraversion*

For extraversion, a moderate negative effect was found for the healthy/unspecified comparison, indicating that FSD cases are less extraverted than healthy/unspecified controls (Fig. 4). This effect showed a large degree of heterogeneity with PIs crossing zero. For the comparison with somatic controls, no significant effect was found, and a large degree of heterogeneity was observed.

3.3.3. *Openness*

For openness, no effect was found for either healthy/unspecified or somatic controls, and in both cases large heterogeneity was observed (Fig. 5).

3.3.4. *Agreeableness*

For agreeableness, a small but significant negative effect was found for the healthy/unspecified comparison, indicating that FSD cases are slightly less agreeable than healthy/unspecified controls (Fig. 6). For somatic controls, a moderate positive effect was found, indicating that FSD cases were more agreeable than somatic controls. A moderate degree of heterogeneity was observed for the healthy/unspecified

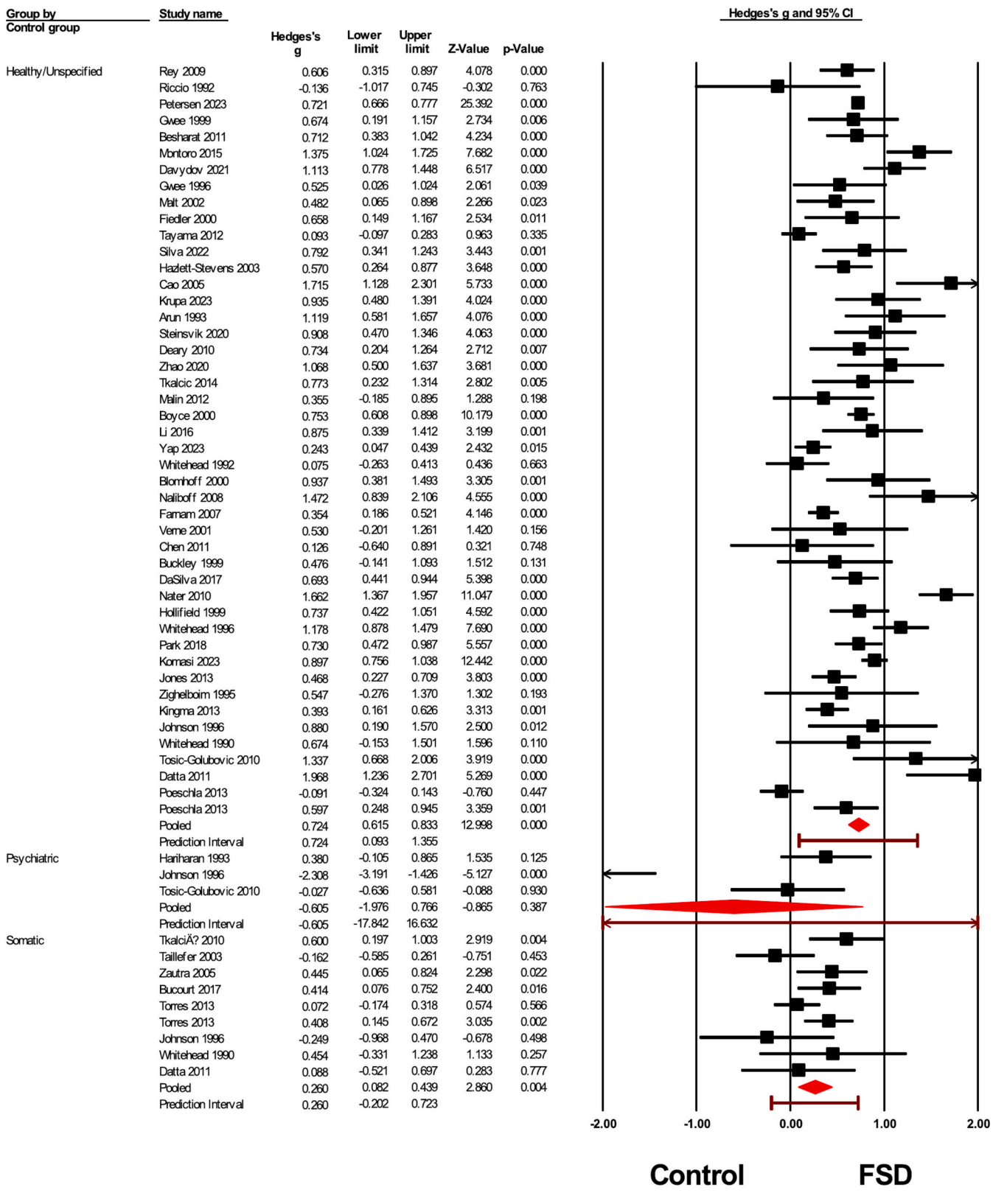

Fig. 3. Forest plot of meta-analytic results for neuroticism across healthy/unspecified, psychiatric and somatic control conditions.
This forest plot illustrates all included effect sizes calculated for neuroticism, across types of control condition. The pooled effect size (red diamond) and prediction interval (Deep red bracket) for control group type is displayed. **Abbreviations**: FSD, Functional Somatic Disorder.

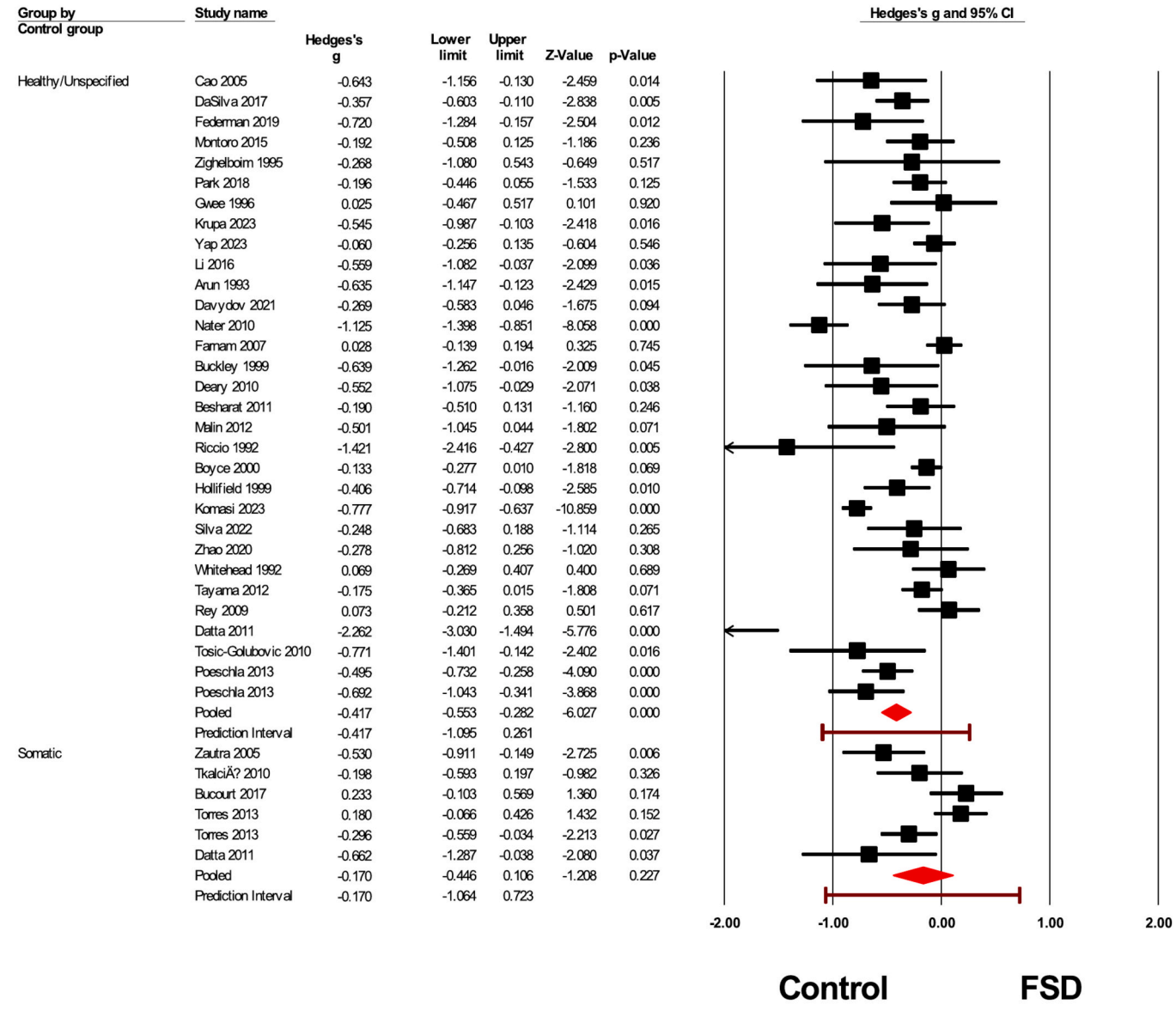

Fig. 4. Forest plot of meta-analytic results for extraversion across healthy/unspecified and somatic control conditions.
The forest plot illustrates all included effect sizes calculated for extraversion, across types of control condition. The pooled effect size (red diamond) and prediction interval (Deep red bracket) for control group type is displayed. **Abbreviations**: FSD, Functional Somatic Disorder.

comparison with the PIs crossing zero. For somatic controls, no heterogeneity in the effect was observed although this comparison only included four effect sizes.

3.3.5. *Conscientiousness*

For conscientiousness, a small and insignificant negative effect was found for the healthy/unspecified comparison, indicating that FSD cases may be slightly less conscientious than healthy/unspecified controls (Fig. 7). This effect exhibited a large degree of heterogeneity with CIs and PIs crossing zero. No difference was found between FSD cases and somatic controls on conscientiousness, however this comparison only included four effect sizes.

3.4. *Subgroup analyses*

To examine to which degree the observed dispersion in pooled effect size estimates stemmed from specific methodological characteristics, subgroup analyses were conducted for all moderator variables (FSD operationalization, method of determining FSD, type of FFM trait measure) where more than three effect sizes were available. Results are summarized below, and all details can be found in appendix G.

3.4.1. *Healthy/unspecified controls*

For neuroticism, no significant difference in effect size was observed in relation to the FSD operationalization or the type of FFM trait measure used when comparing with healthy/unspecified controls. An effect was observed based on the method used for determining FSD, where clinical interviews had a larger effect and slightly lower heterogeneity

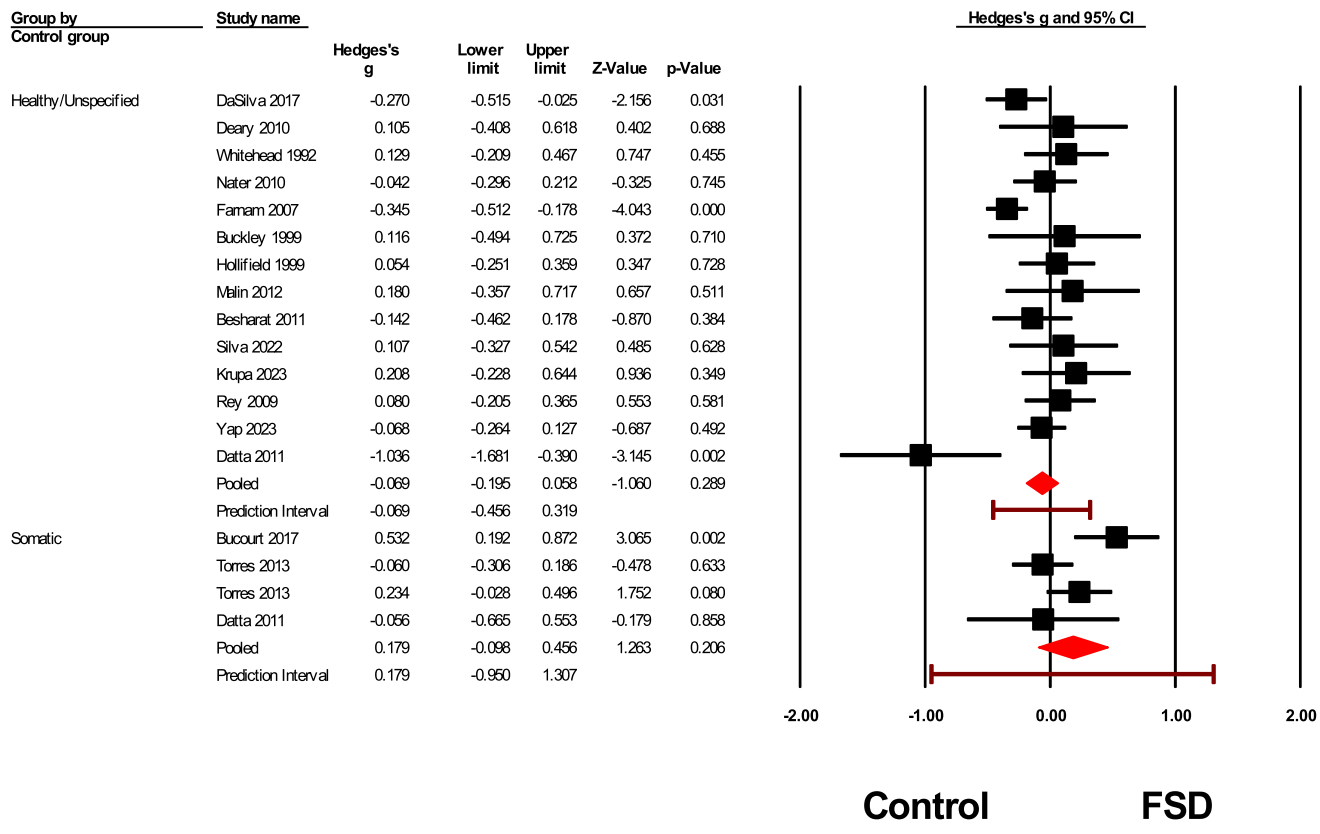

Fig. 5. Forest plot of meta-analytic results for openness across healthy/unspecified and somatic control conditions.
The forest plot illustrates all included effect sizes calculated for openness, across types of control condition. The pooled effect size (red diamond) and prediction interval (Deep red bracket) for control group type is displayed. **Abbreviations**: FSD, Functional Somatic Disorder.

than FSD set via psychometric cut-off although a large degree of heterogeneity remained.

For extraversion, a significant difference in effect size was observed in relation to FSD operationalization, with CFS having a larger effect and IBS the lowest. In terms of the FFM trait measure used, no significant difference was observed. For method used to determine FSD, no significant differences were observed, although psychometric cut-off had a smaller effect size.

For openness, no notable difference was observed across FSD operationalizations.

For agreeableness, no significant difference in effect size or heterogeneity was observed in sub-group analyses, though a slight deviance from the main effects analysis was observed across FSD operationalization, with CFS having a larger effect and FM a lower effect.

For conscientiousness, no statistically significant difference in effect size was observed in relation to FSD operationalization, although paradoxically both FM, IBS, and CFS seemed to have a lower effect size than the main effect analysis, potentially due to these comparisons consisting of a smaller selection of studies. Subgroups comparing different levels of the moderator variables were not possible for the remaining moderator variables due to a lack of studies.

Only a single study (Komasi, Hemmati, Rahmani, & Rezaei, 2023) included a measure specifically designed for maladaptive manifestations of FFM traits (i.e., the PID-5) and the significance of using this type of measure could therefore not be tested in subgroup analyses. Findings from this study showed that individuals with Somatic Symptom Disorder had a statistically higher score on neuroticism and a lower score on extraversion, conscientiousness, agreeableness, and openness as compared to an unspecified Iranian population sample.

3.4.2. *Somatic controls*

For somatic controls, subgroup analyses with multiple levels of the moderator variable were not possible for any moderator variable. Subgroup analyses which only included the moderator variables for which there were sufficient studies were conducted (e.g. only estimating effects from studies using the Big Five measures), but no significant differences were observed across comparisons.

3.5. *Meta-regression*

Meta-regression for neuroticism ($k = 58$, $b = 0.01$ [95 % CI = -0.00; 0.02], $Z = 1.81$, $p = 0.08$, R^2-analogue = 0.00, $I^2 = 84.47$); extraversion ($k = 39$, $b \leq -0.01$ [95 % CI = -0.02; 0.00], $Z = -0.90$, $p = 0.38$, R^2-analogue = 0.04, $I^2 = 83.07$); openness ($k = 18$, $b \leq 0.01$ [95 %CI = -0.01; 0.01], $Z = 0.16$, $p = 0.87$, R^2-analogue = 0.00, $I^2 = 64.76$); agreeableness ($k = 19$, $b = 0.00$ [95 %CI = -0.02; 0.02], $Z = 0.01$, $p = 0.98$, R^2-analogue = 0.00, $I^2 = 85.06$); and conscientiousness ($k = 19$, $b = 0.01$ [95 %CI = -0.02; 0.01], $Z = -0.36$, $p = 0.71$, R^2-analogue = 0.07, $I^2 = 88.68$) indicated that year of publication was not associated with effect size for any of the FFM traits. Removing outlying effect sizes did not affect the degree to which, the year of publication influenced the effect size in any of the models.

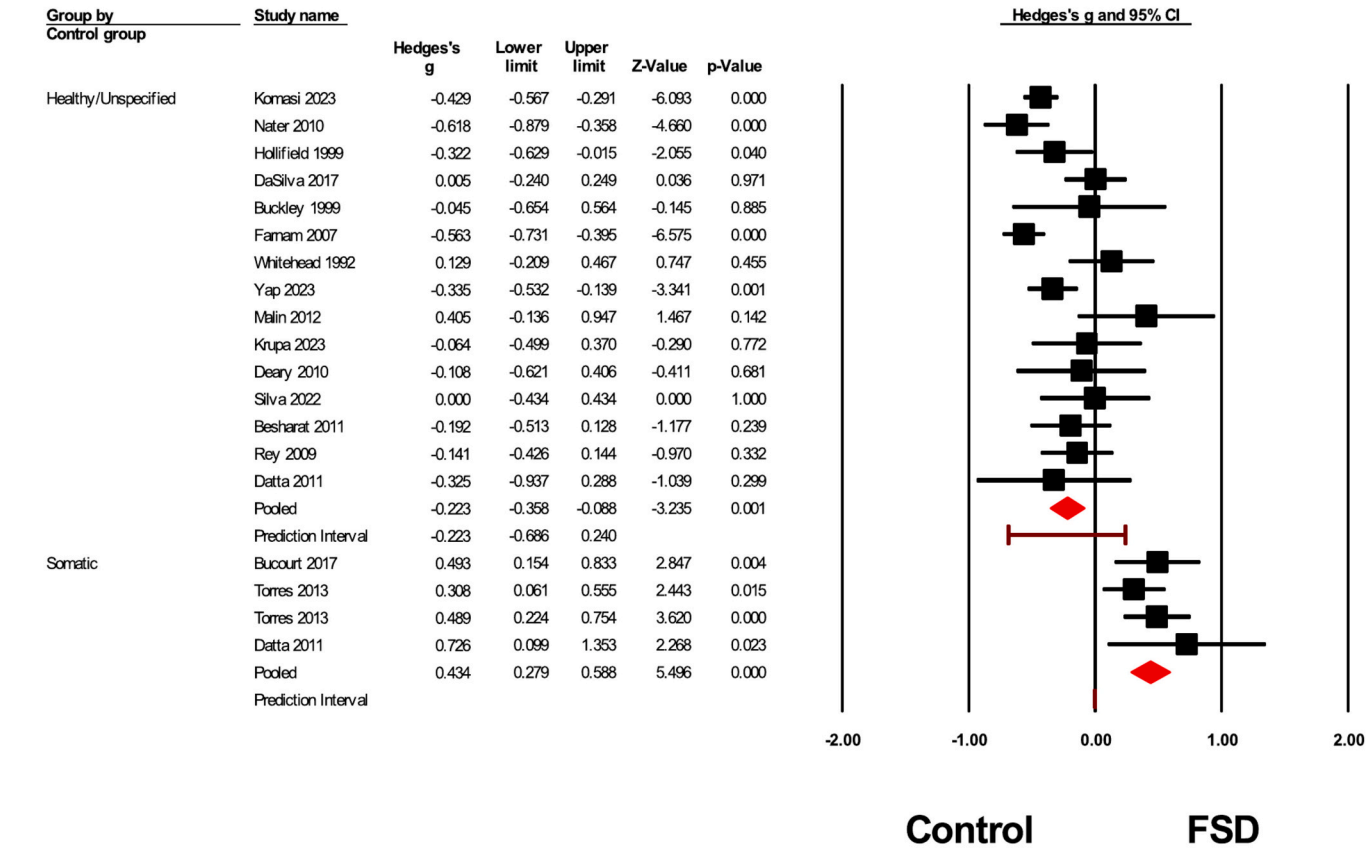

Fig. 6. Forest plot of meta-analytic results for agreeableness across healthy/unspecified and somatic control conditions.
The forest plot illustrates all included effect sizes calculated for agreeableness, across types of control condition. The pooled effect size (red diamond) and prediction interval (Deep red bracket) for control group type is displayed. **Abbreviations**: FSD, Functional Somatic Disorder.

3.6. Publication bias

To assess publication bias, funnel plots and Egger's tests were inspected. Funnel plots indicated that the risk of publication bias was weak. Only studies from comparisons based on healthy/unspecified controls had the required 10 studies. Egger's test was therefore only conducted for these types of controls and was non-significant in all cases except for agreeableness (see Appendix H). Upon visual inspection of the funnel plot for agreeableness, the plot seemed balanced, with most studies aligning with the diagonal lines.

3.7. Sensitivity analyses

Sensitivity analyses were conducted for all eligible comparisons. Findings are briefly summarized below. Detailed test statistics can be found in Appendix I. It should be noted that in many cases, sensitivity analysis was not conducted because the studies excluded during the sensitivity analysis were not a part of the trait by control group comparison in the first place. No sensitivity analyses were conducted for psychiatric controls, as only three studies were included.

In relation to healthy/unspecified controls, no notable differences were observed for neuroticism, agreeableness, extraversion, and openness across the three types of sensitivity analyses. For conscientiousness, the removal of Besharat et al. (2011) where the coding of the control groups was ambiguous resulted in a slightly larger and statistically significant effect. This was also observed when excluding a study where the reporting of trait data was ambiguous (Farnam et al., 2007). Furthermore, by excluding a study where the eligibility of the FSD case definition was questionable, the effect size for conscientiousness was significantly reduced (Datta et al., 2011).

Sensitivity analyses for somatic controls were not possible in most cases, as only a few of the studies that were excluded across the three sensitivity analyses included somatic controls. Where sensitivity analyses were possible, the removal of Datta et al. (2011) and Johnson et al. (1996) had limited effect on neuroticism, extraversion, openness, and agreeableness levels. The removal of Datta et al. (2011) led to a larger effect size and a reduction in heterogeneity for conscientiousness.

4. Discussion

4.1. Summary of findings

This systematic review and meta-analysis examined differences in FFM trait scores between individuals with FSD compared to healthy/unspecified, somatic, and psychiatric control groups. The findings showed that individuals with FSD scored higher on neuroticism compared with somatic and healthy/unspecified controls, lower on extraversion compared with healthy/unspecified controls, lower on agreeableness compared with healthy/unspecified controls, and higher on agreeableness compared with somatic controls. There were no significant differences in openness and conscientiousness between the FSD group and the somatic or healthy/unspecified controls. Few studies have

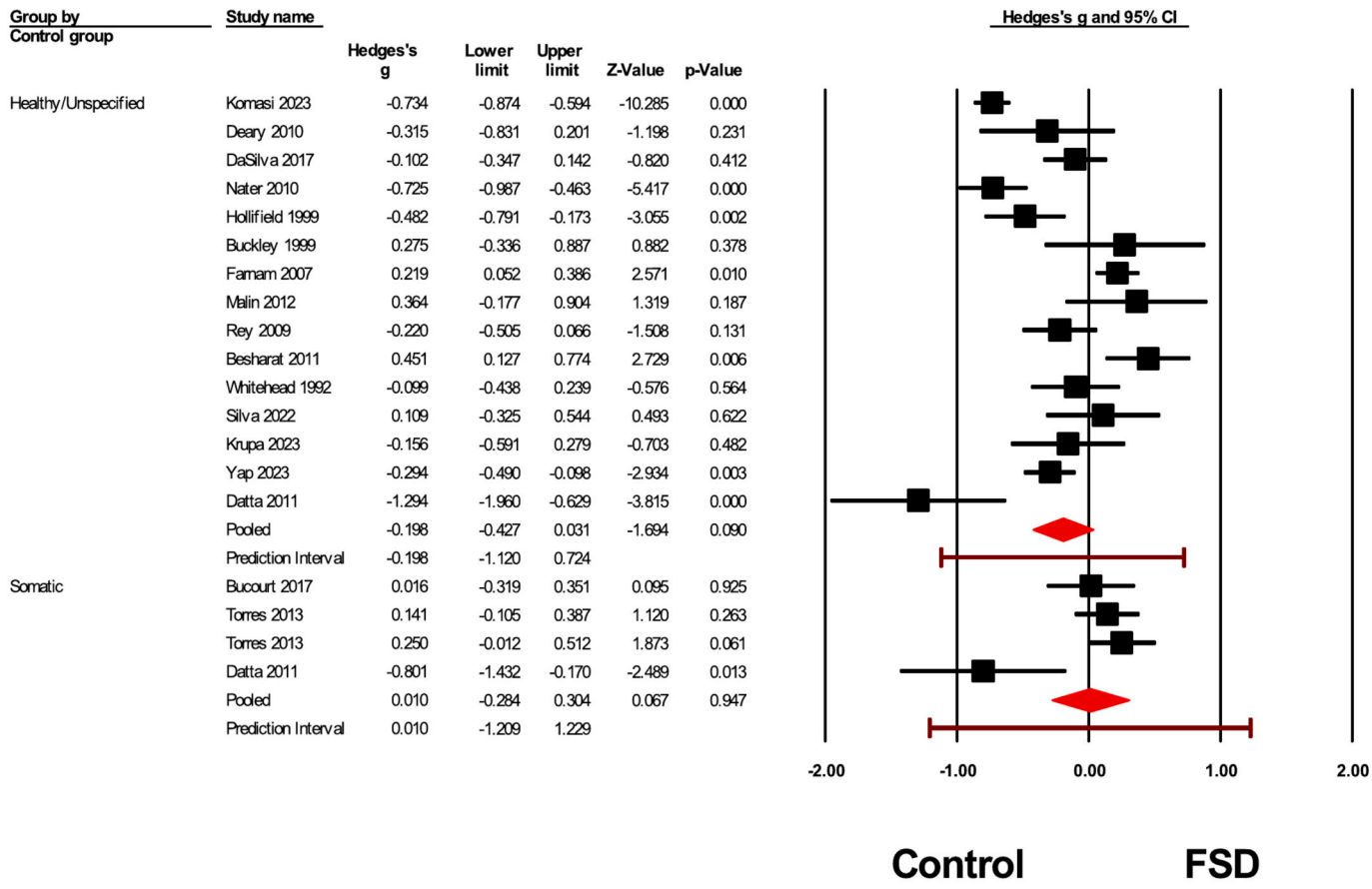

Fig. 7. Forest plot of meta-analytic results for conscientiousness across healthy/unspecified and somatic control conditions.
The forest plot illustrates all included effect sizes calculated for conscientiousness, across types of control condition. The pooled effect size (red diamond) and prediction interval (Deep red bracket) for control group type is displayed. **Abbreviations**: FSD, Functional Somatic Disorder.

included comparisons with psychiatric controls. Findings studies with psychiatric controls indicated that FSD cases scored lower than psychiatric controls on neuroticism. Nevertheless, the few studies and large heterogeneity challenge the validity of this estimate.

Heterogeneity was observed across all comparisons. Effect sizes based on somatic controls tended to exhibit the least heterogeneity, although these comparisons were also based on fewer effect sizes, which challenges the estimation of heterogeneity (Borenstein, 2024). Subgroup analyses showed that none of the chosen moderator variables had a consistent effect on heterogeneity or effect sizes. Meta-regression showed that effect size was unrelated to year of publication for all traits. Sensitivity analyses indicated that findings were generally robust to choices made during the review process.

4.2. Comparison with other studies

The current findings are consistent with findings from other meta-analyses regarding FFM traits and FSD, but expand upon these: The findings pertaining to elevated neuroticism among FSD patients in the current review are in line with previous systematic reviews (Macina et al., 2021; Vesal et al., 2024), but the current review include more studies and cover a much wider range of FSD operationalizations. The current review is furthermore the first meta-analysis to quantitatively synthesize findings regarding the four remaining FFM traits in relation to FSD.

The current findings are consistent with results from meta-analyses regarding the association between FFM traits and various mental disorders, which show that anxiety, depressive disorders, and personality disorders tend to be associated with elevated neuroticism, lower extraversion and conscientiousness, and slightly lower agreeableness (Kotov et al., 2010; Malouff & Thorsteinsson, 2005; Saulsman & Page, 2004). Interestingly, previous reviews have shown that most mental disorders have moderate-strong negative associations with conscientiousness, which is not reflected in the current findings for FSD.

Meta-analyses regarding FFM traits and physical disorders are also in line with current findings showing that neuroticism is consistently associated with physical disease (Garramone et al., 2020; Jokela, Elovainio, et al., 2014; Jokela, Hakulinen, et al., 2014; Low et al., 2013; Santangelo et al., 2018; Terracciano et al., 2014). These reviews also demonstrate robust negative associations between physical disease and conscientiousness, which is not reflected in our findings for FSD. Finally, they show that openness, agreeableness, and extraversion are inconsistently associated with physical disorders, which is not aligned with what is found for FSD, where there seems to be robust associations with agreeableness and extraversion.

Interestingly, Jokela, Hakulinen, et al. (2014) have shown that after developing a chronic physical illness, individuals tend to score higher on neuroticism and lower on conscientiousness, extraversion and openness.

This is consistent with the findings from the current review, which showed similar alterations for FSD cases compared with healthy/unspecified controls. The findings from Jokela et al. can thus be used to cast doubt as to whether the trait associations found in the current study play a specific role for FSD, or whether they are the result of having to adjust to living with a chronic illness.

In the current review, differences between FSD patients and somatically ill controls are found only for neuroticism and agreeableness, which could indicate a degree of specificity of these traits within FSD. Again it should be considered whether this could be confounded by, e.g., comorbid clinical depression, which is known to affect a sizeable portion of FSD patients (Henningsen, Zimmermann, & Sattel, 2003) and have transient state effects on individuals' neuroticism levels (Karsten et al., 2012; Ormel et al., 2004). A counterargument is that it may not be meaningful to consider depression as a confounder of neuroticism, as the two constructs have content overlap and relate to similar underlying constructs (Riese, Ormel, Aleman, Servaas, & Jeronimus, 2016). Furthermore, chronic illness does not seem to impact agreeableness levels in Jokela, Hakulinen, et al. (2014), which could indicate that the effect observed in the current study is not just a state effect.

Due to the cross-sectional nature of the included studies, the current data cannot be used to establish whether the identified FFM traits act as risk factors for FSD or are the product of living with a severe condition. Nevertheless, two longitudinal studies have shown that neuroticism is associated with the prospective onset of FSD (Kato, Sullivan, Evengård, & Pedersen, 2006; Petersen et al., 2024). Furthermore, it has been demonstrated that the onset of depression prospectively predicts the onset of FMS and IBS (Chang et al., 2015; Sibelli et al., 2016). As depression is a central component within the neuroticism domain, it seems plausible to hypothesize that neuroticism could predispose individuals for a higher risk of developing FSD; however, further studies are needed to explore this hypothesis. To our knowledge, no prospective studies have been conducted for the other FFM traits.

While this review focused on categorical operationalizations of FSD, the construct of FSD is conceived as inherently dimensional, varying in pervasiveness and severity (Burton et al., 2020). It follows that the personality trait associations demonstrated in the current review may also be applicable within dimensional or subclinical operationalizations of FSD and could even be applicable within the concept of persistent physical symptoms (Löwe et al., 2024). While the current data cannot serve as direct evidence for this, our findings are consistent with previous meta-analyses examining physical symptoms such as fatigue, pain, headache, and cognitive symptoms in relation to FFM traits (Aschwanden et al., 2020; Atanassova et al., 2024; Stephan et al., 2021, 2022).

Finally, the lack of associations between FSD and conscientiousness proves a puzzling finding of the current review. It has frequently been proposed, mainly based on clinical observation, that FSD patients are characterized by traits related to excessive orderliness, perfectionism, and rigidity (Deary et al., 2007; Malin & Littlejohn, 2012b; van Geelen et al., 2007; Van Houdenhove, Neerinckx, Onghena, Lysens, & Vertommen, 2001); a few studies have even examined this empirically, supporting this notion (Bonvanie et al., 2015; Deary & Chalder, 2010; Kempke et al., 2011; White & Schweitzer, 2000). While these traits are not explicitly defined within the FFM model, the trait which probably resembles the rigid perfectionism proposed earlier is most likely the conscientiousness domain, which is characterized by orderliness, self-discipline, and dutifulness (McCrae & John, 1992; Samuel & Widiger, 2011; Stoeber, Otto, & Dalbert, 2009). Based on the current data, this association does not seem viable though, as there appears to be no difference on conscientiousness. FSD patients even appear to be associated with slightly less conscientiousness compared with healthy/unspecified controls. This challenges the notion that FSD should be associated with excessive tendencies towards orderliness, self-discipline, and dutifulness.

Regarding perfectionism, it is nevertheless unclear to which degree the FFM trait conscientiousness actually represents perfectionism well (Haigler & Widiger, 2001; Mike, King, Oltmanns, & Jackson, 2018; Rojas, Crego, & Widiger, 2019; Samuel & Widiger, 2011; Smith et al., 2022). In fact, it has been demonstrated empirically that perfectionism is best understood as a multidimensional construct with both healthy and unhealthy manifestations (Frost, Marten, Lahart, & Rosenblate, 1990; Hewitt & Flett, 1991; Smith et al., 2022). In a recent meta-analysis, Smith et al. (2019) evaluated the relation between FFM traits and multidimensional perfectionism scales and found that FFM traits do not map simply onto perfectionism dimensions: They found that 'perfectionistic concern', which can generally be regarded as a manifestation of unhealthy perfectionism, was in fact *negatively* associated with conscientiousness, while also associated with higher neuroticism, lower extraversion, and lower agreeableness. 'Perfectionistic striving', which can generally be regarded as a healthier manifestation of perfectionism, on the other hand, was associated with higher conscientiousness. These findings seem to align well with the results of the current review if one assumes that FSD is associated with a higher degree of the less healthy manifestations of perfectionism.

4.3. Strengths and limitations

The current review has several notable strengths: First, it is based on an up-to-date and comprehensive search across multiple databases with parallel screening and quality assessment procedures. Second, it is the first review to incorporate a range of different operationalizations of FSD, ensuring a more comprehensive coverage of the FSD construct than previous reviews. Third, it is the first review to systematically review the role of FFM traits within FSD, with a rigorous approach to selecting FFM trait measures based on a predefined list. Fourth, an adapted version of a widely used quality assessment scale (The Newcastle-Ottawa Scale) was tailored to meet the specific needs of this review, ensuring thorough evaluation of study quality. The review also has some limitations, both related to the included empirical studies and the current review methodology.

First, the effect size related to somatic controls was generated based on a limited set of somatic illnesses, predominantly, rheumatological, neurological, and gastrointestinal conditions. Information related to disease characteristics such as severity, duration, impairment, or medication was not systematically reported and could not be accounted for in the analyses. Thus, it is unclear whether the present findings can be generalized to other somatic disorders than the those currently studied, and whether trait associations would be modified by illness characteristics. Furthermore, the current study defines certain control groups as either healthy or unhealthy. This terminology stems from case-control studies within the field, which tends to label cases as "healthy" if they do not suffer from one of the studied conditions. The distinction between healthy/unhealthy is contentious, as health is a multi-facetted and dimensional phenomenon (Schramme, 2023). In the current review, adherence to the terminology used by the primary studies was nevertheless prioritized.

Second, few studies included psychiatric controls, and among the studies that did, a large degree of heterogeneity was observed. This means that it is currently not possible to estimate how much FSD cases differ from psychiatric controls on FFM traits, which represents an important gap in the literature. Future studies could aim to include controls with mental disorders to detail the degree to which personality traits of patients with FSD and mental disorders differ, and how this affects the course of the disorder and treatment.

Third, in/exclusion criteria as well as illness characteristics of FSD cases were poorly described in the majority of studies. Thus, despite the fact that most FSD cases were recruited from clinical settings via clinical interviews, the nature of these conditions, including comorbidity, drug use, severity, and illness duration, could not be accounted for in the analyses.

Fourth, only one study used a dimensional measure of maladaptive

manifestations of the FFM traits. This may have resulted in imprecise estimates for the role of these traits for FSD as standard FFM measures (e.g. NEO-PI-R) only provide limited coverage of the maladaptive manifestations of the FFM domains (Haigler & Widiger, 2001; Rojas et al., 2019). To get a more thorough impression of the role of maladaptive personality traits within FSD, future studies should employ measures specifically developed to measure maladaptive FFM trait manifestations (see appendix A for suggestions). Furthermore, future reviews might examine the prevalence of personality disorder within FSD, as this is not covered in the current review.

Fifth, the chosen FSD operationalizations still reflect a broad, but nonetheless selected definition of the FSD construct, leading to the omission of important symptom clusters and syndromes (e.g. functional neurological symptoms/conversion disorder, urogenital symptoms, functional dyspepsia, and more), and other researchers have suggested the use of a more comprehensive approach (Hüsing et al., 2023). The rationale for the selection of FSD operationalizations in the current review was to primarily include diagnostic constructs as operationalized in the major diagnostic systems to heighten homogeneity, diagnostic validity, and clinical utility. Nevertheless, the current review omitted certain operationalizations of FSD, such as FND and dimensional FSD operationalizations (e.g. PPS), and future reviews could therefore examine how FFM traits are related these FSD operationalizations.

Sixth, only unadjusted effects were included for analysis, meaning that the effect sizes proposed here could be confounded by third variables (e.g. neuroticism confounded by comorbid depression, age, sex, or other covariates).

Finally, most studies did not live up to most of the quality criteria outlined in the modified NOS scale. This suggests a significant risk of bias in the included studies, which should be considered when interpreting the current results.

4.4. Implications

The current study has important implications for how to understand, classify, and treat FSD.

Findings from this review indicate that high neuroticism could be a hallmark characteristic of FSD, differentiating FSD cases from healthy controls and somatic controls. This is consistent with experimental and experience sampling research within symptom perception, which shows that neuroticism plays a significant role in generating, amplifying, and perpetuating symptoms (Bogaerts et al., 2005; Bogaerts et al., 2015; Bogaerts et al., 2023; Hennemann, Wenzel, Van den Bergh, Wessels, & Witthöft, 2023; Mewes, Feneberg, Doerr, & Nater, 2022; Van den Bergh, Brosschot, Critchley, Thayer, & Ottaviani, 2021). Several authors that have argued for a strong affective basis for FSD (Jungilligens, Paredes-Echeverri, Popkirov, Barrett, & Perez, 2022; Lumley et al., 2021; Luyten, Van Houdenhove, Lemma, Target, & Fonagy, 2013; Pick, Goldstein, Perez, & Nicholson, 2019). This knowledge could inform psychoeducation and case formulation within clinical work with patients suffering from FSD.

The current findings may also contribute to the classification of FSD within the Hierarchical Taxonomy of Psychopathology (HiToP) model, which is a novel empirically based system for classifying psychopathology (Kotov et al., 2021). Within the HiToP model, the somatoform spectrum has been tentatively placed in the emotional dysfunction superspectrum as separate – but related to – internalizing disorders (Watson et al., 2022). Elevated neuroticism is generally assumed to be the fundamental trait underlying all conditions within the emotional dysfunction superspectrum (Watson et al., 2022; Widiger et al., 2019). Future studies could examine the difference in neuroticism between patients with FSD and controls with internalizing disorders such as anxiety and depressive disorders to examine if neuroticism plays a similar role in such disorders – and potentially other spectra as well – to further inform the relative positioning of the two spectra within the HiToP model.

While it cannot be established whether the personality traits identified in the current review affect the risk of developing FSD, the difference in personality traits may affect the course of illness, which may impact the clinical care of patients with FSD (Gumà-Uriel et al., 2016). Previous studies have already established that personality traits affect the treatment response in psychotherapy and pharmacological treatment (Bierling et al., 2024; Bucher et al., 2019; Newton-Howes, Tyrer, & Johnson, 2006). As such, it would be useful to systematically assess the personality profiles of patients and, e.g. offer interventions that may be adjusted to accommodate patients' personality-related vulnerabilities.

5. Conclusion

This systematic review and meta-analysis examined the degree to which individuals with FSD score differently on the FFM traits compared with healthy/unspecified, somatic, and psychiatric controls. The results indicate that FSD cases score higher on neuroticism than somatic and healthy/unspecified controls, higher on extraversion than healthy/unspecified controls, lower on agreeableness than healthy controls, and higher on agreeableness than somatic controls. While the current review cannot provide direct evidence that FFM traits are potential risk factors for FSD, findings suggest a potentially important relationship between FSD and neuroticism, agreeableness, and extraversion and raise questions about the role of conscientiousness and perfectionism within FSD. To further elaborate upon the knowledge generated in the current review, future research could seek to use prospective designs, include control groups suffering from mental disorders, measure maladaptive manifestations of FFM traits, and use more comprehensive operationalizations of FSD.

6. Glossary

- **Functional Somatic Disorder**: is a classification for conditions characterized by persistent and impairing somatic symptoms, which are not better explained by other psychiatric or somatic diagnoses, subsuming a variety of conditions such as irritable bowel syndrome, chronic fatigue syndrome, somatization disorder, somatic symptom disorder, etc.
- **Five-factor model**: is an empirically derived framework for understanding personality traits, proposing that these traits are best categorized into five universal and independent dimensions: neuroticism, agreeableness, conscientiousness, extraversion, and openness.
- **Neuroticism**: a trait dimension which describes an individual's tendency to experience negative emotions.
- **Agreeableness**: a trait dimension which describes an individual's tendency towards prosocial behavior.
- **Conscientiousness**: a trait dimension which describes an individual's capacity for long-term goal pursuit, self-control and orderliness.
- **Extraversion**: a trait dimension which describes an individual's tendency to be energetic, assertive, decisive and experience positive emotions.
- **Openness**: a trait dimension which describes an individual's tendency to be explorative and curious.

Statement of ethics

No ethical approval was sought for the current study as only data from existing published peer-reviewed studies were used, and no participants were enrolled.

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Use of generative AI tools

During the preparation of this work the author(s) used Chat GPT 3.5 in order to improve the language of the manuscript during the manuscript preparation phase. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

Declaration of competing interest

The authors have no conflicts of interest to declare.

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Appendix A. The Personality Measurement Catalogue

No.	Measure	Measure Factors > domain coding	Measure type	Reference
1	NEO-FFI = NEO Five-Factor Inventory	Neuroticism Agreeableness Conscientiousness Extraversion Openness	Big Five	Costa & McCrae (2012)
2	NEO-FFI-R = NEO Five-Factor Inventory Revised	Neuroticism Agreeableness Conscientiousness Extraversion Openness	Big Five	Costa & McCrae (2012)
3	NEO-FFI-3 = The NEO-Five Factor Inventory-3	Neuroticism Agreeableness Conscientiousness Extraversion Openness	Big Five	McCrae & Costa (2007)
4	NEO-PI-Rsf = NEO Personality inventory short form	Neuroticism Agreeableness Conscientiousness Extraversion Openness	Big Five	Hansen & Mortensen (2004)
5	EPQ = Eysenck personality Questionnaire	Neuroticism > Neuroticism Extraversion > Extraversion Psychoticism > [not coded]	Eysenck	Goldberg et al. (1994) Scholte & Bruyn (2004) Kotov et al. (2010)
6	EPQ-R = Eysenck personality Questionnaire revised	Neuroticism > Neuroticism Extraversion > Extraversion Psychoticism > [not coded]	Eysenck	Goldberg et al. (1994) Scholte & Bruyn (2004) Kotov et al. (2010)
7	EPI = Eysenck personality Inventory	Neuroticism > Neuroticism Extraversion > Extraversion Psychoticism > [not coded]	Eysenck	Goldberg et al. (1994) Scholte & Bruyn (2004) Kotov et al. (2010) Moore (1974)
8	BFI = Big Five Personality Inventory	Neuroticism Agreeableness Conscientiousness Extraversion Openness	Big Five	Rammstedt & John (2007)
9	MID = Midlife Development Inventory	Neuroticism Agreeableness Conscientiousness Extraversion Openness	Big Five	Stephan et al. (2022)
10	IPIP-NEO-300 = International Personality item Pool IPIP-NEO-120 = International Personality item Pool	Neuroticism Agreeableness Conscientiousness Extraversion Openness	Big Five	Johnson (2014) Goldberg et al. (2006)
11	FFPI = Five Factor Personality Inventory	Neuroticism Agreeableness Conscientiousness Extraversion Openness	Big Five	Hendriks et al. (1999)
12	MPI = Maudsley Personality Inventory	Neuroticism > Neuroticism Extraversion > Extraversion	Eysenck	Ferrando (2016)
13	SNAP – Schedule for Non-adaptive and Adaptive Personality	Neuroticism > Neuroticism Antagonism > Low agreeableness Conscientiousness > Conscientiousness Introversion > low extraversion	Maladaptive	Calabrese et al. (2012)

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No.	Measure	Measure Factors > domain coding	Measure type	Reference
14	GBM = Goldberg's Bipolar Adjectives/Markers	Emotional stability > low neuroticism Agreeableness > agreeableness Conscientiousness > Conscientiousness Surgency > Extraversion intellect > Openness	Big Five	Ferguson (2000) Lopez et al. (2004)
15	GBM = Goldberg's unipolar markers	Emotional stability > low Neuroticism Agreeableness > agreeableness Conscientiousness > Conscientiousness Surgency > Extraversion intellect > Openness	Big Five	Ferguson (2000) Goldberg (1992)
16	GBFQ = Goldberg's Big Five Questionnaire	Neuroticism Agreeableness Conscientiousness Extraversion Openness	Big Five	Deborah (1996)
17	NEO-PI-R = NEO Personality inventory revised	Neuroticism Agreeableness Conscientiousness Extraversion Openness	Big Five	Costa & McCrae (1995)
18	HEXACO-PI HEXACO-60	Emotionality > neuroticism Agreeableness > Agreeableness Conscientiousness > Conscientiousness Extraversion > Extraversion Openness > Openness Honesty/humility > [not coded]	Big Five	Ashton & Lee (2009) Lee & Ashton (2018)
19	HP5i = Health-relevant Personality Inventory	Antagonism > low agreeableness Impulsivity > Low conscientiousness Hedonic capacity > extraversion Negative affectivity > neuroticism Alexithymia > low openness	Big Five	Gustavsson et al. (2003)
20	NEO-PI-3	Neuroticism Agreeableness Conscientiousness Extraversion Openness	Big Five	McCrae & Costa (2007)
21	FFMM = Five Factors Mini-Markers	Neuroticism Agreeableness Conscientiousness Extraversion Openness	Big Five	Stogner (1999) Saucier (1994)
22	COPAS = Comprehensive Personality and Affect Scales	Emotionality > Neuroticism Extraversion > Extraversion Openness > Openness Conscientiousness > Conscientiousness Agreeableness > Agreeableness Negative affect > [not coded] Positive affect > [not coded]	Big Five	Lubin & Whitlock (2002)
23	MINI-IPIP = Mini-International Personality Item Pool	Neuroticism Agreeableness Conscientiousness Extraversion Intellect/imagination	Big Five	Donnellan et al. (2006)
24	BHI = Brief HEXACO Inventory	Emotionality > neuroticism Agreeableness > Agreeableness Conscientiousness > Conscientiousness Extraversion > Extraversion Openness > Openness Honesty/humility > [not coded]	Big Five	De Vries (2013)
25	FPB = Factorial Personality Battery	Neuroticism Agreeableness Conscientiousness Extraversion Openness	Big Five	Silva, Carvalho, and Rodrigues (2022)
26	FFF = The Five Factor Form	Neuroticism Agreeableness Conscientiousness Extraversion Openness	Big Five	Rojas & Widiger (2014)

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No.	Measure	Measure Factors > domain coding	Measure type	Reference
28	PID-5 = Personality inventory for DSM 5	Negative Affect > Neuroticism Detachment > Low extraversion Antagonism > low agreeableness Disinhibition > Low conscientiousness Psychoticism > [not coded]	Maladaptive	Krueger et al. (2012)
29	CAT-PD-SF = Comprehensive Assessment of Traits Relevant to Personality Disorder – Static form *[only static, not IRT form]*	Negative emotionality > Neuroticism Positive emotionality > Extraversion Antagonism > Low agreeableness Disconstraint > low conscientiousness Oddity > [not coded]	Maladaptive	Long et al. (2021)
30	PICD-11 = Personality Inventory for ICD-11	Negative Affectivity > Neuroticism Detachment > Low extraversion Dissociality > Low agreeableness Disinhibition > [not coded] Anankastia > high conscientiousness	Maladaptive	Stricker et al. (2022)
31	FFiCD = Five Factor Personality Inventory for ICD	Negative Affectivity > Neuroticism Detachment > Low extraversion Dissociality > Low agreeableness Disinhibition > [not coded] Anankastia > high conscientiousness	Maladaptive	Oltmanns and Widiger (2019)
32	PAQ-11 = Personality Assessment Questionnaire for ICD-11	Negative Affectivity > Neuroticism Detachment > Low extraversion Dissociality > Low agreeableness Disinhibition > [not coded] Anankastia > high conscientiousness	Maladaptive	Kim et al. (2020)
33	PID5BF + M = Personality Inventory for DSM-5 and ICD-11	Negative Affectivity > Neuroticism Detachment > Low extraversion Antagonism > Low agreeableness Disinhibition > [not coded] Anankastia > high conscientiousness Psychoticism > [not coded]	Maladaptive	Bach, Kerber et al. (2020)
34	DAPP-BQ = Dimensional Assessment of Personality Pathology – Basic Questionnaire	Emotional Dysregulation > Neuroticism Dissocial Behavior > Low agreeableness Inhibitedness > low extraversion Compulsivity > high conscientiousness	Maladaptive	Crego & Widiger (2020) Livesley & Jackson (2009)
35	MMPI PSY-5 = Personality Psychopathology Five	Negative emotionality/Neuroticism > Neuroticism Positive emotionality/Extraversion > Extraversion Aggressiveness > low Agreeableness Constraint > high conscientiousness Psychoticism > [not coded / openness]	Maladaptive	Harkness (1992; 2009)
36	MPQ = Multidimensional Personality Questionnaire	Negative emotional temperament > neuroticism Positive emotional temperament > extraversion Constraint > high conscientiousness Absorption > openness	Other	Tellegen (1982)
37	MPQ-SF = Multidimensional Personality Questionnaire Short-Form	Negative emotional temperament > neuroticism Positive emotional temperament > extraversion Constraint > high conscientiousness Absorption > openness	Other	Patrick et al. (2002)

The Personality Measures Catalogue was an a list of measures developed prior to the review, which was used to denote all possibly eligible personality inventories for the current review. Instructions for the coding of each factor within the five-factor model traits are provided. When [not coded] is stated it is implied that the given trait form that inventory is not included in the current review as it does not fit clearly within the Five-Factor model. The type of measure was coded to be used for sub-group analyses. A citation is provided for each measure to avoid confusions of measures. The main author can be contacted for the specific references.

Appendix B. All search strings

PsycInfo	(tiab("medically unexplained" OR "unexplained disease*" OR "unexplained illness*" OR "MUS" OR "MUPS" OR "unexplained symptom*" OR "unexplained complaint*" OR "medically unexplained somatic symptoms" OR "medically unexplained symptoms" OR "functional somatic syndrome" OR "functional somatic syndromes" OR "functional somatic symptom" OR "functional somatic symptoms" OR "functional syndrome" OR "functional syndromes" OR "functional disorder" OR "functional disorders" OR "functional disease" OR "functional diseases" OR "somatoform disorders" OR "somatoform disorder*" OR "somatoform" OR "somatization" OR "somatisation" OR "Briquet's syndrome" OR "somatisation disorder*" OR "somatization disorder*" OR "undifferentiated somatoform disorder*" OR "somatoform pain disorder*" OR "somatic symptom disorder" OR "somatic symptom disorders" OR "Fibromyalgia" OR "fibromyalgia" OR "fibromyalgias" OR "muscular rheumatism" OR "fibrositis" OR "fibrositides" OR "diffuse myofascial pain syndrome" OR "fibromyositis" OR "fibromyalgia syndrome" OR "primary fibromyalgia*" OR "chronic widespread pain" OR "chronic benign pain syndrome*" OR "chronic benign pain disorder*" OR "Fatigue Syndrome, Chronic" OR "CFS" OR "chronic fatigue syndrome" OR

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	"chronic fatigue disorder*" OR "myalgic encephalomyelitis" OR "royal free disease" OR "post viral fatigue syndrome*" OR "chronic fatigue" OR "fatigue syndrome" OR "chronic fatigue and immune dysfunction syndrome" OR "Neurasthenia" OR "neurasthenia" OR "Irritable Bowel Syndrome" OR "IBS" OR "irritable bowel syndrome" OR "irritable bowel syndromes" OR "irritable colon" OR "recurrent abdominal pain" OR "functional abdominal pain" OR "functional gastrointestinal disorder" OR "functional gastrointestinal disorders" OR "BDS" OR "bodily distress syndrome" OR "bodily distress syndromes" OR "central sensitivity syndrome") OR (MAINSUBJECT.EXACT ("Somatoform Disorders") OR MAINSUBJECT.EXACT("Somatization Disorder") OR MAINSUBJECT.EXACT("Fibromyalgia") OR MAINSUBJECT.EXACT("Chronic Fatigue Syndrome") OR MAINSUBJECT.EXACT("Neurasthenia") OR MAINSUBJECT.EXACT("Irritable Bowel Syndrome"))) AND (tiab("Personality" OR "Trait*" OR "Big five" OR "Big 5" OR "Five-factor Model" OR "Five factor Model" OR "5 factor Model" OR "5-factor Model" OR "Neuroticism" OR "Conscientiousness" OR "Extraversion" OR "Agreeableness" OR "Openness" OR "Personality Disorder*") OR (MAINSUBJECT.EXACT("Personality") OR MAINSUBJECT.EXACT("Personality Traits") OR MAINSUBJECT.EXACT("Five Factor Personality Model") OR MAINSUBJECT.EXACT("NEO Personality Inventory") OR MAINSUBJECT.EXACT("Neuroticism") OR MAINSUBJECT.EXACT("Conscientiousness") OR MAINSUBJECT.EXACT("Extraversion") OR MAINSUBJECT.EXACT("Agreeableness") OR MAINSUBJECT.EXACT ("Openness to Experience") OR MAINSUBJECT.EXACT("Personality Disorders")))
Embase	(('medically unexplained':ab,kw,ti OR 'unexplained disease':ab,kw,ti OR 'unexplained illness':ab,kw,ti OR 'mus':ab,kw,ti OR 'mups':ab,kw,ti OR 'unexplained symptom': ab,kw,ti OR 'unexplained complaint':ab,kw,ti OR 'medically unexplained somatic symptoms':ab,kw,ti OR 'medically unexplained symptoms':ab,kw,ti OR 'functional somatic syndrome':ab,kw,ti OR 'functional somatic syndromes':ab,kw,ti OR 'functional somatic symptom':ab,kw,ti OR 'functional somatic symptoms':ab,kw,ti OR 'functional syndrome':ab,kw,ti OR 'functional syndromes':ab,kw,ti OR 'functional disorder':ab,kw,ti OR 'functional disorders':ab,kw,ti OR 'functional disease':ab,kw,ti OR 'somatoform disorders':ab,kw,ti OR 'somatoform disorder':ab,kw,ti OR 'somatoform':ab,kw,ti OR 'functional diseases':ab,kw,ti OR 'somatization':ab,kw,ti OR 'somatisation':ab,kw,ti OR 'briquets syndrome':ab,kw,ti OR 'somatisation disorder':ab,kw,ti OR 'somatization disorder':ab,kw,ti OR 'undifferentiated somatoform disorder*':ab,kw,ti OR 'somatoform pain disorder':ab,kw,ti OR 'somatic symptom disorder':ab,kw,ti OR 'somatic symptom disorders':ab,kw,ti OR 'fibromyalgia':ab,kw,ti OR 'fibromyalgias':ab,kw,ti OR 'muscular rheumatism':ab,kw,ti OR 'fibrositis':ab,kw,ti OR 'fibrositides':ab,kw,ti OR 'diffuse myofascial pain syndrome':ab,kw,ti OR 'fibromyositis':ab,kw,ti OR 'fibromyalgia syndrome':ab,kw,ti OR 'primary fibromyalgia':ab,kw,ti OR 'chronic widespread pain':ab,kw,ti OR 'chronic benign pain syndrome':ab,kw,ti OR 'chronic benign pain disorder':ab,kw,ti OR 'fatigue syndrome, chronic':ab,kw,ti OR 'cfs':ab,kw,ti OR 'chronic fatigue syndrome':ab,kw,ti OR 'chronic fatigue disorder':ab,kw,ti OR 'myalgic encephalomyelitis':ab,kw,ti OR 'royal free disease':ab,kw,ti OR 'post viral fatigue syndrome':ab,kw,ti OR 'chronic fatigue': ab,kw,ti OR 'fatigue syndrome':ab,kw,ti OR 'chronic fatigue and immune dysfunction syndrome':ab,kw,ti OR 'neurasthenia':ab,kw,ti OR 'ibs':ab,kw,ti OR 'irritable bowel syndrome':ab,kw,ti OR 'irritable bowel syndromes':ab,kw,ti OR 'irritable colon':ab,kw,ti OR 'recurrent abdominal pain':ab,kw,ti OR 'functional abdominal pain':ab,kw,ti OR 'functional gastrointestinal disorder':ab,kw,ti OR 'functional gastrointestinal disorders':ab,kw,ti OR 'bds':ab,kw,ti OR 'bodily distress syndrome':ab,kw,ti OR 'bodily distress syndromes':ab,kw,ti OR 'central sensitivity syndrome':ab,kw,ti) OR ('functional disease'/de OR 'somatization'/de OR 'fibromyalgia'/de OR 'neurasthenia'/de OR 'chronic fatigue syndrome'/de OR 'irritable colon'/de OR 'medically unexplained symptom'/de OR 'somatoform disorder'/de)) AND (('personality':ab,kw,ti OR 'Trait*': ab,kw,ti OR 'big five':ab,kw,ti OR 'big 5':ab,kw,ti OR 'Five-factor Model':ab,kw,ti OR 'Five factor Model':ab,kw,ti OR '5 factor Model':ab,kw,ti OR '5-factor Model':ab,kw, ti OR 'neuroticism':ab,kw,ti OR 'conscientiousness':ab,kw,ti OR 'extraversion':ab,kw,ti OR 'agreeableness':ab,kw,ti OR 'openness':ab,kw,ti OR 'personality disorders':ab, kw,ti OR 'personality disorder':ab,kw,ti) OR ('personality'/de OR 'extraversion'/de OR 'personality disorder'/de OR 'Big Five Inventory'/de)) AND [1990–2024]/py
Pubmed	(("medically unexplained"[Title/Abstract] OR "unexplained disease*"[Title/Abstract] OR "unexplained illness*"[Title/Abstract] OR "MUS"[Title/Abstract] OR "MUPS"[Title/Abstract] OR "unexplained symptom*"[Title/Abstract] OR "unexplained complaint*"[Title/Abstract] OR "medically unexplained somatic symptoms"[Title/Abstract] OR "medically unexplained symptoms"[Title/Abstract] OR "functional somatic syndrome"[Title/Abstract] OR "functional somatic syndromes"[Title/Abstract] OR "functional somatic symptom"[Title/Abstract] OR "functional somatic symptoms"[Title/Abstract] OR "functional syndrome"[Title/ Abstract] OR "functional syndromes"[Title/Abstract] OR "functional disorder"[Title/Abstract] OR "functional disorders"[Title/Abstract] OR "functional disease"[Title/ Abstract] OR "functional diseases"[Title/Abstract] OR "somatoform disorder*"[Title/Abstract] OR "somatoform"[Title/Abstract] OR "somatization"[Title/Abstract] OR "somatisation"[Title/Abstract] OR "Briquet's syndrome"[Title/Abstract] OR "somatisation disorder*"[Title/Abstract] OR "somatization disorder*"[Title/Abstract] OR "undifferentiated somatoform disorder*"[Title/Abstract] OR "somatoform pain disorder*"[Title/Abstract] OR "somatic symptom disorder"[Title/Abstract] OR "somatic symptom disorders"[Title/Abstract] OR "fibromyalgia"[Title/Abstract] OR "fibromyalgias"[Title/Abstract] OR "muscular rheumatism"[Title/Abstract] OR "fibrositis"[Title/Abstract] OR "fibrositides"[Title/Abstract] OR "diffuse myofascial pain syndrome"[Title/Abstract] OR "fibromyositis"[Title/Abstract] OR "fibromyalgia syndrome"[Title/Abstract] OR "primary fibromyalgia*"[Title/Abstract] OR "chronic widespread pain"[Title/Abstract] OR "chronic benign pain syndrome*"[Title/ Abstract] OR "chronic benign pain disorder*"[Title/Abstract] OR "CFS"[Title/Abstract] OR "chronic fatigue syndrome"[Title/Abstract] OR "chronic fatigue disorder*"[Title/Abstract] OR "myalgic encephalomyelitis"[Title/Abstract] OR "royal free disease"[Title/Abstract] OR "post viral fatigue syndrome*"[Title/Abstract] OR "chronic fatigue"[Title/Abstract] OR "fatigue syndrome"[Title/Abstract] OR "chronic fatigue and immune dysfunction syndrome"[Title/Abstract] OR "neurasthenia"[Title/Abstract] OR "IBS"[Title/Abstract] OR "irritable bowel syndrome"[Title/Abstract] OR "irritable bowel syndromes"[Title/Abstract] OR "irritable colon"[Title/Abstract] OR "recurrent abdominal pain"[Title/Abstract] OR "functional abdominal pain"[Title/Abstract] OR "functional gastrointestinal disorder"[Title/ Abstract] OR "functional gastrointestinal disorders"[Title/Abstract] OR "BDS"[Title/Abstract] OR "bodily distress syndrome"[Title/Abstract] OR "bodily distress syndromes"[Title/Abstract] OR "central sensitivity syndrome"[Title/Abstract]) OR ("Somatoform Disorders"[Mesh:NoExp] OR "Medically Unexplained Symptoms"[Mesh] OR "Neurasthenia"[Mesh] OR "Fatigue Syndrome, Chronic"[Mesh] OR "Fibromyalgia"[Mesh] OR "Irritable Bowel Syndrome"[Mesh])) AND (("Personality"[Title/Abstract] OR "Trait*"[Title/Abstract] OR "Big five"[Title/Abstract] OR "Big 5"[Title/Abstract] OR "Five factor Model"[Title/Abstract] OR "Five-factor Model"[Title/Abstract] OR "5 factor Model"[Title/Abstract] OR "5-factor Model"[Title/Abstract] OR "Neuroticism"[Title/Abstract] OR "Conscientiousness"[Title/ Abstract] OR "Extraversion"[Title/Abstract] OR "Agreeableness"[Title/Abstract] OR "Openness"[Title/Abstract] OR "Personality Disorder*"[Title/Abstract]) OR ("Personality"[Mesh:NoExp] OR "Neuroticism"[Mesh] OR "Personality Disorders"[Mesh:NoExp] OR "Extraversion, Psychological"[Mesh]))

This table shows all the search which were employed during the retrieval of records for the current review. It should be noted that filters and limitations are not included in the current search strings and were applied using the UI of each respective database.

Appendix C. Data items

For each study, the following data points were extracted: Main author name; publication year; country; DOI; Journal; design (cross-sectional, case-control, RCT, prospective, other); nature of comparator group (healthy/unspecified control, clinical somatic, clinical psychiatric); mean and SD of FSD duration of morbidity; recruitment setting (clinical somatic, clinical psychiatric, clinical psychosomatic, general practitioner, convenience sample, population cohort, mixed, other); Number of FSD operationalizations; FSD operationalization(s) studied (functional disorder, functional somatic disorder, fibromyalgia, pain disorder, persistent somatoform pain disorder, chronic fatigue syndrome, myalgic encephalomyelitis, neurasthenia, irritable bowel syndrome, somatization disorder, undifferentiated somatoform disorder, somatic symptom disorder, bodily distress syndrome, other); total number of participants; sample gender (% female); sample age (mean, SD); comorbidity (nominal); Number of personality measures; Number of FFM traits measured; FFM traits measured (neuroticism, agreeableness, conscientiousness, extraversion, openness); Personality measure type (Big-five measure; Eysenck measure; Abnormal trait measure); internal consistency measures used (Split-half reliability; Cronbach's alpha reported; Spearman-brown; Kuder-Richardson 20; other); internal consistency of each trait; number of subgroups; number of comparator groups.

The instrument allowed up to three FSD groups and three comparator groups per study. For each subgroup that was intended for inclusion in the analyses, the following data points were extracted: Recruitment setting of subgroup (clinical somatic, clinical psychiatric, clinical psychosomatic, general practitioner, convenience sample, population cohort, mixed, other); method of determining FSD caseness (self-report diagnosis, clinical interviews, psychometric instrument); Mean and SD age of cases; gender of cases (% female); number of cases; mean and SD for trait score for all traits (Neuroticism, Agreeableness, Conscientiousness, Extraversion, Openness); psychiatric comorbidities (nominal); somatic comorbidities (nominal). For FSD groups, and somatic and psychiatric control groups, mean and SD duration of morbidity were extracted.

If raw data (Mean, SD of traits) could not be extracted, the effect sizes (Standardized Mean Difference, Cohen's *d*, Glass' Delta, Eta Squared, Hedges' *g* or a raw mean difference), and test-statistics (*p*-value, degrees of freedom, *t*-value, *F*-value, *z*-value) were extracted for all trait comparisons with the FSD group.

Appendix D. Quality assessment form (Adapted from the NOS)

Item	Response options
(1) Has the FSD subtype of cases been reliably assessed and validated?[a]	• Assessment done by a physician according to international criteria. (2) • Assessment done by a physician, criteria unclear. (1) • Self-report or not clearly stated. (0)
(2) Have all controls been recruited from the same population as the cases?[a]	• Same control population as cases. (2) • Selected population, such as hospital staff or students. (1) • Not clearly stated. (0)
(3) Is the population defined with in- and exclusion criteria?[a]	• Medication use, somatic morbidity, psychiatric morbidity, 3 stated. (2) • Medication use, somatic morbidity, psychiatric morbidity 1–2 stated. (1) • None stated or not clearly stated. (0)
(4) Are disease characteristics presented (duration and severity of CFS or FMS)?[a]	• Duration of disease and severity of disorder is stated. (2) • Only duration or only severity is stated. (1) • None stated. (0)
(5) Do the studies use appropriate sample sizes for each group?[b, c]	• $\geq$ 64 per group (2) • $<$ 64 per group (0)
(6) Does the personality measure(s) used afford sufficient coverage of the measured personality traits?[b]	• Personality measure consisted of at least 10 items per trait. (2) • Personality measure consisted of less than 10 items per trait. (1) • Not reported. (0)
(7) Does the study use a validated personality measures?[b]	• Yes, the study used a validated personality measure. (2) • The study did not report on the validity of the personality measure used. (0)

This table displays the modified version of the Newcastle-Ottawa scale which was used for quality assessment in the current review. Abbreviations: FSD, Functional Somatic Disorder; CFS, Chronic Fatigue Syndrome; FMS, Fibromyalgia Syndrome.
a = adopted from Joustra et al., 2017.
b = adopted from Bucher et al., 2019.
c = The cut-off of 64 participants per group was chosen based on the cut-off used in Bucher et al. (2019). Here it was argued that this cut-off would would result in 80 % power to detect a medium effect size with an alpha value set to 0.05.

Appendix E. PRISMA chart documenting results of the initial search process

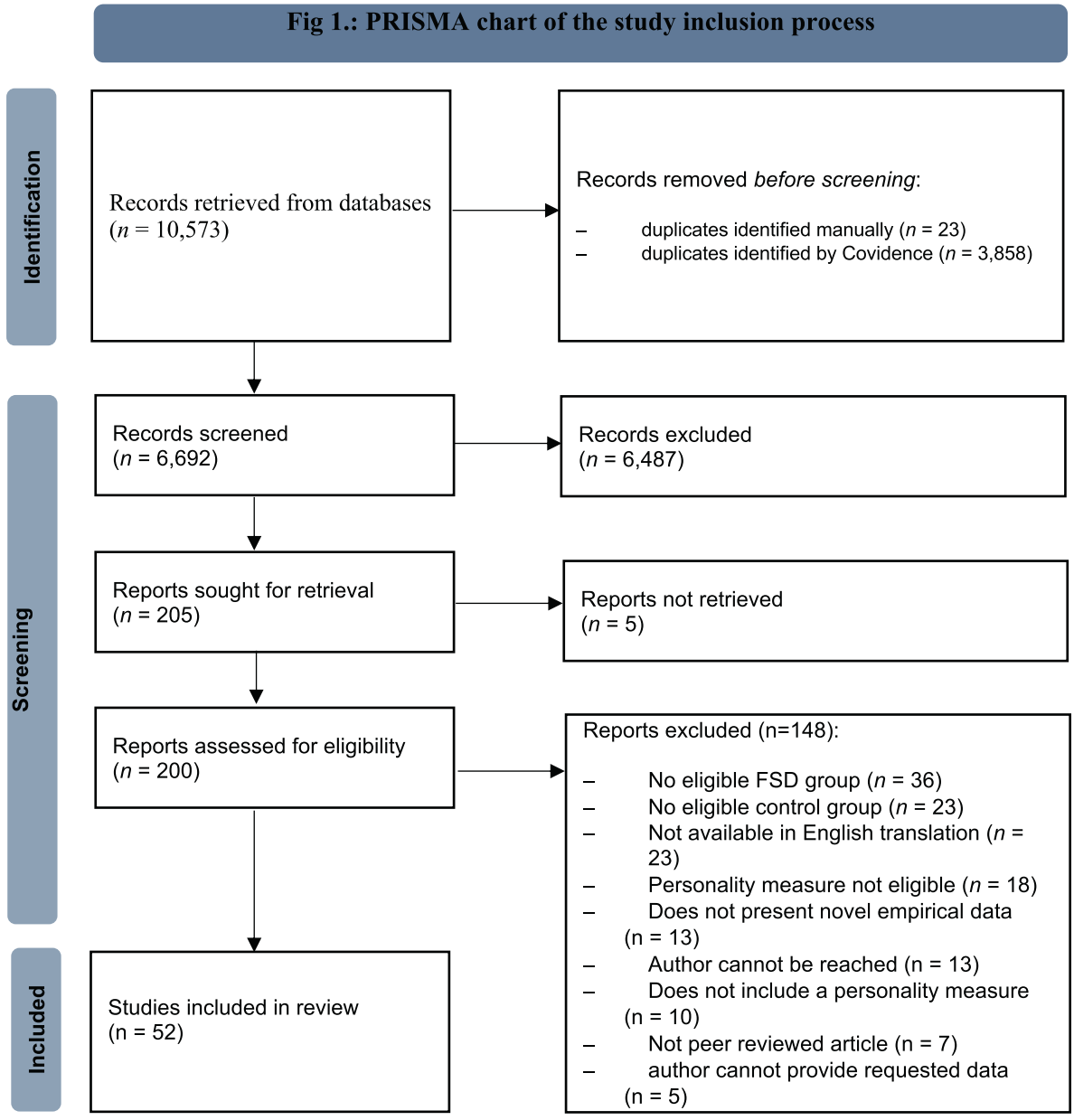

Fig. 1. PRISMA chart of the study inclusion process
Note: This PRISMA chart documents the results from the initial search in January 2024

Appendix F. Results from the Quality Assessment

Study ID	1: FSD assessment validity	2: Sampling of controls	3: In/ exclusion criteria	4: FSD characteristics	5: Sample size	6: Pers. measure number items	7: Validity of Personality measure	Quality score[a]	Total score[b]
Cao, Zhang, & Wang, 2005	2	1	1	0	0	0	2	2	6
Da Silva et al., 2017	2	1	0	0	2	2	2	4	9
Federman, Maltz Schwartz, & Amital, 2019	2	0	1	0	0	0	0	1	3
Montoro & del Paso, 2015	2	1	1	1	2	1	2	3	10
Datta et al., 2011	1	1	0	0	0	2	2	2	6
Chen, Blankstein, Diamant, & Davis, 2011	2	0	2	2	0	0	0	3	6
Zighelboim et al., 1995	2	1	1	1	0	0	2	2	7
Whitehead et al., 1990	2	0	1	0	0	0	2	2	5
Hariharan et al., 1993	2	2	1	0	0	0	2	3	7
Fiedler et al., 2000	0	2	1	0	0	0	0	1	3
Gwee et al., 1999	2	2	1	1	0	0	0	2	6

(continued on next page)

(*continued*)

Study ID	1: FSD assessment validity	2: Sampling of controls	3: In/ exclusion criteria	4: FSD characteristics	5: Sample size	6: Pers. measure number items	7: Validity of Personality measure	Quality score[a]	Total score[b]
Park et al., 2018	2	2	1	1	2	1	0	3	9
Gwee et al., 1996	1	2	1	0	0	0	0	1	4
Krupa et al., 2023	2	1	2	2	0	1	2	4	10
Yap et al., 2023	0	2	1	1	2	0	2	3	8
Li et al., 2016	1	0	1	0	0	0	0	0	2
Arun, Vyas, Rai, Kanwal, & Sushil, 1993	1	1	1	0	0	0	0	0	3
Hazlett-Stevens, Craske, Mayer, Chang, & Naliboff, 2003	0	2	0	0	0	2	0	2	4
Kingma, de Jonge, Ormel, & Rosmalen, 2013	0	2	1	0	2	2	2	4	9
Steinsvik, Valeur, Hausken, & Gilja, 2020	2	1	1	0	0	2	2	3	8
Davydov, Galvez-Sánchez, Montoro, de Guevara, & Reyes Del Paso, 2021	2	1	1	1	0	0	2	2	7
Nater et al., 2010	1	2	1	0	2	0	2	3	8
Farnam et al., 2007	2	1	1	0	2	0	0	2	6
Torres et al., 2013	2	2	1	2	2	2	2	6	13
Johnson et al., 1996	1	1	1	0	0	2	2	2	7
Buckley et al., 1999	1	1	2	2	0	1	2	3	9
Deary et al., 2010	2	1	0	2	0	2	0	3	7
Besharat et al., 2011	2	2	1	1	2	2	2	5	12
Blomhoff, Jacobsen, Spetalen, Dahm, & Malt, 2000	2	1	1	1	0	0	0	1	5
Malin et al., 2012a	0	0	0	1	0	1	2	1	4
Riccio, Thompson, Wilson, Morgan, & Lant, 1992	1	1	1	2	0	0	2	2	7
Tosic-Golubovic, Miljkovic, Nagorni, Lazarevic, & Nikolic, 2010	2	1	1	0	0	0	2	2	6
Boyce, Koloski, & Talley, 2000	0	2	0	1	2	0	2	3	7
Naliboff et al., 2008	1	2	2	0	0	0	2	3	7
Whitehead, Burnett, Cook 3rd, & Taub, 1996	0	2	0	0	2	0	2	3	6
Hollifield, Tuttle, Paine, & Kellner, 1999	0	2	0	0	0	2	2	3	6
Verne, Robinson, & Price, 2001	2	0	1	1	0	0	2	2	6
Petersen et al., 2023	0	2	0	0	2	2	2	4	8
Komasi et al., 2023	2	2	2	0	2	2	2	6	12
Zautra et al., 2005	0	2	0	1	0	1	2	2	6
Malt, Olafsson, Lund, & Ursin, 2002	2	1	0	1	0	0	0	1	4
Silva et al., 2022	2	1	2	1	0	2	0	3	8
Zhao et al., 2020	2	1	2	1	0	0	2	3	8
Whitehead, Crowell, Robinson, Heller, & Schuster, 1992	1	2	0	1	0	0	2	2	6
Tayama et al., 2012	0	2	0	1	2	2	0	3	7
Jones, Oudenhove, Koloski, Tack, & Talley, 2013	1	2	1	1	2	0	2	3	9
Tkalcić et al., 2010	2	2	1	1	0	0	2	3	8
Taillefer, Kirmayer, Robbins, & Lasry, 2003	2	1	0	1	0	2	2	3	8
Rey, Moreno Ortega, Garcia Alonso, & Diaz-Rubio, 2009	2	1	1	1	2	0	2	3	9
Bucourt et al., 2017	1	2	1	2	0	0	2	3	8
Poeschla, Strachan, Dansie, Buchwald, & Afari, 2013	0	2	2	0	2	2	2	5	10
Tkalcic, Domijan, Pletikosic, Setic, & Hauser, 2014	2	0	2	1	0	1	2	3	8

The table displays the scoring of each study on all items on the modified Newcastle-Ottawa scale. Full wording of the 8 questions:
(1) Has the FSD subtype of cases been reliably assessed and validated?
(2) Have all controls been recruited from the same population as the cases?
(3) Is the population defined with in- and exclusion criteria?
(4) Are disease characteristics presented duration and severity of CFS and FM)?
(5) Do the studies use appropriate sample sizes for each group?
(6) Does the personality measure(s) used afford sufficient coverage of the measured personality traits?

(7) Does the study use a validated personality measures?
Abbreviations: FSD, functional somatic disorder
Note:
a, The quality score represents a sum score which indicate the amount of items which has received 2 points on the NOS.
b, the total score represents a sum of the total score across all NOS items.

Appendix G. Subgroup analyses for healthy/unspecified and somatic controls

Healthy/unspecified controls									
Trait	Moderator	k	g	[95 % CI]	p	PI	Q (Df)	p	I^2
N	**Main effects[c]**	**46**	**0.72**	**[0.61: 0.83]**	**<0.01**	**[0.09: 1.35]**	**272.11 (45)**	**<0.01**	**83.46**
	FSD operationalization								
	CFS	8	0.7	[0.22: 1.18]	<0.01	[−0.99: 2.39]	84.76 (7)	<0.01	91.74
	FM	7	0.84	[0.59: 1.10]	<0.01	[0.04: 1.64]	18.88 (6)	<0.01	68.22
	IBS	22	0.67	[0.51: 0.82]	<0.01	[0.03: 1.30]	87.11 (21)	<0.01	75.89
	SzD	3	0.63	[0.16: 1.10]	0.01	[−4.95: 6.21]	11.97 (2)	<0.01	83.29
							1.44 (3)	0.7	
	Personality measure								
	Big Five	25	0.67	[0.51: 0.82]	<0.01	[−0.02: 1.36]	160.94 (24)	<0.01	85.09
	Eysenck	20	0.8	[0.61: 0.99]	<0.01	[0.00: 1.59]	101.029 (19)	<0.01	81.19
							1.08 (1)	0.3	
	FSD case definition								
	Clin. Int./medical as.	35	0.82	[0.68: 0.96]	<0.01	[0.11: 1.53]	145.00 (34)	<0.01	76.55
	Psychometric cut-off	9	0.53	[0.30: 0.75]	<0.01	[−0.27: 1.33]	108.58 (8)	<0.01	92.63
E	**Main Analysis[c]**	**31**	**−0.41**	**[−0.55: −0.28]**	**<0.01**	**[−1.10: 0.27]**	**169.33 (30)**	**<0.01**	**82.28**
	FSD operationalization								
	CFS	6	−0.62	[−0.92: −0.32]	<0.01	[−1.59: 0.35]	21.26 (5)	<0.01	76.49
	FM	7	−0.35	[−0.48: −0.21]	<0.01	a	4.12 (6)	0.66	0
	IBS	11	−0.14	[−0.26: −0.02]	0.02	[−0.45: 0.17]	17.82 (10)	0.06	43.9
	SzD	3	−0.21	[−0.46: 0.03]	0.09	[−2.64: 2.22]	3.63 (2)	0.16	44.92
							11.30 (3)	0.01	
	Personality measure								
	Big Five	18	−0.43	[−0.62: −0.24]	<0.01	[−1.21: 0.36]	106.85 (17)	<0.01	84.09
	Eysenck	12	−0.3	[−0.44: −0.16]	<0.01	[−0.65: 0.05]	18.016 (11)	0.08	38.94
							1.10 (1)	0.29	
	FSD case-definition								
	Clin. Int./medical as.	24	−0.46	[−0.64: −0.28]	<0.01	[−1.28: 0.36]	140.77 (23)	<0.01	83.66
	Psychometric cut-off	6	−0.29	[−0.46: −0.12]	<0.01	[−0.83: 0.25]	17.67 (5)	<0.01	71.7
							1.78 (1)	0.18	
O	**Main analysis[c]**	**14**	**−0.07**	**[−0.20: 0.06]**	**0.29**	**[−0.45: 0.32]**	**27.68 (13)**	**0.01**	**53.03**
	FSD operationalization								
	CFS	4	−0.04	[−0.22: 0.14]	0.64	a	0.94 (3)	0.81	0
	FM	4	0	[−0.27: 0.27]	1.00	[−1.00: 1.00]	5.59 (3)	0.13	46.34
	IBS	3	−0.07	[−0.40: 0.27]	0.69	[−4.07: 3.94]	10.14 (2)	0.01	80.29
							0.10 (2)	0.95	
	FSD case definition								
	Clin. Int./medical as.	11	−0.09	[−0.25: 0.07]	0.26	[−0.57: 0.39]	24.79 (10)	0.01	59.66
A	**Main effects[c]**	**15**	**−0.22**	**[−0.36: −0.09]**	**<0.01**	**[−0.69: 0.24]**	**42.92 (14)**	**<0.01**	**67.38**
	FSD operationalization								
	CFS	4	−0.3	[−0.60: 0.00]	0.05	[−1.45: 0.85]	6.78 (3)	0.08	55.76
	FM	4	0.04	[−0.14: 0.22]	0.69	a	2.08 (3)	0.56	0
	IBS	3	−0.21	[−0.63: 0.21]	0.33	[−5.39: 4.95]	15.89 (2)	<0.01	87.42
							4.06 (2)	0.13	
	Personality measure								
	Big Five	14	−0.28	[−0.36: −0.20]	<0.01	a	39.53 (13)	<0.01	67.12
	FSD case definition								
	Clin. Int./medical as.	12	−0.23	[−0.39: −0.07]	<0.01	[−0.74: 0.28]	35.96 (11)	<0.01	69.42
C	**Main effects[c]**	**15**	**−0.2**	**[−0.43: 0.03]**	**0.09**	**[−1.12: 0.72]**	**131.25 (14)**	**<0.01**	**89.33**
	FSD operationalization								
	CFS	4	−0.09	[−0.75: 0.57]	0.79	[−3.16: 2.98]	33.37 (3)	<0.01	91.01
	FM	4	−0.02	[−0.21: 0.16]	0.83	[−0.45: 0.41]	3.08 (3)	0.38	2.83
	IBS	3	−0.01	[−0.31: 0.29]	0.94	[−3.48: 3.46]	7.97 (2)	0.02	74.92
							0.04 (2)	0.98	
	Personality measure								
	Big Five	14	−0.12	[−0.20: −0.04]	<0.01	a	75.3 (13)	<0.01	82.74
	FSD case-definition								
	Clin. Int./medical as.	12	−0.27	[−0.34: −0.19]	<0.01	a	124.10 (11)	<0.01	91.14
Somatic controls									
Trait	Moderator	k	g	[95 % CI]	p	PI	Q (Df)	p	I^2
N	**Main analysis[c]**	**9**	**0.26**	**[0.08: 0.44]**	**<0.01**	**[−0.20: 0.72]**	**14.20 (8)**	**0.08**	**43.65**
	FSD operationalization								
	FM	4	0.31	[0.12: 0.50]	<0.01	[−0.036: 0.99]	4.94 (3)	0.18	39.36
	FSD case definition								
	Clin. Int./medical as.	8	0.23	[0.04: 0.43]	0.02	[−0.29: 0.75]	13.21 (7)	0.07	47.04
E	**Main analysis[c]**	**6**	**−0.17**	**[−0.45: 0.11]**	**0.23**	**[−1.06: 0.72]**	**19.12 (5)**	**<0.01**	**73.86**
	FSD operationalization								

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(*continued*)

Healthy/unspecified controls									
Trait	Moderator	k	g	[95 % CI]	p	PI	Q (Df)	p	I^2
	FM	4	−0.09	[−0.43: 0.25]	0.59	[−1.63: 1.44]	15.52 (3)	<0.01	80.67
	FSD case-definition								
	Clin. Int./medical as.	5	−0.1	[−0.38: 0.19]	0.51	[1.05: 0.86]	13.69 (4)	0.01	70.79
O	**Main analysis[c]**	**4**	**0.18**	**[−0.10: 0.46]**	**0.21**	**[−0.95: 1.31]**	**8.46 (3)**	**0.04**	**64.52**
	FSD operationalization								
	FM	3	0.22	[−0.10: 0.54]	0.18	[−3.53: 3.97]	7.93 (2)	0.02	74.79
A	**Main analysis[c]**	**4**	**0.43**	**[0.28: 0.59]**	**<0.01**	**a**	**2.11 (3)**	**0.55**	**0**
	FSD operationalization								
	FM	3	0.41	0.26: 0.57	<0.01	a	1.22 (2)	0.54	0
C	**Main analysis[c]**	**4**	**0.01**	**[−0.28: 0.30]**	**0.95**	**[−1.21: 1.23]**	**9.45 (3)**	**0.02**	**68.24**
	FSD operationalization								
	FM	3	0.15	[−0.01: 0.31]	0.06	a	1.18 (2)	0.55	0

This table displays all sub-group analyses which were conducted for both healthy/unspecified controls and somatic controls. In the final row of sub-group analyses with multiple levels, a Q-value with degrees of freedom and a significance value is reported which test whether there were statistically significant differences in effect sizes across the levels of the moderator variable. **Abbreviations**: N, Neuroticism; A, Agreeableness; C, Conscientiousness; E, extraversion; O, Openness; Clin. Int./medical as, Clinical interview/medical assessment; FM, Fibromyalgia; CFS, Chronic Fatigue Syndrome; IBS, Irritable Bowel Syndrome; SzD, Somatization Disorder; *k*, amount of studies; *g*, Hedge's *g*; CI, confidence interval; p, significance level reported as *p* value; PI, Prediction Interval; Q(Df), Q-statistic and degrees of freedom.
Note:
c. Results come from the main analyses conducted for each trait by control comparison. The data is identical to the ones found in Table 3.
a. The prediction interval could not be calculated because the variance within in this particular comparison was too low.

Appendix H. Egger's test for publication bias

Trait	*k*	*t*-test	p
Neuroticism	46	t(44) = 0.6	0.53
Agreeableness	15	t(13) = 3.01	<0.01
Conscientiousness	15	t(13) = 0.84	0.41
Extraversion	31	t(29) = 1.51	0.13
Openness	14	t(12) = 1.31	0.21

This table describes the results of all the Egger's tests which were conducted to assess for publication bias. All tests were conducted for comparisons which were based on healthy/unspecified controls as there weren't a sufficient amount of effect sizes to conduct Egger's test for psychiatric and somatic controls. **Abbreviations**: k, amount of studies; p, significance level expressed as p-value.

Appendix I. Sensitivity analyses for all traits

Healthy/unspecified Controls										
Trait	Sensitivity analysis	k	g	[95 % CI]	p	PI	Q (Df)	p	I^2	Excluded studies[b]
N	**Main effect[c]**	**46**	**0.72**	**[0.61: 0.83]**	**<0.01**	**[0.09: 1.35]**	**272.11 (45)**	**<0.01**	**83.46**	
	Coding of control group	45	0.72	[0.61: 0.84]	<0.01	[0.09: 1.36]	272.06 (44)	<0.01	83.82	Besharat et al. (2011)
	Ineligible FSD operationalization	45	0.71	[0.6: 0.81]	<0.01	[0.09: 1.32]	260.10 (44)	<0.01	83.08	Datta et al. (2011)
	Unclear reporting	43	0.74	[0.62: 0.85]	<0.01	[0.10: 1.37]	256.79 (42)	<0.01	83.64	Farnam et al. (2007); Johnson et al. (1996); Zighelboim et al. (1995)
E	**Main effect[c]**	**31**	**−0.41**	**[−0.55: −0.28]**	**<0.01**	**[−1.10: 0.27]**	**171.46 (30)**	**<0.01**	**82.5**	
	Coding of control group	30	−0.43	[−0.57: −0.29]	<0.01	[−1.12: 0.26]	168.46 (29)	<0.01	82.79	Besharat et al. (2011)
	Ineligible FSD operationalization	30	−0.38	[−0.51: −0.25]	<0.01	[−1.00: 0.24]	145.15 (29)	<0.01	80.02	Datta et al. (2011)
	Unclear reporting	29	−0.44	[−0.58: −0.30]	<0.01	[−1.11: 0.23]	148.58 (28)	<0.01	81.15	Farnam et al. (2007)
O	**Main effect[c]**	**14**	**−0.07**	**[−0.20: 0.06]**	**0.29**	**[−0.45: 0.32]**	**27.68 (13)**	**0.01**	**53.03**	
	Coding of control group	13	−0.06	[−0.20: 0.08]	0.39	[−0.48: 0.36]	27.64 (12)	0.01	56.58	Besharat et al. (2011)
	Ineligible FSD operationalization	13	−0.05	[−0.16: 0.06]	0.35	[−0.35: 0.24]	19.65 (12)	0.07	38.94	Datta et al. (2011)
A	**Main effect[c]**	**15**	**−0.22**	**[−0.36: −0.09]**	**<0.01**	**[−0.69: 0.24]**	**42.92 (14)**	**<0.01**	**67.38**	
	Coding of control group	14	−0.22	[−0.37: −0.08]	<0.01	[−0.71: 0.26]	42.31 (13)	<0.01	69.27	Besharat et al. (2011)
	Ineligible FSD operationalization	14	−0.22	[−0.36: −0.08]	<0.01	[−0.70: 0.26]	42.92 (13)	<0.01	69.71	Datta et al. (2011)

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(*continued*)

Healthy/unspecified Controls										
Trait	Sensitivity analysis	k	g	[95 % CI]	p	PI	Q (Df)	p	I^2	Excluded studies[b]
	Unclear reporting	14	−0.19	[−0.33: −0.05]	0.01	[−0.62: 0.24]	32.96 (13)	<0.01	60.56	Farnam et al. (2007)
C	**Main effects[c]**	**15**	**−0.2**	**[−0.43: 0.03]**	**0.09**	**[−1.12: 0.72]**	**131.25 (14)**	**<0.01**	**89.33**	
	Coding of control group	14	−0.25	[−0.47: 0.02]	0.03	[−1.13: 0.63]	111.28 (13)	<0.01	88.31	Besharat et al. (2011)
	Ineligible FSD operationalization	14	−0.14	[−0.37: 0.09]	0.22	[−1.04: 0.76]	122.05 (13)	<0.01	89.35	Datta et al. (2011)
	Unclear reporting	14	−0.23	[−0.45: −0.01]	0.04	[−1.08: 0.61]	91.37 (13)	<0.01	85.77	Farnam et al. (2007)
Somatic controls										
Trait	Moderator	k	g	[95 % CI]	p	PI	Q (Df)	p	I^2	Excluded studies[b]
N	**Main effect[c]**	**9**	**0.26**	**[0.08: 0.44]**	**<0.01**	**[−0.20: 0.72]**	**14.20 (8)**	**0.08**	**43.65**	
	Ineligible FSD operationalization	8	0.27	[0.08: 0.46]	0.01	[−0.25: 0.79]	13.86 (7)	0.05	49.5	Datta et al. (2011)
	Unclear reporting	8	0.29	[0.11: 0.46]	<0.01	[−0.17: 0.74]	12.18 (7)	0.09	42.54	Johnson et al. (1996)
E	**Main effect[c]**	**6**	**−0.17**	**[−0.45: 0.11]**	**0.23**	**[−1.06: 0.72]**	**19.12 (5)**	**<0.01**	**73.86**	
	Ineligible FSD operationalization	5	−0.11	[−0.39: 0.17]	0.44	[−1.10: 0.88]	15.92 (4)	<0.01	74.88	Datta et al. (2011)
O	**Main effect[c]**	**4**	**0.18**	**[−0.10: 0.46]**	**0.21**	**[−0.95: 1.31]**	**8.46 (3)**	**0.04**	**64.52**	
	Ineligible FSD operationalization	3	0.22	[−0.10: 0.54]	0.18	[−3.51: 3.97]	7.93 (2)	0.02	74.79	Datta et al. (2011)
A	**Main effect[c]**	**4**	**0.43**	**[0.28: 0.59]**	**<0.01**	**a**	**2.11 (3)**	**0.55**	**0**	
	Ineligible FSD operationalization	3	0.41	[0.26: 0.57]	<0.01	a	1.22 (2)	0.54	0	Datta et al. (2011)
C	**Main effect[c]**	**4**	**0.01**	**[−0.28: 0.30]**	**0.95**	**[−1.21: 1.23]**	**9.45 (3)**	**0.02**	**68.24**	
	Ineligible FSD operationalization	3	0.15	[−0.01: 0.31]	0.06	a	1.18 (2)	0.55	0	Datta et al. (2011)

This table displays results from all sensitivity analyses which were conducted. **Abbreviations**: N, Neuroticism; A, Agreeableness; C, Conscientiousness; E, Extraversion; O, Openness; FSD, Functional Somatic Disorder; *k*, amount of effect sizes; *g*, Hedge's *g*; CI, confidence interval; p, significance level reported as *p* value; PI, Prediction Interval; Q(Df), Q-statistic and degrees of freedom.

Notes

a, The prediction interval could not be calculated because the variance within in this particular comparison was too low.

b, Several sensitivity analyses were not possible to conduct as the studies specified for exclusion in a given comparison did not provide effect sizes for that comparison. Sensitivity analyses were conducted across all available effect sizes.

c, Results come from the main analyses conducted for each trait by control comparison. The data is identical to those in Table 3.

Data availability

All data are available upon reasonable request and can be obtained via written contact with the corresponding author Thomas Tandrup Lamm (THLAMM@rm.dk).

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