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REVIEW PAPER

The Prevalence and Correlates of Self-restraint in Individuals with Autism and/or Intellectual Disability: a Systematic Review and Meta-analysis

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Abstract

Purpose Self-restraint, purposeful restriction of one's own bodily movements is observed in individuals with neurodevelopmental conditions. Case studies and cross-sectional investigations have reported that self-restraint co-occurs with self-injurious behaviour; however, small sample sizes limit understanding of prevalence and function. We aimed to synthesise the existing literature and estimate the pooled prevalence of self-restraint in autistic individuals and/or individuals with intellectual disability, and the pooled effect size with self-injury.

Methods Six databases were systematically searched in accordance with PRISMA guidelines.

Results A total of 21,567 papers were retrieved, with 15 samples from 13 records included in the analyses. The pooled prevalence estimate of self-restraint in individuals with autism and/or intellectual disability was 39%, 95% CI [26.25, 51.59]. Age and presence of autism significantly increased prevalence rates. Pooled prevalence estimates were consistent across gender, presence of intellectual disability, and type of measurement of self-restraint. Meta-analyses of 31 topographies of self-restraint revealed 'holds or squeezes objects' and 'holding onto others, holding onto others' clothing' were the most prevalent behaviours amongst those who self-restrained (both 32%). The least prevalent behaviour was 'chooses mechanical restraint' (1%). Pooled prevalence estimates of self-restraint in individuals known to self-injure were 34%, 95% CI [21.36, 46.97], and 13%, 95% CI [5.01, 21.43], in individuals who did not self-injure. Self-restraint and self-injurious behaviour were positively correlated, $r = 0.21$, 95% CI [0.14, 0.27], $K = 13$.

Conclusions Findings highlight that on average, over one third of individuals with autism and/or intellectual disability show self-restraint. Clinical and theoretical implications of findings are discussed.

Keywords Autism · Intellectual disability · Self-restraint · Self-injurious behaviour · Meta-analysis

Self-restraint behaviours are behaviours initiated by an individual to restrict or inhibit their own movement and are most commonly seen in individuals with neurodevelopmental conditions, specifically autism and/or intellectual disability (ID). Isley et al. (1991) identified three broad categories of self-restraint: restriction of body movements using clothing or material, such as entwining hands inside one's shirt (Hardy et al., 1984); use of one's own body to limit movement, for example sitting on one's hands (Ball et al., 1975); and holding or squeezing nearby objects, such as clinging to furniture (Callias, et al., 1973). Oliver et al. (2003) identified a fourth category describing a preference for imposed restraint, for example, gesturing for or requesting physical restraint of the body (May et al., 1981) or hands (Ball et al., 1975), or indicating a preference for imposed mechanical restraint devices (Saposnek & Watson, 1974) such as arm splints (Foxx & Dufrense, 1984) or helmets (Muttar, 1975). While the implementation of restraint by other people may not appear to be *self*-restraint, the distinction from reactive involuntary restraint is that the individual presents a desire to restrict movement, possibly through verbalisations, actions, or serious distress upon restraint removal (Oliver et al., 1998). The overarching aim of this study is to synthesise the existing evidence describing self-restraint in autism and

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ID and identify the overall prevalence of self-restraint and its topographies.

Purposeful self-restrictive practices are relatively common within the general population. For example, it is not unusual to employ techniques such as sitting on hands or crossing arms to prevent fidgeting (Sturmey, 2015). However, self-restraint has been more commonly observed in individuals with neurodevelopmental conditions than in neurotypical peers, with high rates of self-restraint shown in autistic individuals and/or those with ID (Richards et al., 2017; Smith et al., 1992). The increased likelihood of self-restraint in these populations may be linked to the elevated prevalence of self-injurious behaviour (SIB) also observed within such groups (Adamek et al., 2011). SIB refers to pervasive behaviours that are initiated by and towards an individual, causing physical change or damage (e.g. biting, scratching, and head hitting). Despite heterogeneity in diagnoses, autism and ID are both commonly associated with SIB. Autism is a life-long neurodevelopmental condition characterised by difficulties with social interaction and communication, and restrictive or repetitive behaviours/interests (American Psychiatric Association [APA], 2013). Autism commonly co-occurs with ID (Cervantes & Matson, 2015), which is classified as having an intellectual quotient (IQ) score below 70 and impairments in adaptive daily functioning activities (APA, 2013). Estimates suggest that up to 50% of autistic individuals self-injure, while prevalence rates in individuals with idiopathic ID are approximately 12% (Oliver et al., 1987; Steenfeldt-Kristensen et al., 2020). Vulnerability to SIB increases when an individual has a co-occurring diagnosis of autism and ID (Matson & Rivet, 2008). Self-restraint is hypothesised to be a functional response that emerges in order to inhibit self-injury (Schroeder & Luiselli, 1992), suggesting that populations with autism, ID, and co-occurring autism and ID represent high-risk groups in which the prevalence of self-restraint and co-occurrence of self-restraint and SIB should be evaluated.

The Prevalence of Self-restraint

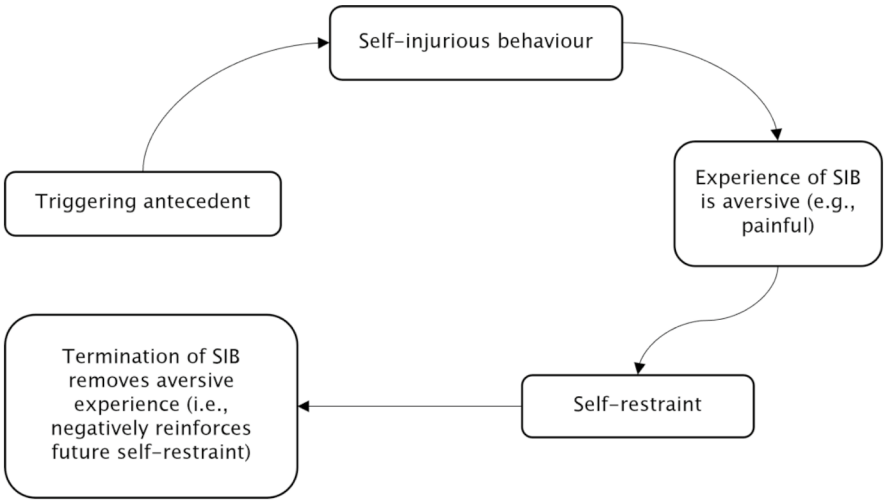
It is important to delineate the overall prevalence of self-restraint and identify those most at-risk because self-restraint has been associated with a range of deleterious consequences. Extreme and prolonged restraint can render individuals immobile (Isley et al., 1991) posing serious risks to physical health, including halted motor development and muscular atrophy (Smith et al., 1992). Chronic self-restraint can also impact socialisation and reduce opportunities to engage in independent functional skills (Scheithauer et al., 2015), with downstream effects on overall wellbeing. To consider theoretical implications derived from operant theory, self-restraint may be negatively reinforced by the termination of pain caused by SIB (Fig. 1a). This theory postulates an inverse association between self-restraint and SIB, where low rates of SIB are related to high rates of self-restraint. Conversely, when self-restraint becomes unavailable, SIB occurs as a 'side effect' until self-restraint is re-introduced (Isley et al., 1991, p. 90). Alternatively, self-restraint may maintain and increase SIB through positive reinforcement (Fig. 1b). Opportunities to self-restrain may provide internal reinforcement via sensory feedback or external reinforcement via environmental consequences that positively reinforce the self-injury elicited in order to access self-restraint (Favell et al., 1978). Through such mechanisms of operant learning, self-restraint can take on powerful stimulus control, and in extreme cases, self-restraint can become the dominant behavioural response (Baroff & Tate, 1968; Pace et al., 1986; Rojahn et al., 1978) with individuals seeking a state of restraint for up to 24 hours a day (O'Reilly et al., 2003). Altogether, the negative consequences of SIB and contingent self-restraint can present serious threats to wellbeing and quality of life. Despite clear consequences of severe self-restraint, there is limited understanding of its prevalence in the most vulnerable groups. Therefore, the first aim of this study is to address this gap in understanding by pooling together extant data to estimate the prevalence of self-restraint.

The majority of studies exploring self-restraint have described prevalence estimates within populations with ID. Fovel et al. (1989) reported 2.5 to 2.9% of attendees at a school for ID showed self-restraint, while 4 out of 21 individuals with ID (19%) demonstrated a preference for restraint (Favell et al., 1981). Research in Cornelia de Lange syndrome (CdLS), a rare genetic syndrome associated with ID, identified a prevalence of 53.4% (Hyman et al., 2002), while Oliver et al. (2003) reported that 76.1% of a sample with ID showed self-restraint. A recent study, however, suggested that self-restraint is not unique to ID, reporting that 40.9% of autistic children and 42.6% of autistic adults showed self-restraint behaviours (Richards et al., 2017), while Laverty et al. (2020) found 43% of autistic individuals self-restrained. This presents a need to look beyond ID populations and explore prevalence of self-restraint across heterogeneous samples with and without autism. Prevalence statistics from individual studies provide useful information about expected occurrence of self-restraint. However, statistical synthesis of all existing prevalence data would provide clearer, more representative estimates of real-world occurrence. These data would lay the groundwork for future large-scale research aiming to understand the function of self-restraint in clinically vulnerable groups and approaches to prevention and intervention.

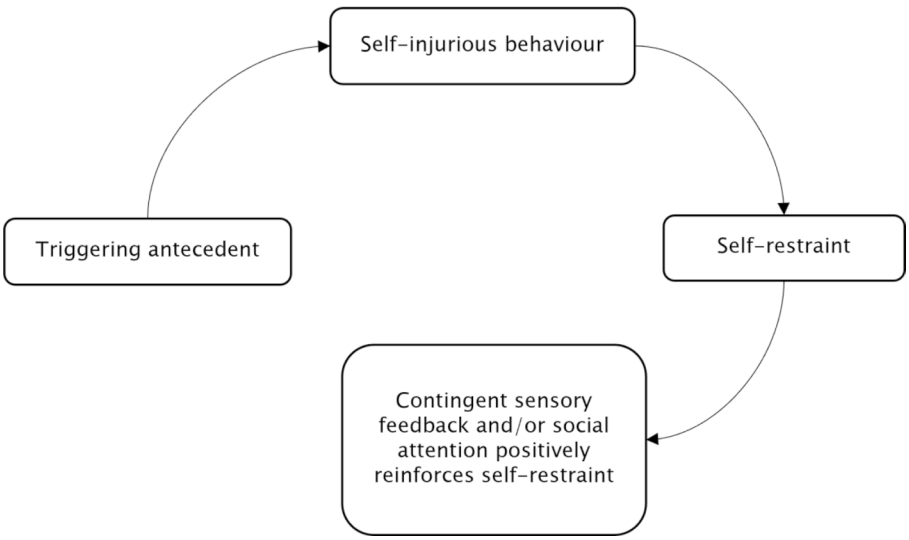
Existing prevalence data suggest self-restraint occurs in 2.5 to 76.1% of vulnerable groups. This wide variation in estimates likely results from three main methodological

Fig. 1 Hypotheses of **a** negative and **b** positive reinforcement (as described by Isley et al., 1991)

a. Hypothesis of negative reinforcement (as described by Isley et al., 1991)



b. Hypothesis of positive reinforcement (as described by Isley et al., 1991)



sources. First, self-restraint is a challenge to conceptualise, with researchers employing differing definitions and parameters. For example, Rojahn (1986) referred to stereotypic 'self-restraint of the arms in own clothing (non-rhythmical)' (p. 269), while Oliver et al. (2003) defined self-restraint according to 23 distinct topographies. Second, the measurement format may under- or over-estimate self-restraint. Questionnaires, such as the Self-Restraint Questionnaire (SRQ; Oliver et al., 2003), rely on informant interpretation of behavioural presentations over self-defined units of time (i.e. 'some', 'half', 'most' or 'all of the time'), whereas observational studies define a timeframe within which self-restraint may occur (e.g. within 16.5 hours; Forman et al., 2002). Finally, differences in study (e.g. sample size) and participant characteristics (e.g. age, gender, diagnosis) can impact estimates. For example, Rojahn (1986) found a prevalence rate of 12% across 25,000 non-institutionalised individuals with ID, while Powell et al. (1996) studied a sample of 99 institutionalised adults with severe and profound ID and identified that 46% showed self-restraint. Overall, the prevalence of self-restraint remains contested due to these limiting factors. Therefore, the current study also aims to examine whether participant characteristics, such as age, gender, presence of ID and presence of autism, and methodological characteristics, such as self-restraint measurement, influence the pooled prevalence estimate for self-restraint.

Prevalence of Self-restraint Topographies

Existing studies present mixed findings about the most common forms of self-restraint. Richards et al. (2017) and Hyman et al. (2002) both identified the most prevalent form of self-restraint to be 'holding onto others and holding objects' (24% and 43% of respective samples), while Powell et al. (1996) found participants were most likely to 'hold or squeeze objects' (50%). Oliver et al. (2003) reported use of materials to be common behaviours, such as 'wrapping hands into material' and 'pulling sleeves over hands' (both 57%); however, the most prevalent topography was 'sitting on hands' (64%). Across these samples, 'choosing mechanical restraint' was consistently the least common topography (0%, Hyman et al., 2002; 8%, Powell et al., 1996; 0%, Richards et al., 2017). However, Oliver et al. (2003) indicated that participants in their sample had a high preference for imposed physical restraint (50% 'asked for hands to be held' and 43% 'asked for arms to be held'). Individual cohort studies are useful for describing self-restraint. However, estimating topographical prevalence over multiple samples provides more representative patterns of behaviour. Research has yet to synthesise these data; therefore, the second aim of the current study is to identify the most and least common forms of self-restraint.

Correlates of Self-restraint

The functions of self-restraint are widely debated within the literature. Research testing the negative reinforcement account, whereby self-restraint functions to control aversive self-injury, has identified an association between self-restraint and SIB (Hyman et al., 2002), such that the presence of SIB predicts the presence of self-restraint (Richards et al., 2017). This research builds on earlier experimental evidence showing a significant decrease in self-restraint when SIB occurs (Forman et al., 2002; Kerth et al., 2009; Rojahn et al., 1978; Smith et al., 1992), and a decrease in self-restraint following SIB intervention (Silverman et al., 1984). Prevalence data also point to an association, with estimates of individuals showing both self-restraint and SIB ranging from 7 to 92% (Iwata et al., 1994; Oliver et al., 2003). Wide variation in these estimates can be attributed to distinctions in how self-restraint is conceptualised and measured as well as participant and study characteristics, and make it difficult to extrapolate a true prevalence estimate of concomitance. Furthermore, alternative theories suggest that SIB and self-restraint function to elicit similar (Pace et al., 1986) or distinct environmental or sensory rewards (Peterson & Peterson, 1968). Such ideas challenge existing theoretical accounts by raising the possibility that, for some individuals, self-restraint is unrelated to SIB. Supporting data has reported that self-restraint occurs in the absence of self-injury within a group of autistic children (27%), autistic adults (28%), and individuals with ID (13%; Hyman et al., 2002; Richards et al., 2017). These contradictory data suggest a need to identify robust individual pooled estimates for the prevalence of self-restraint in both the presence and absence of self-injury.

Cohort studies have repeatedly demonstrated a strong statistical correlation between the presence of SIB and self-restraint (e.g. Hyman et al., 2002). This association appears unequivocal, with research suggesting that self-restraint co-occurs more frequently with SIB than other behaviours that may challenge including aggression and destruction of property (Fisher & Iwata, 1996; Isley et al., 1991). Re-analysis of previous research findings for the present study indicated self-restraint and self-injury consistently share a positive linear relationship. However, the range of correlations vary from smaller effect sizes, such as Pearson's $r = 0.01$ (Rojahn, 1986), to stronger correlations, such as $r = 0.47$ (Oliver et al., 2003). To further quantify this relationship, the final aim of this study is to estimate the overall strength of association between self-injury and self-restraint.

Identification of other behaviours correlated with self-restraint may help to establish the functions and mechanisms associated with self-restraint. For example, qualitative data suggest that amongst autistic adults without ID self-restraint can be employed to prevent negative restrictive/repetitive behaviours (Collis et al., 2022). Additionally, King (1993) theorised that self-restraint was related to compulsivity, suggesting that involuntary self-injury produced compensatory self-restraint behaviours, while Richards et al. (2017) reported that impulsivity/overactivity predicted self-restraint twofold. Finally, Rojahn (1986) suggested self-restraint was stereotypic in nature, with stereotypies described to be repetitive movements unrelated to achieving goals. To evaluate these functional accounts, the final aim of the study is to identify overall effect sizes correlating self-restraint with other behaviours reported to occur in autistic individuals and/or those with ID.

Summary of Aims

To summarise, existing literature suggests a substantial proportion of autistic individuals and/or individuals with ID self-injure and self-restrain; however, prevalence figures of self-restraint are limited by small and non-diverse cohort samples. Both SIB and self-restraint are considered challenging due to the associated negative impacts on physical and emotional wellbeing; however, current understanding of the functional relationship between these behaviours is

Table 1 Eligibility criteria for screening records

Inclusion criteria	Exclusion criteria
Study reported on self-restraint	Study did not report on self-restraint
Participants had an ID, and/or diagnosis of autism, and/or an identified genetic syndrome associated with ID and/or autism (e.g. Fragile X, Tuberous Sclerosis Complex)	Participants were not autistic, did not have an ID, or did not have an associated genetic syndrome
Study yielded quantitative empirical data	Study reported qualitative data only
Paper reported in English, or an English translation was available	No English language translation was available
Cross-sectional or longitudinal study design	Case study or case series
Peer-reviewed published articles or unpublished empirical articles, theses, or dissertations	Reviews, opinion pieces, non-empirical studies
Prevalence data for self-restraint were reported or obtained [a]	Study reported on self-restraint, but prevalence data were unreported, uninterpretable or unavailable [a]

[a]Additional criterion adopted at full text screening

complicated by conflicting hypotheses and empirical evidence. Inconsistent definitions and a broad array of topographies complicate identification and understanding of self-restraint, meaning its clinical presentation is not well described. In order to identify and support those most at-risk of engaging in maladaptive self-restraint, relevant literature must be synthesised and meta-analysed.

The current study has three aims. The first aim is to calculate the pooled prevalence of self-restraint amongst people with autism and/or ID. Effects of study and participant characteristics on these pooled estimates will be explored. The second aim is to calculate pooled prevalence estimates for each topography of self-restraint. The third and final aim is to explore the relationship between self-restraint and putative correlates, including SIB, restrictive/repetitive behaviours, compulsivity, impulsivity/overactivity, and stereotypy.

Methods

Search Strategy

This study was preregistered on PROSPERO (available at https://tinyurl.com/self-restraint-meta) and was performed and reported in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). Systematic searching of electronic bibliographic databases aimed to identify both published and unpublished papers (i.e. theses, preprints, and conference abstracts). Search terms were generated through inspection of previous meta-analyses of self-injury (McClintock et al., 2003; Steenfeldt-Kristensen et al., 2020) and examination of relevant literature. All databases were systematically searched from their earliest available record to the date of the search (February 08, 2021). The full search strategy employed, including exact search terms, truncations, and Boolean operators, is outlined in Table S1 in Supplementary Materials. Beyond exclusion criteria outlined in Table 1, no further search restrictions were set on participant characteristics, such as sample age, gender, or ethnicity (Table 1).

As described above, the self-restraint literature is characterised by inconsistency in terminology and definitions (Forman, 2003). Three strategies were applied to ensure inclusion of all relevant papers through additional backward citation searches. First, reference lists were hand-searched to identify relevant papers not retrieved by database searching. References of both excluded papers, including reviews and qualitative studies, and eligible papers were searched. Any titles deemed relevant were subsequently screened at full text. Second, published titles of authors known to study self-restraint and SIB were searched within PubMed on April 16, 2021. Third, abstracts from major academic ID conferences Seattle Club (available digitally from 2001 to 2018) and Gatlinburg (2021 available only) were hand-searched via respective website browsers on April 20, 2021.

Selection Strategy

Once papers had been identified, they were screened for eligibility (Table 1) using a standardised screening tool. First, titles were reviewed and ineligible papers excluded. Second, abstract and method sections of papers deemed relevant were reviewed for inclusion. If during these first two steps eligibility could not be deduced, the full text was examined. The final step of screening involved assessment of full texts of papers not yet excluded.

Data Collection

Once eligible papers were identified, data were extracted. We extracted participant demographics, study characteristics,

measure and prevalence of self-restraint and its topographies, prevalence of self-restraint in the presence and absence of self-injury, effect sizes of the association between SIB and self-restraint, and effect sizes between self-restraint other associated behaviours (i.e. restrictive/repetitive behaviours, compulsivity, impulsivity/overactivity, and stereotypy). Papers were also screened to identify whether participants were known to self-injure (i.e. if the presence of SIB was included within the study's inclusion criteria). At this stage of study selection, we attempted to contact authors to obtain further relevant data via email, social media, and in-person conversations. Further data were obtained for six samples (see Table S2, Supplementary Materials). In most cases, additional data sources provided information about the sample reported in the publication, such as the prevalence of self-restraint, the frequency of self-restraint topographies, and participant demographic information. However, in the case of Oliver et al. (2003), the additional data source (the author's unpublished PhD thesis; Oliver, 1991) employed different inclusion criteria, and yielded a larger group size than the corresponding journal article. Where data have been extracted from this additional source (i.e. describing some demographic information, and analysing the self-injury and self-restraint correlation statistic), it has been noted in the analysis.

The first author undertook data screening and extraction. To evaluate inter-rater reliability, the second author evaluated 25% (k[1] = 73) of the 292 journal articles screened at full text. Papers included in the inter-rater reliability analysis were identified by assigning each reference with a numerical value and generating 73 numbers at random. Initially, there was moderate agreement between reviewers, κ[2] = 0.65. Following further discussion and clarification of eligibility criteria, disagreements were resolved resulting in perfect agreement, $\kappa = 1.00$. The second author then extracted prevalence data, including the prevalence of self-restraint and its topographies, for 100% ($k = 15$) of the final sample, $\kappa = 1.00$.

Quality Review

We created a quality assessment framework (QAF) to capture information about potential threats to validity (Table 2). Based on previous meta-analyses (Mingins et al., 2020; Richards et al., 2015; Surtees et al., 2018), the QAF was designed to rate each individual study included within the final sample for bias. Studies were scored across four domains as required: sample identification, autism measurement, ID measurement, and self-restraint measurement. Not all domains were applicable to each paper. For example, a study that recruited individuals with ID only (i.e. without co-occurring autism) did not require an autism measure rating. Thus, mean quality ratings were calculated by summing individual scores and dividing by the maximum possible score (i.e. 9 or 12). Across samples, the maximum possible mean rating was 1, and scores ranged from 0.22 to 0.67. Two coders independently rated all (100%, $k = 15$) of the eligible samples to estimate reliability of the QAF. A high degree of reliability was identified across both authors, with an average intraclass correlation coefficient of 0.883, 95% confidence interval ranging from 0.798 to 0.933, $F(52) = 8.832$, $p < 0.001$. Disagreements in ratings were resolved during consensus meetings, and amendments to the QAF resulting from reliability discussions can be found in Table S3, Supplementary Material. Justification for each quality rating given by the first author can be found in Table S4, Supplementary Material.

Data Synthesis

Raw summary statistics were extracted and entered into Excel and SPSS (IBM; v 27.0.1.0). Where possible, relevant but unreported data were obtained through contacting study authors, and/or conducting backwards calculations. For example, in order to meta-analyse correlates of self-restraint, all reported effect sizes were converted to Pearson's r (Borenstein et al., 2021). Estimates were then converted to Fisher's Zr to minimise the sampling distribution of Pearson's r and identify a less skewed and biased statistic (Corey et al., 1998; Lenhard & Lenhard, 2014). Where authors had not conducted analyses of the association but had reported prevalence figures for both self-restraint and the associated behaviour (e.g. self-injury), data were re-analysed to generate Fisher's Zr.

Meta-analyses were conducted in R (v 1.3.1093; R Core Team, 2021), and weighted prevalence values were generated using the inverse-variance method. Random effects models were adopted due to observation of high heterogeneity according to the Higgins I^2 statistic (i.e. I^2 figures over 30%; Higgins et al., 2011). Since the distribution of prevalence estimates were non-normal, a restricted maximum likelihood estimator was used to calculate between-study variance. This estimator is considered more robust than traditional DerSimonian-Laird estimates when used with non-normal distributions due to its restriction of likelihood estimates in order to control for underestimation (Cheung, 2013). Sensitivity analyses were then performed to identify studies bearing disproportionately high influence on the overall meta-analytic effect. These included visual inspection of Baujat scatter charts, and 'leave-one-out' omitting analyses whereby the weighted prevalence was re-calculated following removal of each study in turn (Baujat et al., 2002). An additional quality rated analysis

[1] k refers to the number of samples.

[2] κ references Cohen's kappa.

Table 2 Quality assessment framework

	Quality rating			
	Poor (0)	Fair (1)	Good (2)	Excellent (3)
A. Sample identification of an autistic and/or sample with intellectual disability	Unspecified	Single restricted or non-random sample (e.g., a specialist clinic or previous research study). Single regional sample (e.g., a regional parent support group).	Multiple (i.e., two or more) restricted or non-random samples (e.g., multi-region specialist clinics, multiple schools). National non-random sampling (e.g., national parent support group).	Random or total population sample (e.g., national/clinical/birth registry).
B. Measurement of autism Reliability/validity of measurement of autism	Unspecified	Recruitment from specialist school, service or similar (not confirmed in this study). Score above threshold on screening instrument (e.g., 15 on SCQ*). Clinician judgement against specified diagnostic criteria (e.g., DSM-V or ICD-10). Diagnosis of autism obtained from official records.	One diagnostic measure of autism (e.g., ADOS, ADI-R). Previous diagnosis of autism by multidisciplinary team using multiple assessment methods unconfirmed but specified in the present study.	Consensus from multiple assessments, including at least one diagnostic instrument, confirmed in this study (not in previous study or as part of assessment through clinic).

was also conducted, adjusting study weights according to overall quality ratings as determined by the QAF.

Individual meta-analyses were conducted to identify the prevalence of self-restraint across all samples, the prevalence of self-restraint in individuals known to self-injure and the prevalence of self-restraint in individuals known to *not* self-injure. The prevalence of 31 topographies of self-restraint was also extracted and meta-analysed.

We examined the influence of participant characteristics on prevalence rates using meta-regression. The influence of age, gender, presence of ID, and presence of autism was explored. Characteristics were explored where eight or more studies had reported data, including age ($k = 9$) and presence of autism ($k = 8$). While falling below the commonly-cited rule of ten studies per analysis (Higgins et al., 2011), such analyses were conducted in order to retain data and identify characteristics that may influence prevalence estimates. Results evaluating the influence of age and presence of autism on the prevalence of self-restraint should therefore be considered with caution. Due to insufficient data (i.e. data from fewer than eight studies), the effect of frequency of autism characteristics, severity of ID, and presence of various health characteristics or conditions on the prevalence of self-restraint could not be evaluated. Subgroup analyses

Table 2 (continued)

	Quality rating			
	Poor (0)	Fair (1)	Good (2)	Excellent (3)
C. Measurement of ID Reliability/validity of ID measure	Unspecified	Recruited from specialist ID school, service or similar (not confirmed in this study). Diagnosis of ID obtained from official records. Diagnosis of ID included in study eligibility criteria. Syndrome group known to be associated with ID (e.g., CdLS).	Self/parent/teacher informant report using a well-validated measure of adaptive functioning (e.g., The Wessex Scales).	Formal IQ test administered by researcher or clinician (e.g., Wechsler Intelligence Scale for Children, Mullen Scales of Early Learning, Stanford-Binet) *and/or* Formal measure of adaptive functioning administered by researcher or clinician (e.g., Vineland Adaptive Behaviour Scales).
D. Measure of self-restraint	Unspecified (e.g., "a survey").	Clinical case records. Observational measure with unreported interrater reliability.	Self/parent/teacher report using a validated measure (e.g., SRC, SRQ) *or* Observational measure reporting at least substantial ($\kappa \geq 0.70$) inter-rater reliability, conducted in this study.	Self/parent/teacher report using a validated measure (e.g., SRC, SRQ). *and* Observational measure reporting at least substantial ($\kappa \geq 0.70$) inter-rater reliability, conducted in this study.

SCQ: Social Communication Questionnaire (Rutter *et al.*, 2003); DSM-V: Diagnostic and Statistical Manual of Mental Disorders, fifth edition: ICD-10: International Classification of Disease, tenth edition; ADOS: Autism Diagnostic Observation Schedule; ADI-R: The Autism Diagnostic Interview-Revised.

CdLS: Cornelia de Lange syndrome; κ: Cohen's kappa; SRC: Self-Restraint Checklist (Powell *et al*., 1996); SRQ: Self-Restraint Questionnaire (Oliver *et al*., 2003); IQ: Intelligence Quotient.

*According to recommended cut off (Berument *et al.,* 1999).

were conducted to identify the influence of study characteristics (i.e. how self-restraint was measured) on the prevalence rates.

Meta-analyses of effect sizes of putative correlates were conducted when two or more papers reported data. An a priori power analysis using G*Power (v 3.1.9.7; Faul et al., 2009) identified a pooled sample size of 614 individuals was required to detect a small effect size ($r = 0.10$) with an alpha of 0.05 and power of 0.80.

Results

Study Selection

Initial database searches yielded a response of 19,191 papers (Fig. 2). A further 2376 studies were identified through other sources: review of author publications, reference list searching, hand searching conference abstracts, and unpublished dissertations. After duplicates were removed ($k = 4500$), the remaining 17,067 papers were reviewed at different stages: 14,691 database papers were reviewed at title stage only, 3868 papers underwent title and abstract review ($k = 1625$ database, $k = 1706$ author publications, $k = 537$ conference abstracts), and 292 papers were reviewed at full text ($k = 159$ database, $k = 129$ citation searching, $k = 4$ dissertations). In total, 17,054 papers were excluded ($k = 13{,}066$ at title review, $k = 3708$ at title and abstract review, $k = 280$ at full text). This left a total of 13 eligible papers, of which two reported more than one sample. Thus, data were extracted from a total of 15 samples. Reasons for article exclusions can be found in Fig. 2.

During full text screening, four studies (Breau et al., 2003; Nagy et al., 2019; Schroeder et al., 1982; Shapira et al., 2004) that met initial criteria for inclusion were excluded due to insufficient or uninterpretable prevalence data (Table 1). Authors were contacted in attempt to obtain these data prior to exclusion.

Study Characteristics

In total, 2309 participants ($M = 154$, median = 67, range = 18 – 686) were identified across 13 studies conducted between 1981 and 2020. Records included published journal articles ($k = 14$) and two unpublished doctoral theses (Forman, 2003; Oliver, 1991). Studies were conducted in the UK ($k = 7$), the USA ($k = 7$), and Germany ($k = 1$). Further study and participant characteristics alongside outcome prevalence data can be found in Table 3. A visual matrix of quality ratings is also provided, colour-coded to represent scores; red items reflect scores of 0 (poor), orange scores of 1 (fair), yellow scores of 2 (good), green scores of 3 (excellent), and white items represent non-applicable domains.

Participant ages ranged from 1 to 72 years. Gender information was provided for 1541 participants (66.78% of the total sample), of whom 62.36% were male ($n = 961$). Six samples included individuals with ID only ($n = 852$ with severity of ID known), three samples included individuals who were autistic only (or had a similar diagnosis, see Table S5, Supplementary Materials; $n = 491$) and five samples included participants with autism and/or ID ($n = 197$ participants). Furthermore, one study included a group with CdLS ($n = 88$), a rare genetic syndrome associated with ID (Oliver et al., 2008). A total of 11 genetic syndromes were identified within 124 individuals across six samples. A full list of the syndromes identified across studies can be found in Table S6, Supplementary Materials.

The most common assessment of self-restraint was the Self-Restraint Checklist (SRC; Powell et al., 1996) survey, used across five samples. Four studies employed observational methods. The remaining studies used a variety of survey instruments, as outlined in Table 3.

Prevalence of Self-restraint

The inverse-variance weighted pooled prevalence estimate indicated that self-restraint occurred in 39%, $z = 6.02$, $p < 0.0001$, 95% CI [26.25, 51.59], of participants with autism and/or ID (Fig. 3). Heterogeneity between the prevalence rates was high, $\text{tau}^2 = 0.059$, Higgin's $I^2 = 99\%$, $Q(14) = 924.42$, $p < 0.0001$, suggesting high variability between studies. When effects were weighted by quality ratings, the pooled prevalence estimate remained largely unchanged, 40%, $z = 5.99$, $p < 0.0001$, 95% CI [27.05, 53.35] (Figure S1, Supplementary Materials). Analyses exploring study heterogeneity and influence on the pooled prevalence estimates were conducted (see Figure S2). Results indicated no studies were bearing disproportionate influence, and thus no studies were subsequently removed from the prevalence analyses.

Influence of Participant Characteristics on Prevalence Rates

The data allowed for exploration of the influence of several participant characteristics on the prevalence rates of self-restraint, including age, gender, and presence of ID and autism (Table 4). Mean ages were extracted from nine (60%) studies, and the percentage of male participants was extracted from 14 (93%) studies. The percentage of participants reported to have ID was extracted from 11 (73%) studies, and the percentage of participants known to be autistic was extracted from eight (53%) studies.

The meta-regression analysis revealed that the association between the proportion of male participants and prevalence rates of self-restraint, and the proportion of participants with

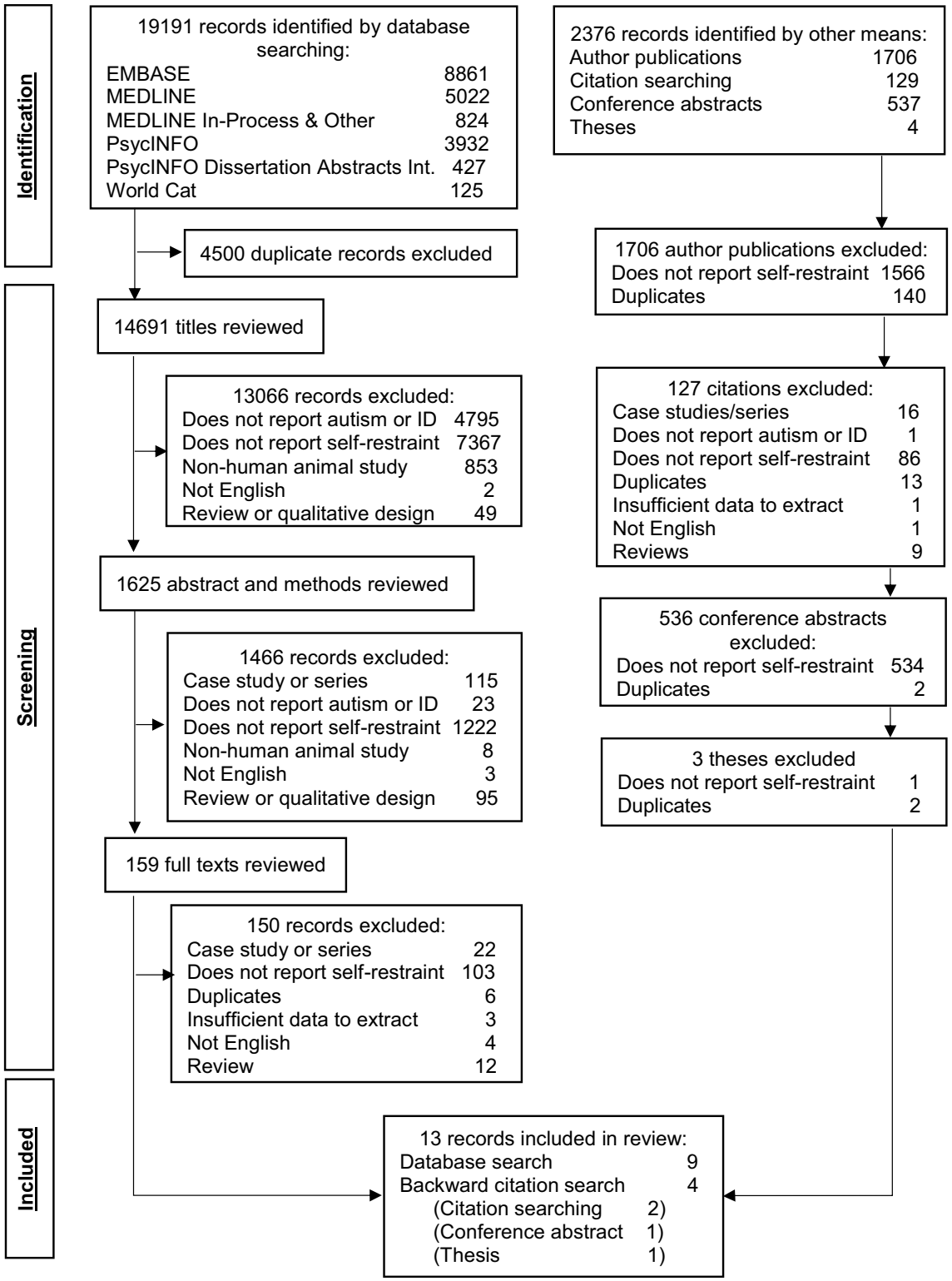


Fig. 2 PRISMA flow chart for all stages of study screening

ID and prevalence rates of self-restraint, was non-significant. This suggests neither gender nor presence of ID influenced the prevalence of self-restraint. There was a significant association between mean age of participants and prevalence of self-restraint such that studies with the oldest participants had the highest levels of self-restraint. The presence of autism and prevalence of self-restraint were also significantly associated, such that as the percentage of individuals

Table 3 Quality criteria, study and sample characteristic, and outcome data for studies reporting prevalence of self-restraint

Sample	Quality rating					Study and sample characteristics							Outcome data		
	Domain				Mean overall rating	N	SIB known (Yes/No)	Location	Mean age (SD) *Range*	*n* male (%)	*n* autistic (%)[a]	*n* ID (%)[a]	Measure of self-restraint	Prev. of SR *n* (%)	Prev. SR + SIB *n* (%)[b]	Prev. SR without SIB *n* (%)[b]
	A	B	C	D												
Bruhl *et al,* 1982					0.42	18	Y	USA	15.39 (5.73) *7 – 31*	11 (61.10)	4 (22.20)	18 (100)	Observation	10 (55.60)	10 (100)	0 (0)
Favell *et al,* 1981					0.44	21	Y	USA	24.60[b] (8.39) *15 – 30*	2[b] (66.10)	N/A	3[b] (14.29)	Friedin Rating Scale	4 (19.05)	4 (100)	0 (0)
Forman, 2003					0.67	63	Y	UK	30.90 (12.60) *6 - 64*	40 (63.50)	53 (84.13)	63 (100)	SRQ	41 (65.00)	41 (100)	0 (0)
Fovel *et al,* 1989					0.22	789	N	USA	NR NR *24 – 72*[c]	16[c] (47.06)	N/A	34[c] (5.00)	Unspecified survey	34 (4.96)	28 (82.35)	6 (17.65)

with autism in the sample increased, the prevalence of self-restraint increased.

Influence of Study Characteristics on Prevalence Rates

To examine the influence of measurement of self-restraint on the prevalence rates, subgroup analyses were conducted. Eleven samples used questionnaire measures and four samples used direct observations. Figure 4 shows the forest plot of the random effects model splitting data into subgroups. Overall, there was no significant difference between the subgroups, $X^2 = 1.75$, $p = 0.186$. This suggested measurement of self-restraint did not significantly influence prevalence rates.

Prevalence of Different Topographies of Self-restraint

A total of 12 samples ($n = 1448$) reported the prevalence of different topographies of self-restraint. In order to address the second aim of this meta-analytic study, prevalence data for each topography were extracted to generate individual pooled prevalence estimates. 31 topographies were generated based on items listed in the SRQ (23 items) and SRC (8 items). Where studies used observational techniques, named topographies were sorted according to the 31 items listed across the two questionnaires. Table S7 reports how each observed topography was categorised.

A series of meta-analyses were conducted to identify and compare pooled prevalence estimates of the total 31 topographies. Figure 5 represents topography estimates calculating prevalence from individuals reported to show self-restraint. Pooled prevalence estimates for each topography calculated from the total number of participants can be found in Figure S4. Random effects and quality rated forest plots for each individual topography in the total number of participants and those known to self-restrain can be found in Figures S5-S8.

Within the pooled sample of individuals known to self-restrain, the most prevalent forms of self-restraint were 'holding or squeezing objects' and 'holding onto others or holding onto others' clothing' (both 32%). The least common topographies were 'chooses mechanical restraint'

Table 3 (continued)

Sample	Quality rating						Study and sample characteristics							Outcome data		
	Domain				Mean quality rating	N	SIB known (Yes/No)	Location	Mean age (SD) *Range*	*n* male (%)	*n* autistic (%)	*n* ID (%)	Measure of self-restraint	Prev. of SR *n* (%)	Prev. SR + SIB *n* (%)[b]	Prev. SR without SIB *n* (%)[b]
	A	B	C	D												
Hagopian *et al*, 2015					0.50	52	Y	USA	NR NR *3 – 21*	37 (71.15)	38 (73.77)	45 (86.54)	Observation	8 (15.38)	8 (100)	0 (0)
Hyman *et al*, 2002					0.67	88	N	UK	12.89 (8.02) *1 – 38*	42 (47.72)	N/A	N/A	SRC	47 (53.41)	36 (76.60)	11 (23.40)
Iwata *et al*, 1994					0.56	152	Y	USA	NR NR *'1 - 10 to 50+'*	87 (57.24)	N/A	152 (100)	Observation	11 (7.24)	11 (100)	0 (0)
Laverty *et al*, 2020					0.58	67	N	UK	24.5 8[d] (8.75)[d] *14 - 58*	54 (80.60)	67 (100)	N/A	SRC	29[d] (43.28)	10[d] (34.48)	19[d] (65.52)
Oliver *et al*, 2003 Devices					0.42	41	Y	UK	21.70 (9.06) *'0 - <5 to 45+'*[e]	22 (53.66)	16[e] (29.63)	41 (100)	SRQ	24 (58.50)	24 (100)	0 (0)
Oliver *et al*, 2003 No Devices					0.44	47	Y	UK	18.10 (5.40) *NR*	22 (46.81)	N/A	47 (100)	SRQ	43 (91.50)	43 (100)	0 (0)
Powell *et al*, 1996					0.44	99	Y	USA	NR	NR	N/A	99 (100)	SRC	46 (46.00)	46 (100)	0 (0)

(1%) and 'other' (2%; qualitative descriptions of 'other' forms of self-restraint can be found in Table S8, Supplementary Materials).

Correlates of Self-restraint

To explore the relationship between self-restraint and SIB, a prevalence analysis including only studies that recruited participants known to self-injure ($k = 15$) was conducted. Results indicated that self-restraint occurred in 34% of the pooled sample, $z = 5.23$, $p < 0.0001$, 95% CI [21.36, 46.97] (Fig. 6a). Heterogeneity was high, $tau^2 = 0.061$, Higgin's $I^2 = 98\%$; $Q(14) = 799.77$, $p < 0.0001$, requiring further inspection. The random-effects model weighted by quality rating also indicated a prevalence of 34%, $z = 5.06$, $p < 0.0001$, 95% CI [21.04, 47.63] (Figure S9, Supplementary Materials).

Table 3 (continued)

Sample	Quality rating						Study and sample characteristics						Outcome data		
	Domain				Mean quality rating	N	SIB known (Yes/No)	Location	Mean age (SD) *Range*	*n* male (%)	*n* autistic (%)	*n* ID (%)	Measure of self-restraint	Prev. of SR *n* (%)	Prev. SR + SIB *n* (%)[b]	Prev. SR without SIB *n* (%)[b]
	A	B	C	D												
Richards *et al*, 2017 Adults					0.67	216	N	UK	34.10[d] (11.06)[d] *18 – 61*[d]	152 (70.37)	216 (100)	N/A	SRC	92 (42.60)	61 (66.30)	31 (33.70)
Richards *et al*, 2017 Children					0.67	208	N	UK	13.72[d] (2.45)[d] *6 – 17*[d]	181 (87.02)	208 (100)	N/A	SRC	85 (40.90)	54 (63.53)	30 (35.29)
Rojahn, 1986					0.56	528	Y	Germany	NR NR *3 – 62*	278 (52.95)	N/A	519 (98.30)	Unspecified survey	57 (10.80)	52[f] (86.67)	NR
Rooker *et al*, 2020					0.25	23	Y	USA	NR NR *'5 - 12 to 18+'*	17 (73.91)	20 (87.00)	22 (95.65)	Observation	8 (34.78)	8 (100)	0 (0)

SR = Self-Restraint; SIB = Self-Injurious Behaviour; N/A = Not Applicable; SRQ = Self-Restraint Questionnaire (Oliver et al., 2003); NR = Not Reported; SRC = Self-Restraint Checklist (Powell et al., 1996).

[a] See Table S5 for a breakdown of each study's classification of autism and/or intellectual disability.

[b] Percentages of SR + SIB and SR – SIB prevalence columns calculated as a proportion of the total number of individuals who self-restrain; data were not all reported directly and so were calculated based on other information (e.g., number of individuals who self-restrained in the absence of SIB = the difference between total population who self-restrained and those who self-restrained and self-injured).

[c] Demographic data were only reported for those who self-restrain ($n = 34$).

[d] Data extracted from additional data source (see Table S2 in Supplementary Materials).

[e] Data retrieved from additional data source with a larger total N of 54

[f] SR + SIB prevalence only reported for a subgroup of sample ($n = 431$).

An additional random-effects weighted analysis was conducted to identify the prevalence of self-restraint in the absence of self-injury ($k = 5$). An estimate of 13% was identified, $z = 3.16$, $p = 0.0016$, 95% CI [5.01, 21.43] (Fig. 6b). Heterogeneity was high, $tau^2 = 0.0078$, Higgin's $I^2 = 96\%$, $Q(4) = 96.20$, $p < 0.0001$. The random-effects model weighted by quality rating showed a prevalence of 15%, $z = 3.42$, $p = 0.0006$, 95% CI [6.45; 23.75] (Figure S10, Supplementary Materials). Exploration of heterogeneity and influence identified no studies bore disproportionate influence on the pooled prevalence estimates (Figures S11-S12).

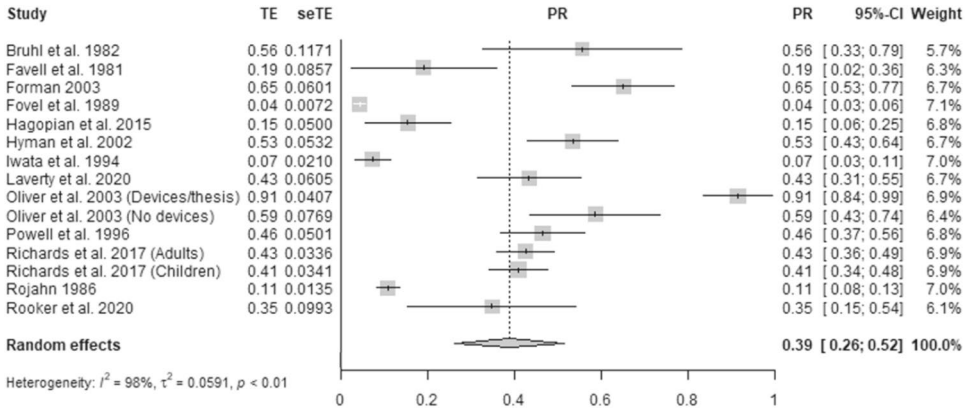


Fig. 3 Random effects forest plot for the overall pooled prevalence estimate for self-restraint

Table 4 Influence of participant characteristics on self-restraint prevalence rates

Covariate	Estimate	S.E	*Z*	*p*	Lower 95% CI	Upper 95% CI	*k*
Age (mean age)	**0.562**	**0.232**	**2.424**	**0.015**	**0.108**	**1.016**	**9**
Gender (% male)	0.421	0.372	1.134	0.257	-0.307	1.150	14
Presence of ID (%)	0.052	0.209	0.246	0.805	-0.359	0.462	11
Presence of autism (%)	**0.809**	**0.206**	**3.937**	**< .001**	**0.406**	**1.212**	**8**

Significant associations are highlighted in bold ($p < 0.05$)

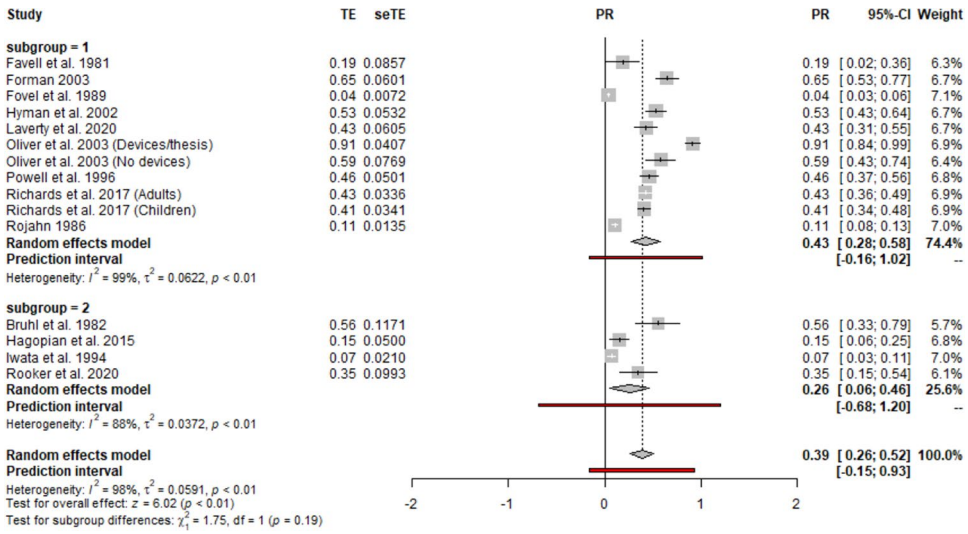


Fig. 4 Random effects forest plot for the subgroup analysis exploring measurement of self-restraint

To further quantify the strength of the association between self-restraint and self-injury, as well as other related correlates of restricted/repetitive behaviours, compulsive behaviours, impulsivity/overactivity, and stereotyped behaviours, effect sizes were meta-analysed. Table 5 reports the pooled effect sizes for each correlate, using the generic inverse variance method meta-analysing Fisher's *z* transformation of correlations. Random effects and quality-weighted forest plots for each correlation analysis can be found within Figure S13 and S14. Results revealed a moderate positive correlation between self-restraint and SIB, while other correlations were revealed to be non-significant.

Discussion

This meta-analysis of 15 samples involving 2309 participants revealed three key findings. First, the overall pooled prevalence estimate indicated that self-restraint occurs in 39% of individuals with autism and/or ID. This prevalence rate was influenced by participant age and presence of autism; however, participant gender, presence of ID, and measurement of self-restraint did not significantly influence the prevalence rates. Second, the prevalence of 31 self-restraint topographies were meta-analysed, revealing the most common

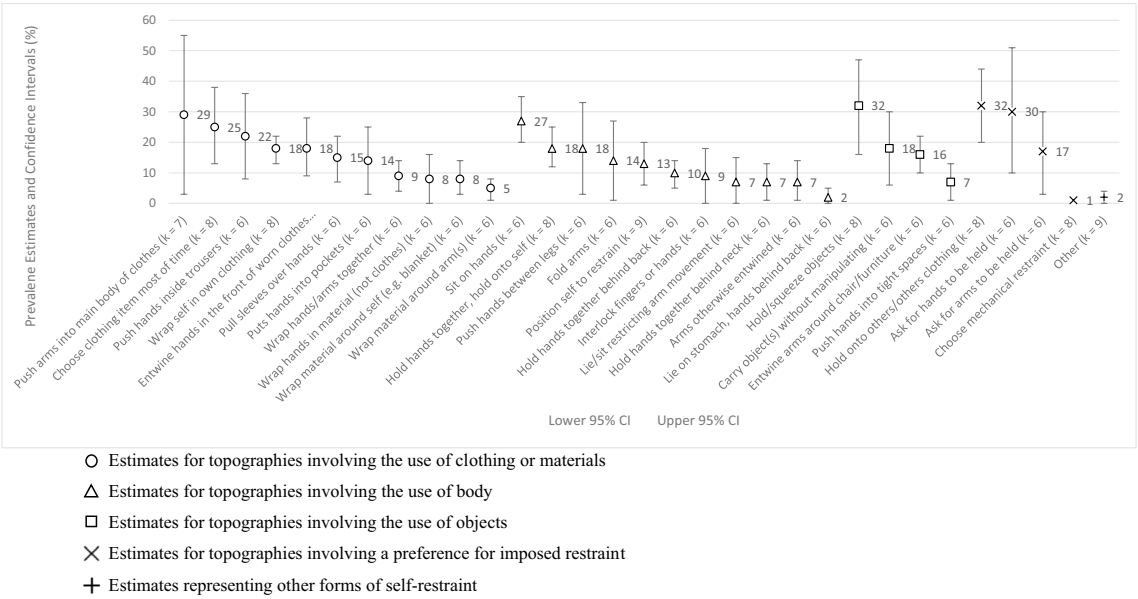


Fig. 5 Prevalence estimates and confidence intervals of each topography of self-restraint in those known to self-restrain

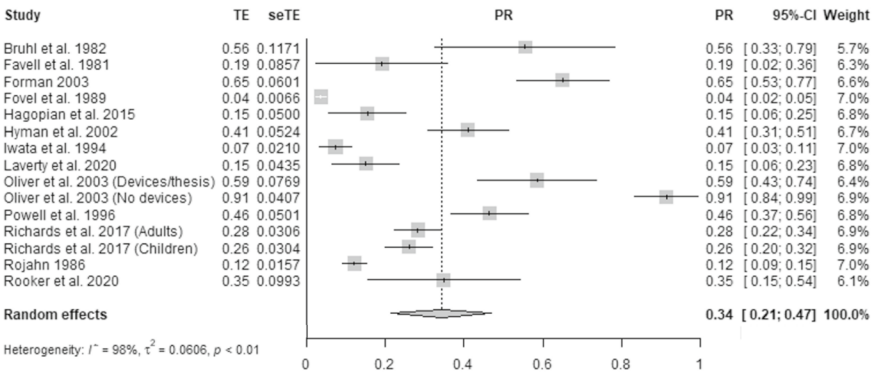
behaviours were 'holding or squeezing objects' and 'holding onto others or holding onto others' clothing' (both 32%), and 'choosing mechanical restraint' the least common (1%). Third, there was a moderate positive correlation between self-restraint and behavioural correlate self-injury, $r = 0.21$, such that self-restraint occurred amongst 34% of participants who self-injure, while self-restraint occurred in 13% of participants who did not self-injure. Restricted/repetitive behaviours, compulsive behaviour, impulsivity/overactivity, and stereotypy were not significantly correlated with self-restraint. We now discuss the theoretical and practical implications of these findings.

Over one third of autistic individuals and/or individuals with ID included in the existing literature were reported to self-restrain. This represents a clinically significant proportion of individuals and provides an informative estimate extending previously heterogeneous figures. It is important to acknowledge that since the inclusion criteria of this study involved investigating self-restraint, it would be erroneous to conclude that 39% of all autistic individuals and/or those with ID self-restrain. A degree of sample bias is recognised, as many studies recruited participants based on displaying SIB. Therefore, the prevalence figures reported in this study reflect the pooled estimate of relevant samples, who had autism and/or ID, and/or showed SIB.

Self-restraint and self-injury co-occurred at a rate of 34% and shared a statistically significant medium positive correlation ($r = 0.21$; interpretation according to Gignac & Szodorai, 2016). The function of self-restraint and the direction of the association with self-injury is still unclear, and as of yet there are no data documenting the cause and development of the two behaviours. To explore theoretical implications, the high prevalence of self-restraint amongst those who self-injure supports existing accounts that self-restraint and self-injury are bound together by paradigms of positive and negative reinforcement. For example, it is possible that self-restraint is a functional response to escape from aversive self-injury (Luiselli, 1993). The prevalence estimate of self-restraint in the absence of self-injury was, as expected, substantially lower (13%), deserving discussion. At face value, this suggests that for a subgroup of individuals, self-injury and self-restraint are not related nor do they share a functional relationship. Perhaps for some, self-restraint provides sensory comfort unrelated to behavioural control, such as the warmth provided when wrapped up in a blanket (Peterson & Peterson, 1968) or the physical sensory feedback provided by contact behaviours. Alternatively, self-restraint occurring in the absence of self-injury may be explained by the stimulus control hypothesis, suggesting that some restraining behaviours or devices ('symbolic restraints'; Pace et al., 1986, p. 384) obtain reinforcing properties indicative of injury-free behaviour. Supported by experimental studies of restraint fading, whereby mechanical restraints are reduced down to non-restrictive items such as eye-glasses, wristwatches (Foxx & Dufrense, 1984), and tennis wrist bands (Pace et al., 1986), this theory suggests not all self-restraint behaviours are incompatible with self-injury, but instead serve as a discriminative stimulus for the absence of SIB. In this way, self-restraint becomes highly effective at preventing self-injury. Currently, no longitudinal study of self-restraint has been undertaken to explore the aetiology and development of self-restraint, and existing studies of

Fig. 6 Random effects forest plot for **a** the prevalence of self-restraint among those who self-injure and **b** in the absence of self-injury

a. Random effects forest plot for the prevalence of self-restraint among those who self-injure



b. Random effects forest plot for the prevalence of self-restraint in the absence of self-injury

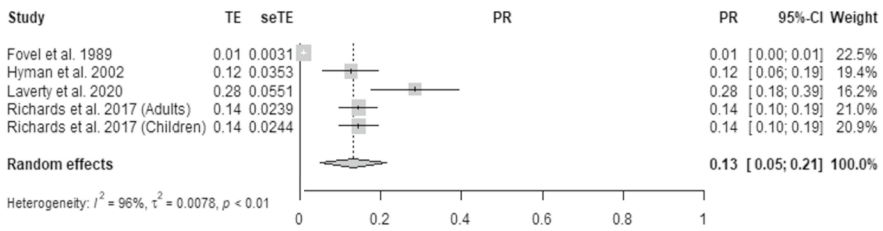


Table 5 Pooled correlation coefficients correlating behaviours with self-restraint

Correlate	Pooled effect size	95% confidence intervals	*p*-value	*k*	*N*
Self-injurious behaviour	**.208**[a]	**.141; .273**	**< .001**	**13**	**1576**
Restricted/repetitive behaviours	.001	− .002; .004	.504	3	491*
Compulsive behaviours	.003	− .005; .011	.444	2	187*
Impulsivity/overactivity	.001	− .002; .004	.463	3	491*
Stereotyped behaviours	.002	− .026; .049	.551	2	108*

Significant pooled correlation is highlighted in bold ($p < 0.05$)

[a]Data from one sample included within analysis (Oliver et al., 2003) were derived from the additional data source, with backwards calculations using a larger sample size ($N = 54$) than the sample size included in the journal article ($N = 41$)

*Sample size too small to provide sufficient power according to a priori power analysis (see the Methods section)

the stimulus control hypothesis typically focus on single-case study designs. Investigation of the functional properties of self-restraint over time is therefore essential to understanding *why* self-restraint occurs in the absence of self-injury.

The high prevalence of self-restraint in neurodiverse groups also has practical implications. Given the consequences of self-restraint to physical and emotional wellbeing (Scheithauer et al., 2015; Smith et al., 1992), it is suggested

that practitioners in clinical settings consider self-restraint, and the possible extreme impact on quality of life. Individuals with autism and/or ID presenting to clinical services for SIB must also be assessed for the presence and severity of self-restraint. Assessment using informant measures such as the SRC or SRQ, and/or behavioural observations, should occur both at initial formulation and routinely throughout care, as it is not yet understood how self-restraint may persist and impact wellbeing over the lifespan.

Participant age significantly influenced the prevalence rates of self-restraint. Previous literature has both supported and contradicted this finding; for example, Fovel et al. (1989) reported lower age was associated with self-restraint; however, Oliver et al. (2003) and Richards et al. (2017) reported that age did not have an effect. The meta-regression suggested that as participant age increased, so did the prevalence of self-restraint. It is not possible to identify a particular age group most likely to self-restrain based on this analysis alone; however, from observing the range of mean ages in the current studies (13 years to 34 years), the older participants in this range may be more likely to self-restrain. The presence of autism also influenced the prevalence of self-restraint, such that as the percentage of autistic individuals in the sample increased, self-restraint prevalence also increased. This suggests autism may be a risk factor for self-restraint, over and above ID.

Participant gender did not influence overall prevalence rates. Previous research has produced equivocal findings about the role of gender in showing self-restraint. For example, Oliver et al. (2003) found males were significantly more likely to show at least one form of self-restraint than females; however, Hyman et al. (2002) revealed gender had no effect. Further research is needed to explore gender differences in self-restraint. Finally, whether authors employed questionnaire or observational methods to measure self-restraint did not influence prevalence rates. This may be reflective of the shared approach both methods take in noting topographies. Both questionnaires and observations require informants to identify self-restraint in terms of behaviours observed by the individual, such as 'sitting on hands' or 'pulling sleeves over hands'. This may suggest both methods of measurement measure a similar construct.

It should be acknowledged that there were fewer than ten studies included in the meta-regressions assessing participant age and presence of autism. In order to examine the existing data, and not exclude findings, analyses were conducted on the respective nine and eight samples. The limited power of these analyses means that the results should be interpreted with caution. Importantly, the lack of participant data for individuals who showed self-restraint potentially limits understanding who may be at highest risk of showing self-restraint. There were also insufficient data to meta-analyse severity of ID, characteristics of autism, and health characteristics such as poor vision, hearing problems, digestion problems, and skin problems. Given that pain and painful health conditions are known to be associated with SIB (Richards et al., 2017) (which is in turn linked with self-restraint), it is imperative future research identifies and describes participant characteristics of those who self-restrain to examine the role such characteristics play in self-restraint.

A total of 31 topographies of self-restraint were identified during data extraction. Individual meta-analyses of pooled prevalence estimates were conducted to identify the most and least frequently occurring behaviours within individuals known to self-restrain. Consistent with prior literature, 'holding/squeezing objects' and 'holding onto others, holding onto others' clothing' were the most common self-restraint behaviours (both 32%). 'Asking for hands to be held' was the second most common (30%), while 'choosing mechanical restraint' was the least common (1%). These data define self-restraint within autistic groups and/or individuals who have ID and indicate that some forms of imposed restraint are favoured. Combining individual topographies into broader categories (i.e. use of clothing/materials, body, devices and preference for imposed restraint) may be a less useful way of describing self-restraint, due to the high variation in prevalence within categories. For example, a preference for imposed restraint included the most and least common behaviours. Furthermore, understanding prevalent self-restraint behaviours has clinical implications. Identification of self-restraint, particularly within individuals known to self-injure, may help clinicians to understand the function and severity of self-injury. Self-restraint behaviours identified to be incompatible with SIB may suggest the restraint occurs to supress self-injury, providing information for behavioural management and intervention. Furthermore, given its rarity, showing a strong desire to access mechanical restraint may be an example of 'extreme' self-restraint. The presentation and removal of restraint during care and intervention must be carefully evaluated and considered. Given that a large majority of the population vulnerable to self-restraint and self-injury are often unable to report internal experiences, these findings shed light on how to recognise self-restraint in vulnerable groups.

The third and final aim of this study was to identify behaviours correlated with self-restraint. As discussed, self-injury was positively correlated with self-restraint, but restrictive/repetitive behaviours, compulsivity, impulsivity/overactivity, and stereotypy were not significantly associated with self-restraint. It should be noted that few studies provided sufficient data for inclusion within the analyses; however, all analyses included at least two samples (Valentine et al., 2010). Further research using large, well-powered samples is needed to test these putative associations further. Identification of correlates may further elucidate the function and mechanisms underpinning self-restraint. For

example, research exploring the role of executive functions on SIB has revealed that impulsive individuals are five times more likely to show severe SIB than non-impulsive individuals (Richards et al., 2017), suggesting self-restraint may emerge as a compensatory tool to regain control over the most severe, 'impulsive' self-injury (King, 1993). Supporting this, Richards et al. (2017) reported that the presence of SIB and impulsivity predicted the presence of self-restraint twofold in autistic individuals. Research replicating this finding could pinpoint impaired inhibitory control as a cognitive mechanism underpinning self-restraint.

Limitations and Conclusions

Although this meta-analysis was conducted using robust search, extraction, and analytic methods, it is important to discuss study limitations. First, the field of self-restraint is characteristically small, and by excluding single-case designs the overall number of samples yielded for meta-analysis was low ($k = 15$). This exclusion criterion was essential to avoid bias. However, sensitivity analyses revealed that no single study exerted undue influence on the overall effect size reported here. Second, a range of measures and definitions of self-restraint were employed across studies. The most common measure, the Self-Restraint Checklist (Powell et al., 1996), rated self-restraint according to behaviours shown over the lifetime. Consequently, analyses have identified estimates of individuals who have shown self-restraint across the lifetime, not necessarily individuals who showed self-restraint at the time of assessment. Arguments around the usefulness of characterising self-restraint across the lifetime and only by topography raise questions around the rigor of such measures (Forman, 2003). Future research should aim to define better the parameters of self-restraint. Finally, the objective quality assessment revealed variation in study quality, with scores ranging from 0.22 to 0.67, where a 'perfect' score is 1. By observing quality ratings, it is revealed that the majority of research exploring self-restraint relies on obtaining participant records through specialist services to identify autistic individuals and/or those with ID, rather than by employing direct diagnostic assessments. It must be acknowledged that diagnoses are broad, heterogeneous umbrella terms, with each individual presenting unique strengths, skills, and differences. However, within the context of understanding self-restraint, it is important researchers define participant characteristics that may be related to showing self-restraint. Therefore, where possible, future research should strive to use direct assessments of autism (e.g. ADOS, ADI-R), intellectual functioning (e.g. Wechsler Intelligence Scale for Children), and adaptive ability (e.g. the Vineland Adaptive Behavior Scale) to describe participant characteristics.

In summary, the pooled prevalence of self-restraint amongst individuals with autism and/or ID was estimated to be 39%. Self-restraint and self-injury were found to be positively correlated when accounting for all existing research, such that one third of those who self-injure also self-restrain. However, a prevalence figure of 13% for self-restraint in the absence of self-injury suggests a more complex relationship than that explained solely by models of positive and negative reinforcement. 'Holding onto others or holding onto others' clothing' and 'holding or squeezing objects' were identified to be the most common topographies, while 'chooses mechanical restraint' was the least prevalent. Restrictive/repetitive behaviours, compulsivity, impulsivity/overactivity, and stereotypy were not identified to have a statistically significant relationship with self-restraint, highlighting the need for larger-scale studies of the associations between self-restraint and putative correlates.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s40489-024-00450-5.

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