3 LITERATURE REVIEW OF SCIENTIFIC RESEARCH

The scientific research review was done in three dimensions. Strating with understanding psychological problems associated with developmental disorders narrowing down in the areas of Autism Spectrum Disorder (ASD) and Intellectual Disabilities (ID). Further the literature references explored for co-exisistence of ASD and ID as multiple disabilities, associated problems, caregiver challenges, various behavioural interventions and outcomes. The second segment focuses on available scientific literature in the space of impact of *yoga* interventions on development of psychological skills and narrowing down for any research applying such intervention in the field of developmental disorders ASD or ID. Third and last segment is to deep dive in understanding of Single Case Experimental Design and its applicability in behavioural studies, empirical significance, recommended quality standards, analysis methods, and documentation standards.

3.1 SCIENTIFIC LITERATURE ON CHALLENGES WITH CHILDREN WITH ASD AND ID

Sl. No.	Author(s)	Study Design	Participants and Settings	Intervention	Outcome Measures	Results
1	Cervantes & Matson, (2015)	Comparative observational study	307 adults with severe or profound intellectual disability (ID), divided into two groups: - ASD+ID - ID only	No intervention; this was a screening and assessment study evaluating symptom profiles across groups	Symptom endorsement across 12 psychiatric and behavioural subscales, including: - Anxiety - Mania - Schizophrenia - Stereotypies/tics - Self-injurious behaviour - Eating disorders - Sexual disorders - Impulse control (among others)	Adults with ASD+ID exhibited significantly more symptoms on 8 out of 12 subscales compared to the ID only group. These subscales included: - Anxiety - Mania - Schizophrenia - Stereotypies/tics - Self-injurious behaviour - Eating disorders - Sexual disorders - Impulse control Specific symptom endorsements also revealed distinct patterns between groups.
2	Wolstencroft et al., (2023)	Observational cohort study with cross-sectional	1904 children (ages 5–19 years) with intellectual or developmental	No intervention — the study assessed mental health profiles in children	- Child mental health difficulties (ADHD, emotional	Prevalence: - 36.8% of children with IDD had co-occurring ASD.

		survey design using regression analysis	disability (IDD) of genetic etiology; recruited via the UK National Health Service (NHS) assessments completed by caregivers online	with IDD, comparing those with and without co-occurring ASD, and measured parental psychological distress	disorders, disruptive behaviour disorders) - Severity of symptoms (hyperactivity, emotional and conduct problems) - Parental psychological distress (self-reported)	- Children with IDD + ASD had significantly higher odds of ADHD, emotional disorders, and disruptive behaviour disorders. - Severity: Higher symptom severity in ASD+IDD group across hyperactivity, emotional difficulties, and conduct problems. - Parental Impact: Parents of children with ASD+IDD reported significantly higher psychological distress.
3	Saunders et al., (2015)	Secondary data analysis of a large national survey (cross-sectional design); bivariate and multivariate	Children classified into three groups based on parental report: - ASD alone (n = 2,406) - ID alone (n = 1,363) - ASD + ID (n = 620)	No intervention — analysis focused on comparing reported family financial and caregiver burden among groups	- Financial difficulty - Cutting work hours - Stopping work to care for the child	Prevalence: - 24% of children with ASD also had ID. - Co-occurrence of ID with ASD is associated with negative financial and employment burden on families - Clinical recognition of this dual diagnosis is

		statistical analysis				critical to appropriately support affected families
4	Okoye et al., (2023)	Narrative review of literature on early diagnosis of autism	Not applicable – this is a review; no direct study participants	Review focuses on: - Early signs and symptoms of ASD - Screening and diagnostic tools - Benefits and risks of early diagnosis - Future directions in autism diagnosis and management	Key points discussed include: - Symptoms: eye contact avoidance, name non-response, lack of pretend play, excessive fear - Diagnostic tools: M-CHAT-R/F, SCQ, PEDS, CARS	- Early diagnosis is highly beneficial, facilitating timely, tailored interventions and improving developmental outcomes. - Risks such as labeling, overdiagnosis, and emotional toll on families should be acknowledged and mitigated through supportive, accurate, multidisciplinary diagnostic practices. - Future directions: potential roles for biomarkers and AI in enhancing diagnostic accuracy and personalization of care.

Table 1: Scientific Literature on ASD and ID

3.2 SUMMARY TABLE OF SCIENTIFIC LITERATURE ON *YOGA* AND ITS IMPACT

Sl. No.	Author(s)	Study Design	Participants and Settings	Intervention	Outcome Measures	Results
1	Aleksić Veljković et al., (2021)	Quasi-experimental study (non-randomized control group design) with pre- and post-test assessments; repeated-measures ANOVA for data analysis	45 preschool children (aged 5–6 years) attending regular preschool programs - Intervention group: n = 23 (*yoga*, 30 min, 3×/week, 12 weeks) - Control group: n = 22	12-week *yoga* program - 30-minute sessions, 3 times per week - Focused on improving motor coordination through structured *yoga* activities	Motor abilities assessed using BOT subtests: - Fine motor integration - Manual dexterity Cognitive abilities assessed using School Maturity Test subtests: - Visual memory - Stacking cubes - Codes	Motor improvements (intervention group): - Fine motor integration ($p = 0.022$) - General fine motor skills ($p = 0.029$) - Bilateral coordination ($p < 0.001$) - Balance ($p < 0.001$) - Overall body coordination ($p < 0.001$) Cognitive abilities: No significant improvements observed.
2	Folleto et al., (2016)	Pre-post intervention study with mixed methods (quantitative assessments + qualitative interviews);	16 first-grade children (ages 6–8) from a public elementary school in southern Brazil - Yoga sessions: 2× per week, 45 minutes	School-based *yoga* program integrated into physical education classes - 12-week duration - Focused on motor skill	Motor abilities: - Bruininks-Oseretsky Test of Motor Proficiency (2nd Ed.)	Motor abilities: - Significant improvements in balance, strength, and flexibility - Social behaviour: Qualitative data revealed positive

		statistical analysis using Wilcoxon test	each, for 12 weeks	development and social behaviour enhancement	- Sit-and-Reach Flexibility Test (Eurofit, 1988) Social behaviour: - Pictorial Scale of Perceived Competence and Social Acceptance for Young Children - Semi-structured interviews with children, parents, and teachers.	behavioural changes and application of *yoga* learning outside of school - Acceptability: Yoga program was well received by children.
3	Nanthakumar, (2018)	Narrative literature review of existing studies on *yoga* interventions for school-aged children experiencing stress and anxiety	School-aged children (general population) across studies included in the review - Setting: Primarily school-based programs, international studies; focus on implications	Yoga as a meditative movement practice Included components: - *Asanas* (postures) - *Pranayama* (breath control) - *Dharana* (concentration) - *Dhyana* (meditation)	Psychological effects related to stress and anxiety, as reported in eight reviewed studies	- All reviewed studies showed positive outcomes in reducing and managing stress and anxiety in children - Yoga was effective in improving emotional regulation and coping mechanisms - Despite limitations (small sample sizes, heterogeneity),

			for Malaysian schools			consistent trends support *yoga* as a beneficial intervention.
4	Rashedi et al., (2021)	Paired within-subjects comparison study (quasi-experimental design) conducted over three time points (pre, mid, post); mixed methods (quantitative focus)	154 children (ages 4–6) from 9 classrooms in 3 school districts in the U.S. - Groups: Yoga intervention (TxFirst, *n* = 90) and wait-list control (TxSecond, *n* = 64) - All children were from economically disadvantaged backgrounds (low SES)	8-week *yoga* program - Delivered via 18 manualized video sessions (approx. 10 minutes each), practiced 6× weekly - Included breathing, postures, and relaxation exercises - Teachers received 10 hours of training and guided implementation	Self-regulation: - Head-Toes-Knees-Shoulders (HTKS) task - Preschool Self-Regulation Assessment (PSRA) - Strengths and Difficulties Questionnaire (SDQ) Emotion regulation: - Children's Emotion Regulation Processes Questionnaire (ERQ) - Emotion regulation subscale of SDQ	TxFirst group: - Significant improvement in HTKS scores (self-regulation task) - Reduction in submissive venting and total behaviour problems TxSecond group: - Similar improvements observed post-intervention (after wait-list) Overall: - Gains in behavioural self-regulation and emotional control, particularly in reducing outbursts (submissive venting)

						- Findings sustained over time in some measures
5	Radhakrishna et al., (2010)	Small-scale, two-arm study conducted over two academic years	Sample size: 6 participants per group (intervention vs. control or comparison)	Integrated Approach to Yoga Therapy (IAYT) - Delivered over two academic years - Included therapist-guided body posture imitation with parental involvement and structured support	Improvements in imitation skills, behaviour at home, and family relationships - Parental observations played a key role in outcome reporting	Significant improvements in: - Imitation skills - General behaviour at home - Family dynamics and relationships - Hypothesis: Guided imitation may have stimulated mirror neuron activation, contributing to improved sense of self in children with ASD.
6	Reina et al., (2020)	Pre-post intervention study - Within-subjects design assessing functional fitness before and	8 adults with intellectual and developmental disabilities (IDDs) - Mean age = 31 years (SD = 6.55) - 50% male - Conducted at a special	Group *yoga* intervention - 12 sessions over 7 weeks - 60-minute sessions, twice per week	Functional fitness test assessing: - Lower-body strength - Upper-body strength - Agility and balance	Significant improvements from baseline to post-test: - Lower-body strength: 28% increase (P = 0.04) - Upper-body strength: 27% increase (P = 0.018)

		after *yoga* intervention	population recreation and leisure program			- Agility and balance: 29% improvement (P = 0.036) - Improvements are notable given that functional decline in IDD populations is typically faster than in the general population.
7	Singh & Hwang, (2019)	Narrative literature review (focused on studies published between 2018–2019)	Individuals with intellectual and developmental disabilities (IDD) - Review includes both individual and group-based programs across various levels of disability and settings (home, school, clinical)	Mindfulness-based practices and programs Examples include: - Mindfulness-Based Stress Reduction (MBSR) - MYmind - Mindfulness-Based Positive Behavior Support (MBPBS) - Informal mindfulness practices	Effectiveness of mindfulness for: - Self-management of aggressive and destructive behaviours - Stress reduction - Enhancing quality of life for individuals with IDD - Caregiver well-being	- Individuals with IDD can learn and apply mindfulness techniques to self-regulate behaviour - Randomized controlled trials show significant effectiveness of structured mindfulness programs - Programs improved quality of life, reduced caregiver stress, and managed

						challenging behaviours - Evidence supports both formal programs and informal practices - Research is still developing, and further studies are needed across diverse populations and program formats.

Table 2: Scientific Literature on Yoga and its Impact

3.3 SUMMARY TABLE OF SCIENTIFIC LITERATURE ON SINGLE CASE EXPERIMENTAL DESIGN

Sl. No.	Author(s)	Study Design	Participants and Settings	Intervention	Outcome Measures	Results
1	Smith J, (2012)	Systematic Review	409 SCED related articles published between (2000-2010)	Comparative analysis	- Research Design - Measurement - Analysis Domain - Contemporary Standards and Guidelines - Benchmarks for baseline sampling & method of analysis.	- 69% of the articles applied multiple baseline/combined series design. - Visual Analysis being most prevalent means of reporting impact - Synthesis of recent SCED Standards (What Works,

2	Tate R. L., (2016)	Guideline development study - Method: 2 online surveys and 2-day expert consensus meeting	Experts in behavioural interventions and single-case experimental design (exact number not specified) - Setting: Online surveys and in-person expert consensus meeting	Development of the Single-Case Reporting guideline In BEhavioural interventions (SCRIBE) 2016 - Resulted in a 26-item reporting checklist	- Quality and completeness of reporting in single-case experimental design research - Goal: Improve clarity, transparency, and methodological rigor in scientific reporting	SCRIBE 2016 guideline
3	Lenz, (2013)	Comparative Analysis between three non-overlap methods	Not Applicable	Not Applicable	Strengths and Limitations of PND, PEM and PAND applied to a data set.	Non-overlap methods provide valuable tool for effect size calculation in SCED. PND and PEM is good for small sample, manual and PAND requires calculation. The effectiveness varies in context.
4	Lobo et al., (2017)	Methodological overview and comparison article (descriptive	Not applicable – this article is a methodological discussion, not a	None applied; the article discusses: - Single-case experimental designs	Conceptual comparison of research designs focusing on:	- Single-case designs are distinct from case reports and can demonstrate causal relationships using repeated measures and

		review of research designs)	primary research study	- Comparisons with case studies and randomized clinical trials - Analysis techniques and quality appraisal tools relevant to rehabilitation research	- Internal and external validity - Use of replication, randomization, and multiple participants - Appropriateness for low-incidence conditions or resource-limited settings	independent variable manipulation - When designed rigorously, they can offer high internal and external validity, especially with replication and randomization - Suitable for novel, costly, or under-researched interventions and when large trials are impractical

Table 3: Scientific Literature on SCED