3.0 REVIEW OF SCIENTIFIC LITERATURE

A review of related literature was carried out by searching various databases such as PubMed, Google Scholar, Open Jgate etc. using key terms like ‘physical fitness’, ‘intellectually disabled’, ‘physical activity’ and ‘yoga’. This resulted in an analysis of various scientific studies which are presented as follows:

3.1 LITERATURE RELATED TO STATUS OF PHYSICAL AND PSYCHO-MOTOR ABILITIES OF INTELLECTUALLY DISABLED

Persons with intellectual disability and associated multiple disabilities have been found by many researchers to be a population with deficient physical fitness measures, which can be explained by an inactive lifestyle, a result of lack of awareness of the positive physical effects of physical exercise, or lack of motivation for any motor activity. Chaiwanichsiri et al. (2000) examined the status of physical fitness among mentally retarded children and compared to normal children with the same age group. The results of this study showed that the adolescents with intellectual disability had a significantly lower level of physical fitness and more prevalence of obesity than normal students. A review conducted by Gonzalez-Aguero et al. (2010) showed a general trend toward lower values of physical fitness parameters and worse body composition variables in children and adolescents with Down’s syndrome compared to the population without intellectual disability or even with the population with intellectual disability without Down’s syndrome.

Further, it has been seen that individuals with intellectual disability exhibit lower levels of cardiovascular fitness than their non-disabled peers. The experiment conducted by Gillespie (2003) compared cardiovascular fitness levels of adolescents with and without

mental retardation. Cardiovascular fitness was assessed through 20-meter shuttle run and the results showed that non-disabled children exhibited significantly greater levels of aerobic fitness than those with intellectual disability. Skowronski Horvat, Nocera, Roswal, and Croce (2009) demonstrated that for the assessment of motor fitness, Eurofit special test which comprises strength, speed, flexibility and balance was able to distinguish variations in functioning among individuals with intellectual disabilities. Analyses demonstrated that the Eurofit Special was able to discriminate performance levels by gender, age, and level of intellectual disability. The intellectually disabled tend to be sedentary and less physically active. In fact, the physical activity declines and sedentary behavior increases with age. Phillips and Holland (2011) showed that participants with Down's syndrome engaged in a significantly less physical activity than those with intellectual disabilities without Down's syndrome and levels of activity declined significantly with age. Individuals with intellectual disabilities, especially those with Down's syndrome may be at risk of developing diseases associated with physical inactivity. The negative impact of obesity on physical fitness and motor abilities has been documented in youth of various ages. In fact, youth with intellectual disability are considered more overweight, less physically fit, and less motor proficient than peers without intellectual disability. However, it has been seen that overweight/obesity is minimally associated with aerobic fitness and muscular strength in youth with mild intellectual disability. Body mass index did not impact other fitness measures (sit-up, sit and reach) or motor skills (Frey & Chow, 2006).

Children with intellectual disabilities have motor problems and higher-order cognitive deficits. Hartman, Houwen, Scherder, and Visscher (2010) reported that intellectually disabled individuals scored lower on locomotor ability and object control. These results

support the notion that besides being impaired in qualitative motor skills intellectually challenged children are also impaired in higher-order executive functions. Moreover, adolescents with intellectual disability have difficulty in making optimal use of their working memory when new or complex situations tax their abilities (Van der Molen, Van Luit, Van der Molen, & Jongmans, 2010). However, working memory can effectively be trained in adolescents with mild to borderline intellectual disabilities (Van der Molen, Van Luit, Van der Molen, Klugkist, & Jongmans, 2010).

Naveen and Telles (1999) suggested that sympathetic dysfunction in Down's syndrome was restricted to the sudomotor subdivision, activity of which was associated with attention and recognition. This indicates that individuals with intellectual and developmental disabilities are in need of effective and motivating physical fitness training programmes for the improvement of physical fitness and mental health. In a study conducted by Lotan, Isakov, Kessel and Merrick (2004), 15 children with intellectual disability on a motor functioning level of 7-14 months used a treadmill daily for two months. The findings indicated the most significant improvement in the level of physical fitness of the participants ($p < 0.005$), as measured by pulse at rest and during effort. The improvement in physical fitness modestly ($r = 0.5$), but significantly ($p < 0.05$), correlated with a significant ($p < 0.0007$) improvement in functional ability of the participating children. Judo training was imparted in seven blind mentally retarded children with associated neuropsychiatric disturbances. The results of this study showed improvements in physical fitness, motor skills and psychosocial attitude (Gleser et al., (1992)).

3.2 EXERCISE/PHYSICAL ACTIVITY FOR INTELLECTUALLY DISABLED

Regular physical activity is vital for individuals with intellectual disabilities. In fact, individuals with intellectual disabilities are in need of effective physical training programmes. However, physical fitness and motor function of intellectually disabled has received relatively little attention. Nevertheless, several research studies demonstrated an impact of physical activity/exercise on physical fitness, mental health, memory etc. in intellectually disabled individuals. For example, Yildirim Erbahçeci, Ergun, Pitetti, and Beets (2010) assessed the effects of exercise on reaction time in individuals with intellectual disabilities. 50 children and adolescents with mean age of 14.7 years with a mild intellectual disability without Downs's syndrome were recruited for this study. All the subjects were randomly divided into control and experimental groups. The experimental group was given a structured physical fitness programme for 12 weeks. Reaction time was assessed at baseline and after 12 weeks. The results of this study showed significant improvements in reaction time after exercise programme. Ozmen, Ryildirim, Yuktasir, and Beets (2007) reported that school-based fitness-training programme in children with mental retardation (MR) was effective in improving cardiovascular fitness. Although this training was not effective to bring changes in percent of body fat. effects of aerobic exercise were also explored in the case of intellectually disabled individuals. Pommering et al. (1994) showed that 10-week aerobic exercise treatment produced significant increases in VO2 max, O2 pulse, max vent, max time, and flexibility. However, no significant change was observed in weight or body composition changes. Similar results were observed by Khalili and Elkins (2009) with eight-week training programme of aerobic exercise. Further, validity of various tests such as 600-yard walk/run, the 20-m shuttle run, and a modified 16-m

shuttle run was established to measure aerobic capacity (VO2peak) in children with mild and moderate mental retardation (Fernhall et al. 1998). Healthy physical fitness programmes were also found to be effective in weight, BMI score, BMI category, and positive improvement in V-shape sit and reach test, sit-up in 30s and 60s tests after 6-month interventions among the people with intellectually disabilities living in disability institution. Wu et al. (2010). Baran et al. (2013) reported that eight weeks of Special Olympics unified sport soccer programme was effective in improving fitness and soccer skill performance of youth with intellectually disability. Virtual reality-based exercise programme was explored for the improvement in physical fitness in individuals with intellectual and developmental disabilities (Lotan, Yalon-Chamovitz & Weiss (2010). This programme showed a significant improvement in a heart rate, however, the results were not strong enough to claim that there was a significant improvement in physical fitness of individuals with severe intellectual disability.

Hayakawa and Kobayashi (2011) investigated the effectiveness of using special training machines for children with intellectual disabilities to strengthen their body's inner muscles and improve their ability to maintain standing posture and improve walking movement. A significant improvement was observed in the 50-m dash, mean 10-m walk time, and 10-m obstacle course walk. The hip joint split angle showed a significant increase. A critical review by Bartlo and Klein (2011) revealed moderate to strong evidence that physical activity intervention positively affected balance, muscle strength, and quality of life in individuals with intellectual disability. Various training interventions have been explored by researchers for intellectual disability individuals for improving physical fitness. A 16-week community-based swim training programme

was found to be effective in improving the percent of body fat in children and adolescents with intellectual disabilities. Casey, Rasmussen, Mackenzie, and Glenn (2010) a seven-month aerobic type exercise programme improved cardiovascular efficiency (Tomporowski & Ellis 1984; Golubovic, Maksimovic, Golubovic, & Glumbic, 2012). A case report demonstrated that a group exercise programme of strength and endurance training was a safe and feasible option for children with disabilities (Fragala-Pinkham, Haley, Rabin, & Kharasch, 2005). Additionally, it was found that a combined exercise training had a positive effect on indices of obesity, physical fitness and lipid profile in adolescents with mental retardation (Elmahgoub et al., 2009).

Schurrer, Weltman and Brammell (1985) examined the effects of training on maximal oxygen consumption (VO2 max) and body weight of 5 mentally retarded adults. Their body weight was reduced by 3.6 kg and VO2 max increased 43%. Further favorable behavior changes occurred during the course of the physical training programme. Van der Putten, Vlaskamp, Reynders and Nakken (2005) determined the effects of functional movement activities within the MOVE (Mobility Opportunities via Education) curriculum on the independence of children with profound intellectual and multiple disabilities. Results showed that the children receiving functionally focused activities achieved greater improvements in independence when performing movement activities.

Table 3.1: Status of physical fitness and motor function of individuals with intellectual disability						
Sr. No.	Authors & Year	Design	Participants	Intervention	Outcomes	Results
1.	Alesi et al., 2014	Case study	3 children (2 boys & 1 girl) with Down syndrome. Average age 10.3 years	Exercise training twice a week for two months.	Gross motor development, working memory, reaction time	Improvement in gross motor ability scores and reaction time was observed.
2.	Kubilay et al., 2011	RCT	28 participants with mild to moderate intellectual disability (IQ-50-70). Participants were randomly assigned to exercise (n = 14) and control (n = 14) groups.	Balance training and postural exercise programme with a Swiss ball for 8 weeks at a Frequency of three times per week.	Muscle endurance, flexibility, muscle strength and coordination, Functional mobility and balance.	Significant difference was found in all parameters except flexibility in The exercise groups.
3.	Schott & Holfelder, 2015	RCT	18 children with Down's syndrome, aged 7-11 years, and 18 typically developing children.	Nil	Test of gross motor development, movement assessment battery children-2	Children with DS are not only impaired in higher order EF, but showing deficits too in locomotors and object control skills.
4.	Westerndorp et al., 2011	Comparative	104 children with learning disabilities compared with n = 104 typically developing children.		Test of Gross Motor Development-2, academic performance	Children with learning disabilities scored poorer on motor skills as compared to

						typically developing children.
5.	Staples & Reid 2010	Comparative	25 children with autism spectrum disorder aged 9-12 years compared with 3 typically developing groups		Test for Gross Motor Development-2	Results suggest movement skills of children with ASD reflect deficits in addition to delays.
6.	Collins & Staples, 2017	Single group	Thirty-five children (25 boys, 10 girls) with intellectual disability. Age 7-12 years	Physical activity program once a week, 90 minutes for 10 weeks	The Brockport physical fitness test	Significant increase in aerobic capacity & muscular strength was observed after ten weeks of physical activity.
7.	Durstine et al., 2000	Review			Consequence of inactivity, mobility, Exercise programming considerations, exercise prescription principles	Greater emphasis is prescribed for determining risk & benefits of increased physical activity for individuals with disability.
8.	Chow et al., 2018	Single group	114 adults with mild & moderate intellectual disability, age between 18-65 years.		Body fat, waist & hip circumference, 6 min walk, arm curl, sit & reach, actigraph	Adults with intellectual disability reside in group home have low PA and low fitness levels

9.	Darrah et al. 1999	Single group	23 children with cerebral palsy, mean age 14.2 years	Aerobics, strength training & stretching 3 times a week for 10 weeks.	Energy expenditure index, heart rate, isometric strength of shoulder flexors, knee extensors, hip extensors & abductors, flexibility, perceived competence	Results showed community fitness programme influence muscle strength & perceived competence.
10.	Horvat, 1987	Single group pre post	Individuals with spastic cerebral palsy	Resistance training for eight week, 3 times weekly.	Strength, endurance, range of motion	Improvement was observed in strength, endurance and range of motion on both sides of body.
11.	Maltais et al., 2014	Review	Evidence about three health-related physical fitness attributes for children with cerebral palsy: cardiorespiratory endurance, muscle strength and anaerobic fitness		Cardiorespiratory endurance, muscle strength, anaerobic fitness	Children have reduced fitness across the three attributes, fitness in each area can improve in the short term with exercise training.
12.	Bandini et al., 2005	Survey	The continuous National Health & Nutrition		BMI	Higher prevalence of overweight among children with

			Examination survey 1999-2002.			limitations in physical activity & higher prevalence of overweight in girls with learning disability.
13.	Curtin et al., 2010	Survey	Telephone interview of parents/guardians on 85,272 children of ages between 3-17.	Telephone interviews	BMI	Children with autism have a prevalence of obesity at least as high as children overall.
14.	Must et al., 2014	Review				Children with DD live in the same obesogenic environments as typically developing children but may be at elevated obesity risk due to additional factors that arise from their specific limitations and social circumstances.
15.	Maiano et al., 2016	Review/Meta-analysis	16 studies, published between 1985 and 2015,			Adolescents with intellectual disabilities to be respectively 1.54 and 1.80 times more at risk of overweight-

						obesity and obesity than typically developing adolescents.
16.	Choi et al., 2012	Survey	2404 children with intellectual disability, aged 7-18 years		Height, weight	Approximately one quarter of children with intellectual disability were either overweight or obese. Children's gender was significantly associated with their weight status such that overweight and obesity were more prevalent in girls than boys.
17.	Tamim et al., 2014	Cross-sectional study	Intellectual disability students aged 10-30-year-old, n = 1760		Height, weight, BMI	The prevalence of obesity among intellectual disability students in special schools for the disabled type C/C1 in Jakarta is 16%, with the age, sex, and parental education level as

						Determinant factors associated with obesity.
18.	Jeoung, 2018	Comparative	82 students (age 11 to 20 years) with intellectual disability (borderline, 11; mild, 27; moderate, 19), developmental disability (15), or autism (10)		Bruininks-Oseretsky Test of Motor Proficiency	Compared to borderline, mild intellectual disability, or autism, those with moderate intellectual disability scored significantly lower on almost all items regarding motor skills.
19.	Hogan et al., 2000	Survey			Disability, Family environment	Results indicate that children with disabilities experience similar learning environments as other children, but have somewhat weaker relationships with their parents. In two-parent families, maternal disability lowers parents' school involvement and is associated with a less enriching home environment.

20.	Fisher et al., 2005	Survey	394 boys & girls, mean age 4.2 year		Physical activity, 15 fundamental movement skills	Total physical activity and percent time spent in moderate to vigorous physical activity were significantly correlated with total movement skills score. Time spent in light-intensity physical activity was not significantly correlated with motor skills score.
21.	Wuang et al., 2008	Comparative	233 children with mild intellectual disability aged 7 to 8 years		Cognitive, motor and sensory integrative functioning.	Children with mild intellectual disability performed significantly less well on all test measures. 44.2% of children scored in the impaired range on seven out of 22 sensorimotor measures. They had weaker fine motor skills than gross motor skills.

22.	Vuijk et al., 2010	Comparative	170 children, aged 7-12 years with mild intellectual disability & borderline intellectual functioning		Movement Assessment Battery for Children	81.8% with MID and 60.0% with BIF performed below the 16th percentile on the total score of the MABC. Both groups demonstrated a relative weakness in the area of manual dexterity.
23.	Vandorpe et al., 2012	Longitudinal	371 children, 6-9 years of age		Motor coordination in three consecutive years and a questionnaire on their club sports participation in year 1 and year 3 of testing	Children who consistently practiced sports in a club environment over the three years of testing displayed better coordination levels than the children who only partially participated or did not participate in a club environment at all.

Table 3.2 Exercise for Cardiovascular fitness						
Sr. No.	Authors & Year	Design	Participants	Intervention	Outcomes	Results
1.	Chanias, Reid & Hoover, 1998	Review	Studies of the effects of exercise programmes on at least one of five health-related physical fitness components of individuals with an intellectual deficit were included.	Aerobic, resistance and combined exercise programmes		Exercise training appeared to improve several health-related physical fitness components. It is clear that muscular and cardiovascular endurance can be greatly influenced by exercise training.
2.	Halle, Gabler-Halle & Chung, 1999	A between-group multiple-baseline	17 children with moderate and severe cognitive disabilities	Peer-mediated exercise programme	Aerobic fitness	Aerobic fitness of participants, measured by exercise heart-rates, improved when the exercise programme was introduced.
3.	Schurrer et al., 1986	Single group	Five mentally retarded adults	23-week physical-training programme. Supervised training sessions were held 4 to 6 days per week.	Maximal oxygen consumption (VO2 max) and body weight	Body weight was reduced by 3.6 kg and VO2 max increased 43%.

4.	Ozmen, 2007	RCT	30 boys (8-15 years old) with mild to moderate mental retardation were randomly divided into 2 groups--experimental and control.	School-based cardiovascular-fitness-training programme for 10 weeks	20-m shuttle-run-test, body fat	Increase in cardiovascular fitness level was seen. No change in body fat was observed.
5.	Pommering et al., 1994	Single group pre-post	14 community-based adults with mental retardation.	Ten-week aerobic exercise programme	VO2 max, O2 pulse, max vent, and max time before and after the training program. Flexibility, weight, and body composition changes were assessed before, midway through, and after the training program.	The treatment produced significant increases in VO2 max, O2 pulse, max vent, max time, and flexibility. However, no significant change was observed in weight or body composition changes.
6.	Khalili & Elkins, 2009	RCT	Forty-four 12-year old children with Down syndrome or other intellectual disability with an average IQ of 42	The experimental group performed aerobic exercises for 30 minutes, five days per week, for eight weeks. The exercise was supervised walking, running,	Lung function as FEV1 and FVC in litres	An eight-week programme of aerobic exercise improved lung function in children with intellectual disability significantly.

				and cycling, with a target of moderate intensity		
7.	Tomporowski & Ellis, 1984	RCT	65 subjects, randomly assigned to exercise, attention control and nonintervention control group	Aerobic exercise (running, calisthenics and circuit training) for seven month, three hours/day, five days a week.	Cardiovascular efficiency, adaptive behavior.	Cardiovascular efficiency improved in the exercise group. IQ and adaptive behavior did not improve as a result of any treatment.
8.	Golubovic et al., 2012	RCT	42 children with intellectual disability & 45 typically developing children	Exercise	Eurofit test battery	intellectual disability children score lower on physical fitness tests than typically developing children.
9.	Wu et al., 2017	RCT	43 students with intellectual disability (aged 13-19 years); 28 overweight/obese children with intellectual disability were assigned to obesity-control group (n = 14); obesity-exercise group (n = 14); and those with normal weight were assigned to a normal weight group (n = 15).	12 weeks Cross circuit training five days a week for 50 mins.	Body composition, 1-min sit-ups, dynamic and static balance, vertical jumps, and cardiorespiratory fitness.	The results showed improvement in cardiorespiratory fitness, dynamic balance, muscular strength and endurance, and weight control in students' intellectual disability

10.	Oviedo et al., 2014	RCT	66 participants with intellectual disability. Intervention group (n = 37) & control group (n = 29)	Aerobic, strength and balance training 3 day/week, 1 h/day over 14 weeks.	Cardiovascular fitness, strength, balance and functional measures	The training intervention increased cardiovascular fitness, handgrip strength, leg strength, and balance. Body weight and body mass index decreased in the intervention group. The control group showed no changes in any parameter.

Table 3.3 Exercise for Cardiorespiratory fitness

Sr. No.	Authors and Year	Design	Participants	Intervention	Outcomes	Results
1.	Kim, 2017	RCT	24 men with intellectual disabilities, but capable of learning, were randomly assigned to aerobic exercise (N = 8), half-bath (N = 8), or control (N = 8) treatment groups	12-week treatment period, the aerobic exercise group did treadmill and stationary bicycle. The half-bath treatment group was placed in a sitting position in a 39–40°C bath for 10 minutes.	Body composition, Heart rate, respiratory, and circulatory variables	The results showed improvement in vascular function.

2.	Kocic et al., 2017	RCT	Fifty adolescents with mild MR	Basketball training Program in duration of eight weeks.	Body height, body weight, and percentage of fatty tissue. six-minute walk test, basketball skills	Results showed improvement in cardiorespiratory fitness and sport skills performance.
3.	Asonitou et al., 2018	RCT	38 adults with intellectual disabilities, intervention group (n = 19) who participated in exercise training; and the control group (n = 19) who engaged in no exercise training.	Physical training intervention conducted twice a week, for four consecutive months, consisting of activities and games	muscle strength, speed, balance and flexibility	Physical fitness measured for the intervention group reflected positive improvements at post-tests

Table 3.4 Exercise for Physical fitness

Sr. No.	Authors and Year	Design	Participants	Intervention	Outcomes	Results
1.	Berktas et al., 2011	RCT	69 elementary school students with mental challenges, 34 children aged 12.3 were included in physical education, 35 children aged 12.1 participated in a special class for children with mental challenges.	Physical education programme.	Balance tests, grip strength and Brockport Physical Fitness Test (BPFT)	Results indicated that physical fitness parameters; 20-meter shuttle run, push-up, trunk lift, vertical jump and balance test scores were significantly lower in children in the special class

2.	Elmahgoub et al., 2009	RCT	30 adolescents with intellectual disability were divided into exercise training (n = 15) & no training (n = 15).	Combined exercise training	Body composition, physical fitness and lipid profile	Weight, BMI Waist& fat mass decreased significantly. Triglycerides, LDL decreased while HDL increased. The distance covered in the 6-min walk test (6MWT) increased with 50 m
3.	Tamin et al., 2015	RCT	212 subjects with intellectual disability; age 10-30 years. Randomized into three groups.	Lower extremity muscles endurance exercise for 20 RM followed by cardiorespiratory endurance exercise for 24-25 min (Group-1), lower extremity muscles endurance exercises for 10 RM followed by cardiorespiratory endurance exercises for 26-27 minutes (Group-2), and threw a tennis ball with 10 m distance for 10 minutes as	Physical fitness	Lower extremity muscles endurance exercise followed by a cardiorespiratory endurance exercise was found to increase physical fitness in intellectual disability patients with obesity.

				control (Group-3). Performed 3 times a week for 4 months.		
4.	Calders et al., 2011	RCT	45 adults with intellectual disability, mean age: 42 were assigned into.	Combined exercise training (n = 15); endurance training (n = 15) twice a week for 70 minutes per session for 20 weeks and no training (n = 15)	Lipid profile, physical fitness; blood pressure and body composition	Combined exercise training showed reduction in cholesterol levels and Improvement in aerobic capacity, muscle strength and resting systolic blood pressure. Endurance exercise training had significant effects on aerobic capacity and resting systolic blood pressure. Results showed a tendency towards more beneficial effects of combined exercise training in adults with intellectual disability.
5.	Wu et al., 2010	Single group	146 participants with intellectual disabilities (age 19-67 years)	Healthy physical fitness programme for 6 months	V-shape sit and reach test, sit-up 30s, sit-up 60s, and shuttle run	The results showed significant decreases in individual's weight, BMI score, BMI category, and positive

						improvement in V-shape sit and reach test, sit-up in 30s and 60s tests after 6-month interventions.
6.	Baran et al., 2013	RCT	23 youth with intellectual disability and 23 without intellectual disability, age 12-15 years were in training while 15 with intellectual disability & without intellectual disability in control group	Special Olympics unified sport soccer program for 8 weeks, 1.5 hr per session, 3 times/week	Brockport physical fitness test & soccer skill performance test	SO athletes and non-disabled partners scored significantly higher with regard to physical fitness and football skills in most variables compared with their CG.
7.	Hayakawa and Kobayashi, 2011	Single group	23 high school boys with intellectual disability	Four special training machines were used for walking, standing and walking balance, for leg-hip extension, and for isolateral movement in a sitting position. Each participant underwent 30 min. of training once a week over a period of 3-months.	50-m dash, 10-m walk time, and 10-m obstacle course walk	Body control ability required to perform each training exercise was improved over the training period. A significant improvement was observed in the 50-m dash, mean 10-m walk time, and 10-m obstacle course walk

8.	Bartlo and Klein, 2011	Review	An electronic database search			Critical review revealed moderate to strong evidence that physical activity positively affected balance, muscle strength, and quality of life in individuals with intellectual disability.
9.	Casey et al., 2010	Convenience sample	Children and adolescents (n = 8; mean age +/- SD, 13.1 +/- 3.4 y), 2 girls and 6 boys with ID, of varying fat levels	A swim training programme lasting for the duration of 16 weeks with three 1-hour sessions held at a 25-m pool each week.	Percent body fat using DXA	After the 16-week exercise training programme, 1.2% median increase in body fat percentage was seen.

Table 3.5 Exercise for Reaction Time

Sr. No.	Authors and Year	Design	Participants	Intervention	Outcomes	Results
1.	Yildirim et al., 2010	RCT	50 children of mean age: 14.7 years with mild intellectual disability were randomly divided into control (20 boys, 5 girls) and	Structured physical fitness programme for 12 weeks	Reaction time	Significant improvements in reaction time were observed in the exercise group but not for the control group.

			experimental (19 boys, 6 girls) groups.			
2.	Nagamtsu et al., 2013	RCT	86 women aged 70–80 years with subjective memory complaints into one of the three groups: resistance training, aerobic training, or balance and tone (control)	Exercise twice per week for six months	Verbal memory and learning using the Rey Auditory Verbal Learning Test and spatial memory using a computerized test	Aerobic training group remembered significantly more items in the loss after interference condition of the RAVLT compared with the control group after six months of training. Both experimental groups showed improved spatial memory performance
3.	Aouadi, Alanazi& Tim, 2015	RCT	51 male adolescents, aged 14 to 16 years were divided into three groups: (1) healthy group (2) a trained group (3) a sedentary group.	Aerobic programme, consisting of one daily session (~60 min), twice weekly, during a period of three months	Reaction time	The results showed significant differences ($p < 0.001$) in reaction time between SG and TG in different time periods. In addition, the mean of reaction the time in TG was similar to that observed in HG.

Table 3.6 Exercise for Gross Motor Function						
Sr. No.	Authors and Year	Design	Participants	Intervention	Outcomes	Results
1.	Guidetti et al., 2010	Comparative	22 track and field, 19 basketball, and 23 non-athletic adults with intellectual disability	Sport specialization training, assessed before and after a 9-month period.	Body composition, flexibility, arm muscular strength, lower and upper-body muscular strength and endurance, explosive leg power, cardiovascular endurance, balance ability, motor coordination.	Findings of this study showed that physical activity improved fitness in adult athletes with intellectual disability, decreasing health risks.
2.	Hale, Bray and Littmann, 2007	Single group	20 adults with profound intellectual disability		Neuromuscular systems and balance capabilities	Low motor control composite scores indicated a slowing of motor responses to postural perturbations.
3.	Minshew, Sung, Jones, & Furman, 2004	Comparative	79 autistic individuals without mental retardation and 61 healthy volunteers		Postural control	The autistic subjects had reduced postural stability. Examination of age effects revealed

			between age given of 5 and 52 years			that the development of postural stability was delayed in the autistic subjects and failed to achieve adult levels
4.	Alesi et al., 2014	Case study	3 children (2 boys & 1 girl) with Down syndrome. Average age: 10.3 years	Exercise training twice a week for 2 months	Gross motor development, working memory, reaction time	Improvement in gross motor ability scores and reaction time was observed.
5.	Jankowicz-Szymanska et al., 2012	RCT	40 young females and males with mild down syndrome were assigned into the experimental and control groups	Exercises with rehabilitation balls and air pillows twice a week for 3 months.	Balance, general centre of gravity	After the training sessions, the results of both the tests improved in the group of the persons subjected to the training programme.
6.	Carlon et al., 2013	Review	Electronic databases			Young people with cerebral palsy participated in significantly lower levels of habitual physical activity than their peers, and less than the

						recommended guidelines.
7.	Damiano, & DeJong, 2009	Review	277 unique articles from which 29 met all the inclusion criteria.			Efficacy of treadmill training in accelerating walking development in down syndrome was well demonstrated.
8.	Valentin-Gudiol , et al., 2013	A Cochrane systematic review with meta-analysis.	Included randomized, quasi-randomized and controlled clinical trials that evaluated the effect of treadmill intervention in children up to six years of age.			The available evidence indicated that treadmill intervention may accelerated the development of the independent walking in children with down syndrome.
9.	Dehghanizade et al., 2018	Quasi-experimental study	30 participants were divided into experimental (n = 15) and control group (n = 15)	Exercises were performed in three 60-minute sessions per week for a total period of eight weeks	Ulrich's Test of Gross Motor Development	Braitonic exercise can help improve the motor skills of children with intellectual disability.
10.	Lewis & Fragala-Pinkham, 2005	Case study	A 10.5-year-old girl with down syndrome	Exercise programme: 30 to 60 minutes of moderate- to high-	Cardiovascular variable, strength, body composition,	Improvements in submaximal heart and respiration rates, aerobic performance,

				intensity exercise 5 days per week for 6 weeks	flexibility, and skill	muscle strength and endurance, gross motor skills, and anaerobic power was observed. There was no change in weight and flexibility.
11.	Giagazoglou et al., 2013	RCT	18 children with moderate intellectual disability, mean age of 10.3 years. The participants were assigned in experimental (n = 9) & control (n = 9) groups.	12 weeks of trampoline training intervention. 20-minute individualized sessions	Motor performance and balance	Significant improvement in balance and motor performance was observed after trampoline training
12.	Lotan et al., 2004	Single group self as control	15 children aged 5–10 years (mean: 7.9; 7 girls and 8 boys)	Treadmill exercise daily 2 months for an average of 19.9 min. every day.	Functional ability	The programme improved physical fitness of children with intellectual disability
13.	Mikolaiczyk and Jankowicz-Szymanska, 2015	RCT	34 adolescents, aged 14-16 years, with moderate intellectual disability assigned into experimental (n = 17) and control (n = 17) groups.	Dual task exercise (balance exercises on unstable surfaces) for 12 weeks.	Postural balance	The experimental group revealed a significant improvement in static balance.

14.	Elmahgoub et al., 2011	RCT	45 adolescents with intellectual disability, age-14-22 years	Combined exercise training three times a week for 30 sessions (10 weeks; n = 15), twice a week for 30 sessions (15 weeks; n = 15), or no training (10 weeks; n = 15).	Body composition, physical fitness and lipid profile	Combined exercise training three times a week resulted into a significant improvement of physical fitness, obesity indices, and lipid profile.
15.	Fotiadou et al., 2017	RCT	20 children aged 8-12 years	16-week psychomotor education programme for 45 minutes., 2 lessons per week	Motor development index, static balance	The training intervention could reduce the values of static balance variables for all the positions.

Table 3.7 Yoga for intellectual disability Individuals

Sr. No.	Authors & Year	Design	Participants	Intervention	Outcomes	Results
1.	Uma et al. 1989	RCT	90 children with mild to severe intellectual disability. Intervention group (n = 45) & control group (n = 45)	Integrated yoga practices such as breathing exercises & pranayama for 5hrs/week for one year.	IQ & social adaptation parameters	The result showed a significant improvement in IQ & social adaptation parameters.

2.	Srilakshmidevi and Suseela, 2017	Single group pre-post	10 children, aged 10-20 years	Yoga training for 5 days/week for six weeks; 60 min/session	Flexibility	The yoga training improved flexibility in children with intellectual disability
3.	Bedekar and Hande, 2017	Single group, pre-post	30 female medical students aged 18-25 years	Yoga training 60 min per session for 4 weeks	Cardiovascular fitness, body composition, flexibility, muscular strength	The results indicated that yoga *asanas* led to an improvement in cardiorespiratory endurance, body composition, flexibility and muscular strength.
4.	Sharma et al., 2016	RCT	20 children with intellectual disability assigned into experimental (n = 10) & control (n = 10) groups	Yoga practices 5 days/week, 1 hour, for 3 months	Hand steadiness	The intervention group showed a significant effect on decrease in errors on hand steadiness test.
5.	Parisa et al., 2015	RCT	30 Intellectually disabled girls experimental and control groups. In each group n = 15, average age 15.6 years.	Yoga training for 8 weeks; 3 sessions /week; 1hr/sessions	Static balance, Dynamic balance and Gait	Yoga training improved balance and gait as compared to the control group.
6.	Radhakrishna, 2010	Assessment 3 points. Pre, mid and post	6 in each group	YG: 10 months; 5 session /week; 45mins /session for and regular practice at home	Imitation and other skills, and behavior	IAYT may offer benefits as an effective tool to increase imitation, cognitive skills and social-communicative

						behaviors in children with ASD
7.	Singh & Singh, 2014	RCT one group pre post	5 mild intellectually impaired children of age 7 - 10 yrs	Omkar-5min for 5days, LNB and RNB for 10 minutes, M-5min 60 days	Fine motor coordination abilities	Significant differences between mean/average time taken in performing the inserting pegs task in pre-test and post-test.
8.	Pise et al., 2018	RCT	70 intellectually disabled children were divided into experimental group and control group.	Yoga intervention for 12 weeks, one hour daily	Static balance, eye hand coordination, agility and reaction time	Within the group, a significant improvement in static balance, eye hand coordination, agility, and reaction time

Table 3.8 Yoga for Normal Children

Sr. No.	Authors & Year	Design	Participants	Intervention	Outcomes	Results
1.	Polsgrove et al., 2016	Quasi experimental	Male college athletes (N = 26), divided into yoga and non-yoga group	Yoga sessions, 2 in mornings for 10 weeks	Flexibility and balance	Regular yoga practice increased the flexibility and balance.
2.	Petric et al., 2014	Pilot study	9 young healthy females (mean age 23.8 ± 2.9 years)	Yoga exercises twice a week for 5 months	Joint mobility for shoulder, hip and ankle	Improvement in flexibility was seen.

3.	Cowen, 2010	Quasi experimental	77 firefighters	Yoga training for 6 weeks	Functional fitness, flexibility, perceived stress	Improvement in flexibility and perceived stress was observed.
4.	Amin and Goodman, 2014	Pre-Post Single group Pilot study	16 low to moderately active females, aged 52.37 years	Iyengar yoga for 6 weeks, 90 minutes session/week	Flexibility	Significant increase in flexibility was seen.
5.	Kongkaew C, Lertsinthai P 2018	Meta-analysis	7 RCT included			Thai yoga exercises appeared useful, in particular, on body and right shoulder joint flexibility. Regular stretching exercise of Thai yoga and/or in combination with exercises could promote health-related physical fitness.
6.	Moonaz , Bingham 2015	RCT	75 sedentary adults aged 18+ years with rheumatoid arthritis (RA) or knee osteoarthritis	8 weeks of yoga (two 60-min classes and 1 home practice/week)	Fitness, mood, stress, self-efficacy, SF-36 health-related quality of life (HRQOL), and RA disease activity	At eight weeks, yoga was associated with significantly higher PCS, walking capacity, positive affect. Significant improvement in SF-36, improvement in QOL

7.	Satish, Rao 2018	RCT	802 students randomized to yoga group (n = 411) or physical exercise (n = 391)	Yoga/exercise training for 2 months	VO2 max	The results showed a significant improvement in VO2 max in both groups.

Table 3.9 Physical Activity Status among Individuals with ID

Sr. No.	Authors and Year	Design	Participants	Intervention	Outcomes	Results
1.	Whitt-Glover, Neill, & Stettler, 2006	Comparative	Children with DS (n = 28) and their siblings (n = 30), between 3-10-years		PA was measured over 7 days using accelerometers.	Children with DS participated in less total and sustained VPA and had higher BMI levels compared with their siblings.
2.	Bandini et al., 2013	Cross sectional	58 typically developing & 53 children with autism spectrum disorder, aged 3-11 years.		Physical activity by accelerometer	Although both the groups of the children engaged in similar levels of moderate and vigorous activity (MVPA) as measured by accelerometer, the children with ASD engaged in fewer physical activities and for less time according to a parental report
3.	Hill et al., 2013	Cross-sectional and prospective	28 children with DS and 35 sibling controls aged 3-10 years	Four annual measurement visits were conducted	Resting energy expenditure, thyroxin	Children with DS had lower REE than sibling controls

		cohort design				
4.	Bhaumik et al., 2008	Population-based prevalence study	1119 adults with intellectual disability aged 20 and over		Body mass index, physical, mental and skills attributes	Obesity in women and underweight in both men and women was more common among adults with intellectual disability than in the general population after controlling for differences in the age distributions between the two populations.
5.	Hartman et al., 2010	Comparative	61 children aged 7-12 years with borderline intellectual disability (33 boys & 28 girls) and 36 children with mild intellectual disability (24 boys and 12 girls).	Comparison between borderline intellectual disability and mild I intellectual disability	Motor skills, i.e. locomotors ability and object control,	The children with mild intellectual disability scored significantly lower than the children with borderline intellectual disability in locomotors skills. Motor performance and executive functioning were correlated positively.

3.3 YOGA AND PHYSICAL FITNESS

The purpose of this study was to analyze the effects of a yoga training intervention on physical fitness and motor abilities among intellectually disabled children. Hence, the researcher reviewed the impact of yoga intervention on physical fitness and motor function in various populations, and this provided a rationale for the investigation on yoga practices as a protocol for promoting physical and mental health in intellectually disabled children. The review of the relevant literature is presented as follows:

Several earlier studies indicated that yoga practices improve physical fitness. It has been observed that six months of yoga training increases hand grip strength and hand grip endurance (Madanmohan, Jatiya, Udupa, & Bhavnani, 2003). A significant study reported that pranayama training results in a significant increase in the hand grip strength of both hands and also a significant increase in maximal work output with a significant reduced level of oxygen consumption per unit work (Raghuraj & Telles, 1997). Further, another study revealed that eight weeks of yoga training resulted in a significant increase in isokinetic muscular endurance (Tran, Holly, Lashbrook, & Amsterdam, 2001). The relevant literature indicates that yoga has a potential to improve health and functional capacity. At a basic level, yoga promotes physical fitness (Collins, 1998; Gharote, 1976; Telles, Hanumanthaiah, Nagarathna & Nagendra, 1993) by promoting increased muscle strength (Raub, 2002), flexibility (Armstrong & Smedley, 2003; Ray et al., 2001), and stability (Telles et al. 1993). Overall, a mindfulness practice, including yoga and meditation, may improve health quality, reduce chronic care visits (Roth & Stanley, 2002), reduce medication usage (Bonadies, 2004; Brownstein & Dembert, 1989; Latha & Kaliappan, 1992; Williams et al. 2005),

improve general functioning of the central nervous system (Shannahoff-Khalsa, Sramek, Kennel & Jamieson, 2004), and promote self-care (Herrick & Ainsworth, 2000).

A number of remarkable studies (Bera & Rajapurkar, 1993; Pansare, Kulkarni & Pendse, 1989; Raju et al. 1986, Ray et al. 2001; Tran et al. 2001) reported a significant improvement in overall cardiovascular endurance of young subjects who were given varying periods of yoga training (months to years) and compared to a similar group who performed other types of exercises. Other studies have reported benefits of yoga practice in untrained adolescent subjects (12 to 18 years of age). Bera and Rajapurkar (1993) reported that cardiovascular endurance was improved in male high school students who participated in a controlled yoga study for a year.

The literature presented above indicates that individuals with intellectual disabilities score lower on standardized tests of physical fitness during all the phases of their lives than individuals without intellectual disability. Children with intellectual disability are found to be more overweight, less physically fit, and less motor proficient than peers without intellectual disability. It has also been found that children with intellectual disability have motor problems and higher-order cognitive deficits. These results support the notion that besides being impaired in qualitative motor skills, intellectually challenged children are also impaired in higher-order executive functions.

This study therefore attempts to propose a framework to help children with intellectual disability to overcome their limitation with the help of proper and adequate training in yoga and witness a new one within themselves.