

CHAPTER I

INTRODUCTION



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1.1 PHYSICAL EDUCATION

Physical Education (PE) is a component of school curriculum that is formal, structured, and integral not simply for the benefit between lessons (recess) but to facilitate the whole of a child. Worldwide, it is defined as a planned, sequential kindergarten-12th grade instructional program that delivers cognitive and learning components across a range of physical activity contexts (CDC, 2022). Play, physical literacy development, and movement knowledge and skills—these are among the core goals of quality PE, along with fostering positive attitudes toward health and well-being (SHAPE America, 2015). Physical education is officially a part of the National Curriculum Framework (NCF) in India, though implementation, pedagogy, and perceived importance can vary drastically by school, often being marginalized in favor of core academic subjects (Kumar & Sharma, 2016). There are several domains of a strong physical education program.

The psychomotor domain involves the acquisition of movement competences, such as basic motor skills (locomotor, non-locomotor and manipulative), sport-specific methods, and general health-related fitness elements, including cardiovascular performance, strength, flexibility and body composition (Haywood & Getchell, 2019).

The cognitive domain is where students are shown the basics of movement, rules and strategies for games, how to keep safe and understand the physiology and biomechanical details of physical activity. Finally, in the affective domain, social and emotional competences such as cooperation, sportsmanship, leadership, confidence, and intrinsic motivation for physical activity are considered to promote health (Lund & Tannehill, 2014). For children with neurodevelopmental differences like ADHD, the classical large-group, performance-based

Physical Education model can be a major source of stress and inability which can be detrimental for behavioral symptoms, and serves to legitimize social exclusion (Li et al., 2014). Without the ability to maintain sustained attention over extended periods for long periods of time, impulse control and motor coordination, children may struggle to follow multi-step directions or wait for their turn to execute complex movement sequences, and become frustrated while engaging in the activity.

Thus, the demands for re-designing Physical education teaching around principles of Differentiated instruction and universal design, in which activities that are inclusive, relevant, and successful to all (Lieberman & Houston-Wilson, 2017), is urgent. This could perhaps require changes in tool and resources (larger, softer balls) or rules, visual representations, instantaneous feedback or simply a structuring to reduce distraction and to focus on how hard you try, and how well you perform instead of “normal” performance. For ADHD maintenance, a well-organized Physical education program provides a distinct therapeutic outlet. It fosters a valid, structured source of extra energy that may stabilize arousal levels and in turn, support the future focus of the classroom (Pontifex et al., 2013). This helps address the common gross motor deficits in this population (Fliers et al., 2008) where Physical education is being used explicitly to teach and reinforce fundamental movement skills (FMS) more strategically. Through the integration of strategies, such as breaking skills like throwing, catching and jumping into bite-sized components and ensuring plenty of positive practice,

Physical education can evolve from a time of possible humiliation to a successful intervention, one that promotes physical competence and increases self-efficacy, and one that affords a frame of reference for managing both self-regulation and socialisation. Hence, reframing Physical education as a key discipline to integrate in the educational program from a marginal “games period” to a subject specific to learning skills and inclusion is an important aspect of supporting children with ADHD.

1.2 PHYSICAL ACTIVITY

Caspersen, Powell, and Christenson (1985) established that physical activity comprises any skeletal muscle-induced movement resulting in energy expenditure exceeding that of rest. However, this wide-ranging phrase sets physical activity apart from the specific curricular topic of Physical Education. Physical activity sits on a continuum from unstructured play and active transportation (walking, cycling, etc.) to structured exercise, sports, and household chores. In children, engaging in physical activity is not just a health behavior, but it is an important driving force of holistic growth and development related to their physical, cognitive, social and emotional development (World Health Organization [WHO], 2020). The WHO recommends that 5 to 17 years accumulate on average 60 min per day of moderate- to vigorous-intensity physical activity (MVPA), primarily aerobic and to include muscle- and bone-strengthening exercises at least three days a week.

The dimensions of physical activity consist of four key aspects, commonly known by the acronym FITT, which are: Frequency (how often), Intensity (how hard, e.g., moderate vs. vigorous), Time (duration), and Type (the mode of activity) (Howley, 2001). For children, physical activity is of particular variety; it can take a form of lifestyle activities (playing in a park, helping with chores) and structured/sport activities (dance class, football practice) and muscle- and bone-strengthening activities (climbing on playground equipment, jumping rope). Studies reveal that various types and intensities of physical activity can produce different physiological and neurological effects. For example, moderate-to-vigorous aerobic exercise is highly associated with cardiovascular health, acutely improve cognitive functions (e.g., attention and executive control) probably cerebral blood flow will gained and neurochemical changes (Hillman, Erickson, & Kramer, 2008).

In sharp contrast to, skill-based activities that focus on learning and practicing complex motor patterns such as martial arts, gymnastics, or sports drills require a lot from the brain

regarding motor planning, working memory, and cognitive control regions (Diamond, 2015). Given the characteristic difficulties associated with ADHD, these activities become especially valuable for affected children. While aerobic exercise may help regulate overall arousal and mood, skill-based physical activity provides direct training for motor coordination, sequential processing, and sustained focus on technique, thus potentially providing multiple benefits in cognitive and motor domains (Pesce, 2012).

For children with ADHD, physical activity participation is frequently difficult. Their core symptoms—inattention, impulsivity, and motor clumsiness—may make taking part in organized sports difficult, leading to negative experiences, including criticism from coaches or peers, and eventual withdrawal (Harvey & Reid, 2003). Moreover, the displacement of free play by academic pressures and screen time is a global trend acutely felt in urban Indian settings, contributing to sedentary lifestyles (Gupta et al., 2019). Because regular physical activity may act as a complementary therapy for ADHD, this activity deficit is a major cause of concern. At the molecular level, acute bouts of physical activity are linked to increased availability of key neurotransmitters in the prefrontal cortex, namely dopamine and norepinephrine—the same systems targeted by first-line stimulant medications (Wigal et al., 2013). Prolonged involvement may foster neuroplasticity via elevated levels of brain-derived neurotrophic factor (BDNF) and facilitate neuronal health and connectivity (Skriver et al., 2014).

Thus, an understanding of physical activity in its context—as a multidimensional behaviour characterized by distinct forms and intensities—is the essential prerequisite for a good intervention design. For the child with ADHD, the emphasis is no longer “increasing activity” but prescription of the form of physical activity (e.g., skill-based vs. aerobic), structure (adult-led vs. child-led), and social setting (individual vs. small group) that can

maximize engagement, build competence, and target their specific areas of need, including the foundational development of gross motor skills.

1.3 INCLUSIVE PHYSICAL ACTIVITY

Inclusive Physical Activity (IPA) represents a fundamental philosophical and pedagogical shift away from segregation and toward the full integration of individuals of all abilities into mainstream physical activity, recreation, and sport environments. At its core, this framework champions inclusivity: no matter one's physical, cognitive, or sensory characteristics, everyone deserves access to participation that is meaningful, safe, and appropriately challenging (Kasser & Lytle, 2013). This extends beyond mere physical presence to encompass genuine engagement, social belonging, skill development, and the pursuit of personal excellence within a supportive community. The concept aligns with the broader international mandates for inclusion, such as the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD), which upholds the right to participate in recreational, leisure, and sporting activities on an equal basis with others (United Nations, 2006).

A significant challenge emerges when children with neurodevelopmental disorders, such as ADHD, encounter traditional one-size-fits-all physical activity programs that fail to accommodate their needs. Regular sports or game sessions tend to emphasize competition, complex rules, rapid decision-making, and high levels of motor skill proficiency—all of which may be difficult for a child with inattention, impulsivity, and motor coordination difficulties (Li et al., 2014). Without intentional inclusion, these children often experience failure, frustration, peer ridicule, and eventual withdrawal—encouraging a cycle of inactivity and negative self-concept.

The realization of IPA is realized in a strategic and appropriate use of a model of adaptation and change. The TREE framework is one such successful model to encourage

implementation of practice modification of four fundamental aspects: teaching style (e.g., visual cues, peer tutors), rules (e.g., simplifying rules, allowing multiple tries), equipment (e.g., using larger, softer, or lighter balls; lowering targets), and environment (e.g., reducing playing area, using clear boundaries, minimizing distractions) (Australian Sports Commission, 2020). Another principle that is also used is Universal Design for Learning (UDL) in physical environments to offer several ways to engage students (choice, relevance), representation (visual, verbal, physical demonstrations) and action & expression (varying ways to perform and demonstrate skills) (Lieberman & Houston-Wilson, 2017).

Within the framework of ADHD, practical IPA strategies are intrinsically multi-sensory and organized. They may include:

- Visual Supports: Picture schedules of the activity sequence, visual timers, and clearly marked boundaries.
- Predictable Structure: Consistent routines for sessions (warm-up, skill practice, game, cool-down) to reduce anxiety and support self-regulation.
- Chunking and Breaks: Breaking down instructions and activities into small, manageable steps with frequent, active breaks to sustain attention.
- Emphasis on Effort and Personal Best: Shifting the focus from winning or outperforming peers to individual effort, improvement, and task mastery.
- Positive Behavioral Strategies: Using clear, consistent expectations, immediate and specific positive reinforcement, and proactive redirection rather than punitive measures.

IPA doesn't mean lowering standards, but raising expectations for participation. It suggests that the activity or setting needs to be adapted to the individual — the child, not the child having to conform to a particular activity. For an ADHD kid, a strategically sequenced inclusive activity can turn physical activity from a stressor to a formidable therapy asset. It offers a

controlled and open platform to work on motor skills, social rules, impulse-management and success, and develop the physical ability and confidence to lead an active life (Goodwin & Watkinson, 2000). Thus, IPA is not an optional adjunct, but is a primary prerequisite for any physical activity intervention targeting, indeed meeting, the needs of children of all abilities, including ADHD.

1.4 ADHD IN INDIA

Attention-Deficit/Hyperactivity Disorder (ADHD), a neurodevelopmental disorder featuring enduring patterns of inattention, hyperactivity, and impulsivity, has risen from an un-addressed disorder to a major health problem in children in India (Arun & Chavan, 2017). Historically, behavioral problems in childhood were commonly linked with disciplinary failures or inherent temperament within Indian cultural frameworks and this resulted in a rampant under-diagnosis and a large “diagnostic gap” (Malhotra & Patra, 2014). But over the past 20 years, mental health professionals in school began to educate themselves and parents have been more aware about its existence. Epidemiological studies conducted as of October 2023 indicate wide variation in diagnosis rates for ADHD among Indian school students spanning 2-17 years of age, including as high as 17%, as predicted globally, suggesting that the prevalence for ADHD among youth is considerably high (Venkata & Panicker, 2013; Thomas et al., 2018). This prevalence translates to millions of children whose academic trajectories, social integration and long-term well-being are at risk without the right support at their ready. The clinical and educational treatment of ADHD in India is severely hampered by systemic impediments such as a paucity of child psychiatrists and clinical psychologists when compared with the population demand, along with major urban-rural inequities in accessing specialist therapies and widespread social stigma hindering help-seeking (Bhola & Chaturvedi, 2020). Moreover, strategies for intervention often rely on pharmacological intervention with predominantly psychostimulants, rather than widespread usage or incorporation of the

evidence-based behavioral, psychoeducational, and lifestyle interventions (Sitholey et al., 2011). To address this service delivery gap, we must identify, validate, and disseminate accessible, cost-effective complementary and alternative interventions that are culturally congruent and acceptable. Rooted in modifiable lifestyle practices, structured physical activity and yogic interventions offer a valuable means of filling this void. They provide support for core ADHD symptoms, associated impairments, and overall development—without the stigma or high costs characteristic of certain traditional treatments.

1.5 TYPES OF ADHD

The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) classifies Attention-Deficit/Hyperactivity Disorder (ADHD) into three broad manifestations, characterized by prominent symptomatology documented within the previous six months. This typology is key to escape a black box understanding of ADHD and customize interventions based on the most salient and disabling behavioral concerns (American Psychiatric Association [APA], 2013). It is divided into: Predominantly Inattentive Presentation, Predominantly Hyperactive-Impulsive Presentation, and Combined Presentation.

ADHD-PI (Predominantly Inattentive Presentation). previously known as Attention Deficit Disorder (ADD) is characterised primarily by major problems with maintaining sustained focus, maintaining organization, and completing tasks, without marked hyperactivity or impulsivity. Kids with ADHD-PI may also come across as daydreamy, forgetful, and easily distracted. However, they frequently have difficulty attending to directions, commit careless errors towards school, lose essential items, and avoid activities that require sustained mental concentration (APA, 2013). Consequently, these students frequently lack adequate support in mainstream classrooms—as they may not disrupt, behave in a disruptive manner—they rather shut off and go silently quiet and their issues are misdiagnosed as lazy, uninterested, or with a learning disability (Milich et al., 2001). They get ignored. This “silent” symptom of the disorder

would have a high risk of being identified and intervened too late in the Indian school environment, which may confuse quietness with compliance (Bhatia et al., 2017).

Hyperactive Impulsive Presentation of the majority (ADHD-HI). This rare presentation, especially in late childhood and adolescence, is characterized by marked hyperactivity and impulsivity with little or no inattention symptoms present. Core signs and symptoms include excessive fidgeting, an inability to maintain a seated position, inappropriate running or climbing, talking excessively, trouble waiting one's turn, and an excessive tendency to blurt out answers or interrupt or talk over others (APA, 2013). Such students frequently receive labels like "always on the move" or acting "driven by a motor." Their behaviors are notably more conspicuous and often regarded as intentionally misbehaving and are subject to more frequent scolding, sanctions, and negative social feedback. Younger preschool-age children typically appear in this presentation since the need for behavioral inhibition is reduced, while the hyperactive-impulsive phenotype remains severely debilitating within formal group settings (Lahey et al., 1998).

Combined presentation (ADHD-C). The Combined Presentation is considered when one has the full diagnostic criteria for inattention and hyperactivity-impulsivity. It is the most common presentation in clinical and referred samples, and is usually correlated with increased overall severity of impairment (Wilcutt, 2012). Children with attention-deficit hyperactivity-disordered type (ADHD-C) display the inattentive type of pervasive attentional dysregulation along with the behavioral disinhibition of hyperactive-impulsive type. This dual burden leads to more frequent academic underachievement, very serious problems with social relationships and a high risk of comorbid problematized conditions; oppositional defiant disorder and conduct problems (Connor et al., 2010). The current study targets children with ADHD-Combined Presentation, the primary clinical group whose primary deficits manifest in cognitive and behavioral dimensions, to which this study was specifically directed. Given their

substantial demand for efforts in order to simultaneously change executive control (focused on attentional deficiencies) and arousal and impulsivity (focused on hyperactivity), they are, in this particular study, a strong candidate group to help inform this study regarding the differential impact of structured movement-based interventions such as aerobic physical activity and Yogic practices on their hyperactivity with which to examine the influence of behavioral and motivational modalities.

1.6 ADHD IN CHILDREN AGED 4-8 YEARS

ADHD is seen in the age group of 4–8. This developmental period from approximately 4 and 8 years of age is a vital time of life where the identification of Attention-Deficit/Hyperactivity Disorder (ADHD) becomes necessary, given that the nature shifts from relatively unstructured home environments to the demands of formal schooling, with unprecedented cognitive and behavioral demands placed on the child. During this period, important symptoms of inattention, hyperactivity and impulsivity—which may have been perceived as normative toddler behavior earlier—are readily apparent and becoming progressively impairing (Willcutt, 2012). This age group is in the Indian context generally associated with the important pre-primary (Kindergarten, LKG, UKG) and early primary education (Classes I and II), encompassing key academic competencies like numeracy, scientific literacy, and digital proficiency. literacy and numeracy and helps with the structured peer interactions that act as the centerpiece of socialization (Kumar & Pradhan, 2018). Those who have undiagnosed or under-treated ADHD in this age group frequently perform poorly in following multi-step instructions, staying on task in teacher-directed tasks, pausing at turn-taking, and emotion regulation, all of which can often be erroneously attributed to willful disobedience or a cognitive gap by school systems and parents (Bhatia et al., 2017).

The impact on this age group of ADHD is serious and immediate. In the academic realm, these children will struggle to catch up in key reading and math skills, a gap of progress

that will increase without assistance when they need it most (DuPaul & Stoner, 2014). On a social level, impulsive and frequently intrusive play behaviors can result in rejection by peers, exclusion from social activities, and internalization of a negative self-image as the “troublemaker” (Hoza et al., 2005). From a family systems perspective in India, Indian parents have reported higher levels of stress, discord in the marriage and a criticism-leaning parenting style partly due to an external pressure towards academic conformity as well as lack of knowledge of this neurobiological condition of young children with ADHD (Prabhakar et al., 2020). In addition, often co-occurring problems, particularly in gross motor coordination, frequently appear in this period. Activities such as running smoothly, catching a ball and hopping—all of which peers achieve easily—can be difficult activities; therefore participation in playground activity is held back further, and social exclusion is reinforced (Fliers et al., 2008). Early intervention, during this stage of plastic neurodevelopment. ADHD symptoms, support lagging academic readiness skills development, improve social competence, and enhance motor competence (e.g., appropriately tailored physical activity programs) are particularly likely to change outcomes in these children and increase resilience, protecting against the cascade of potential secondary academic and psychological comorbidities that frequently characterize later childhood and adolescence.

1.7 THE IMPACT OF PHYSICAL ACTIVITY ON ADHD

Physical Activity (PA) has therapeutic potential beyond the health promotion scope for children with Attention-Deficit/Hyperactivity Disorder (ADHD), providing a strong complementary intervention with demonstrable benefits across the core symptom domains, cognitive functioning, and psychosocial well-being. A growing body of empirical research, including systematic reviews and meta-analyses, supports the efficacy of both acute (single session) and chronic (long-term program) PA in mitigating ADHD-related impairments (Cerrillo-Urbina et al., 2015; Xie et al., 2021).

Reduction in Core Symptom: Structured PA has been consistently effective in reducing the core symptoms of ADHD. The meta-analytic literature suggests that chronic exercise interventions can give improvement in overall ADHD symptoms of small to moderate size with especially strong effects on inattention (Cerrillo-Urbina et al., 2015). When children are exposed to acute bouts of moderate- to vigorous aerobic (e.g., 20-30 minutes) exercise, a temporary effect on attention, on-task behavior, as well as a reduction in disruptive behavior in a classroom setting was observed immediately (Pontifex et al., 2013).

The mechanisms are thought to be neurobiological: PA promotes a rapid increase in the levels of critical neurotransmitters in prefrontal cortex—primarily dopamine and norepinephrine—and similar to the pharmacological action of stimulant drugs (Wigal et al., 2013). This rapid neurochemical rise is thought to increase signal-to-noise ratio within the neural circuit, promoting focus and inhibition of behaviors. Increased Cognitive and Executive Function—One of the most exciting effects of PA is on the functions of executive functions (EFs)—the mental processing involved in the management of behaviors which is severely dysfunctional within ADHD. Meta-analyses suggest that interventions involving exercise, especially cognitively appealing ones (e.g., martial arts, team sports with strategy demand), produce moderate changes in core EFs like inhibitory control, working memory, and cognitive flexibility (Liang et al., 2021). This "EF hypothesis" of PA benefits posits that activities that require continuous self-regulation, attention-shifting, and working memory (e.g., recall of intricate sequences of movement) represent a mode of "cognitive training in motion." Research by Skriver and colleagues (2014) demonstrates that chronic physical activity induces neuroplastic changes through mechanisms including elevated Brain-Derived Neurotrophic Factor (BDNF). BDNF in turn supports neuronal health, synaptic plasticity, and growth of attention-related neural structures, particularly the prefrontal cortex and hippocampus.

Psychosocial and Motor Skill Benefits: PA effect is not only related to thinking but also to motor functioning. Frequent engagement in managed, inclusive PA may play involvement in promoting positive peer-related behaviors as it offers students a supervised environment in which to practice turn taking, cooperation, and rules (Gapin & Etnier, 2010). Self-confidence and self-esteem may also become affected by successful physical behaviours and can in turn offset the negative self-views which are often influenced by academic and social failures. Importantly, as detailed, many ADHD children also exhibit co-occurring gross motor skill deficits. A properly planned and implemented PA plan can remediate these deficits directly; it supports the improvement of fundamental locomotor and object-control skills, thus interrupting the motor incompetence resulting in PA avoidance (Harvey & Reid, 2003).

Specificity considerations: the relationship between PA impact is not universal, and is tempered by the specifics of the PA. Pontifex et al. (2013) show moderate-to-vigorous activity exerts stronger effects than light activity. In addition, cognitively-engaging exercise (e.g., martial arts, dance, tactical sports) could have a greater effect on EFs compared to simple aerobic exercise (e.g., treadmill running) since they both engage the brain and body and providing power (Diamond, 2015). Chronicity and structure is an notable aspect of it; longer follow-up programmes (e.g., 8-12 weeks) with stable routines are more enduring than episodic exercise. PA is effective as a multimodality intervention for ADHD, targeting the neurochemical, cognitive, behavioural, and motor aspects of ADHD. It serves as a non-stigmatizing, available, and no-harm treatment supplement to the traditional treatment. For a child with ADHD, routine PA is not an amusement also a powerful intervention in modifying daily life for them that will enable them to achieve lifelong developmental support through the developmentally adaptive process which may ultimately make a long-term positive impact.

1.8 YOGIC PRACTICES

Yogic methods are a multi-layered, time-honored, holistic discipline, originating in India, for the mastery of physical postures (asanas), controlled breathing techniques (pranayama), and meditative awareness (dhyana/dharana) in order to align mind, body, and spirit in a harmonious order (Iyengar, 1966). Yoga is now being reinterpreted as a secular, therapeutic approach which focuses on mindfulness, self-regulation, present-moment awareness, and physiological modulation in modern health and education settings. It is an all-out practice of mind-body integration with one ‘mind’ (Khalsa & Butzer, 2016), maintaining it as a practice of attention to the bodily sensations, breath, and movement sequences (Khalsa & Butzer, 2016). This deliberate internal integration separates yoga from many forms of physical exercise in the West, in which stress is placed on external performance or cardiovascular activity, as opposed to inner thought and regulation.

1.9 THERAPEUTIC YOGA PROTOCOL FOR CHILDREN

Asanas (Postures): A collection of static and dynamic poses aimed at increasing strength, flexibility, balance, and body awareness. These vary from simple grounding postures such as Tadasana (Mountain Pose) to balancing poses such as Vrikshasana (Tree Pose) and soothing forward folds.

Pranayama (Breath Regulation): Techniques based on conscious control of the breath, including deep diaphragmatic breathing (Dirgha Shvasana), alternate nostril breathing (Nadi Shodhana), or extended exhalation. These techniques positively stimulate the autonomic nervous system, encouraging a switch from sympathetic (fight-or-flight) to parasympathetic (rest-and-digest) control (Brown & Gerbarg, 2005).

Dhyana/Dharana (Meditation & Concentration): Activities meant to develop directed concentration and mindful awareness. For children, that could be simplified to short stretches of guided relaxation (Yoga Nidra), mindful listening, or single-focus (Trataka).

Multi-system effects are a potential therapeutic rationale for yoga in neurodevelopmental and behavioral conditions. From a physiological perspective, long-lasting engagement can reduce basal cortisol levels, increase heart rate variability (an indication of autonomic resilience), and lower physiological arousal (Telles et al., 2013) through continued practice. Neurologically, Yogic practice increases activation and connectivity of prefrontal regions supporting executive function and self-regulation while reducing amygdala activity, a key stress and emotional reactivity hub (Froeliger et al., 2012).

Yoga is such a customized intervention for children with Attention Deficit/Hyperactivity Disorder (ADHD) as it directly addresses key deficits. This challenge to hold postures with attention and control counteracts impulsive and hyperactive behaviors by encouraging physical stillness and disciplined movements. The emphasis on breath and body sensation helps ground wandering focus and teaches the ability to maintain mindfulness (dharana) for an extended period (Hariprasad et al., 2013). In addition, the non-competitive, process-oriented nature of yoga reduces performance anxiety and provides a safe environment for who may struggle with the social and motor demands of team sports.

Regarding the Indian context, yoga has significant cultural resonance and acceptance that could minimize the barriers of adoption faced with more Western-influenced interventions. Research in India has now begun to confirm the empirical benefits. For example, Kauts and Sharma (2009) conducted a randomized controlled trial and found that a school-based yoga program with patients experiencing ADHD dramatically reduced symptoms such as inattention and hyperactivity and improved attention span as and social adjustment to match with a control

group. A further paper from Hariprasad et al. (2013) showed that adolescents exhibited marked reductions in anxiety and improvements in emotional regulation with yoga practice. Rooted in a unified mind-body framework, yoga practices provide a culturally congruent, evidence-informed means of enhancing self-regulation, emotional stability, and cognitive focus in youth with ADHD while addressing the core challenges characterizing this condition.

1.10 IMPACT OF YOGIC PRACTICES ON ADHD

Educating your children on an internal view of self-regulation. Modulating the outcomes from Yogic practices on pediatric populations with ADHD (Attention-Deficit/Hyperactivity Disorder) marks signals a move beyond behavior management directed on the external to training on internal self-regulation. With its focus on the neurocognitive, emotional, and physiological dysregulation that characterizes ADHD, yoga, as a multimodal mind-body intervention, is uniquely positioned to target individual behaviours that result in significant effects independent of, and complementary to, traditional physical activity (Jensen & Kenny, 2004).

1.10.1 REGULATION OF CORE ADHD SYMPTOMS:

The modulating activity of asanas (postures) and pranayama (breath control) addresses inattention, hyperactivity, and impulsivity directly. There are reports of post-intervention reductions of parent- and teacher-assessed ADHD symptoms in participants from yoga programs. For example, results from Kauts and Sharma (2009) shows that involved in a 7-month school-based yoga program experienced significantly larger reductions in total ADHD scores, inattention, and hyperactivity compared to a physical exercise group and a control group. The mechanism is ascribed to yoga's demands for prolonged, focused attention on body and breath that encourages attentional control, whereas holding postures with stillness directly works against both motor impulsivity and restlessness (Peck et al., 2005).

1.10.2 INCREASE IN EXECUTIVE AND SELF-REGULATORY ABILITIES:

Yogic practices are considered strong "cognitive training in stillness" practices. The ongoing practice of attending to the wanderings of the mind in meditation (dhyana) and mindfully re-directing attention to the breath or a mantra augments meta-awareness and cognitive control—two processes found to be deficient in ADHD (Zylowska et al., 2008). Research indicates that yoga enhances specific executive functions. Improvements are evident in response inhibition, working memory, and cognitive flexibility (Chou & Huang, 2017). This enhancement is neurologically plausible, given yoga's connection with greater prefrontal cortex (PFC) activation and cortical thickness, and lower amygdala reactivity. It suggests superior top-down regulation of attention and emotion (Froeliger et al., 2012).

1.10.3 PSYCHOPHYSIOLOGICAL REGULATION AND STRESS REDUCTION:

The most prominent impact of yoga is its impact on the autonomic nervous system (ANS). Children with ADHD show an altered ANS response which may include increased sympathetic ("fight-or-flight") tone and reduced parasympathetic ("rest-and-digest") activity. Yoga-based pranayama and relaxation practices have been shown to increase heart rate variability (HRV) and decrease salivary cortisol levels, both of which demonstrate improvements in autonomic balance and lowered physiological stress (Telles et al., 2013). Thus the physiological substrate is soothed so that the level of anxiety decreases, emotional reactivity improves, and people develop a better tolerance to frustration, which are some common comorbid features found in patients with ADHD (Hariprasad et al., 2013).

Related Domains: Motor Skills and Self-Esteem: Although less researched than cognitive effects, yoga affects motor functioning as well. The practice of balancing (e.g., Vrikshasana/Tree Pose) together with coordinated movement sequences improves proprioception, balance, and motor planning. This can indirectly address the gross motor clumsiness commonly seen in children with ADHD. Additionally, the non-competitive,

mastery-oriented character of yoga encourages a sense of self-efficacy and competence. Attaining a pose or maintaining focus on the breath provides immediate, tangible success, which can bolster self-esteem often eroded by frequent academic and social failures (Haffner et al., 2006).

The influence of various yogic techniques on ADHD is multidimensional and synergistic. It operates by simultaneously calming the physiological arousal system via the ANS, strengthening the cognitive control network in the PFC, and training attentional and behavioral inhibition through disciplined practice. For the Indian child with ADHD, yoga provides a culturally congruent, safe, and holistic intervention that empowers self-management from within. It moves beyond merely expending excess energy to cultivating the inner stillness and control that are foundational for improved behavioral, academic, and social functioning.

1.11 INDIVIDUALIZED EDUCATION PROGRAM (IEP)

The Individualized Education Program (IEP) is a legally mandated, written document and process that is the cornerstone of special education provision in inclusive education systems worldwide. It aims at guaranteeing a disabled child, including neurodevelopmental conditions like Attention-Deficit/Hyperactivity Disorder (ADHD), a Free Appropriate Public Education (FAPE) designed solely for their unique needs (Yell, 2019). According to India's Ministry of Law and Justice (2016), the Rights of Persons with Disabilities Act (RPWD Act), 2016, emphasizes individualized support—a principle increasingly recognized in progressive inclusive education policies. This mirrors the philosophical approach of the United States' Individuals with Disabilities Education Act (IDEA), though the legal frameworks differ significantly.

IEP isn't a set document but an interactive process which is in progress and in constant collaboration. The team is typically composed of the parents, general and special educators,

school administrators, and related service providers (e.g., occupational therapists). To qualify, before a child is said to be eligible a full evaluation must find that the disability adversely affects educational performance. The IEP has a number of principal parts which help the document move from assessment to actionable support:

1. Current levels of academic achievement and functional performance (PLAAFP): gives a summary of the child's functioning and development through an explicit measure of his or her academic, social, behavioral, and motor ability. This would describe, for a child diagnosed with ADHD, not just academic scores, but specifics about their attention span in various subject areas, their ability to limit impulses within group settings, their organizational skills, and their social interactions. The PLAAFP could be an item that identifies the current levels of performance but with some specific criteria such as age level, discipline, participation in group or oral activities or behavior.

2. SMART goals—those that are specific, measurable, achievable, relevant, and time-bound—guide annual target-setting based on the PLAAFP. For a child with ADHD, goals could be academic productivity (e.g., “Will independently complete 80% of in-class assignments with no more than 2 prompts for redirection”), behavioral regulation (e.g., “Will utilize a self-monitoring checklist to reduce calling-out behaviors to fewer than 3 times per class period”) or organizational skills.

3. Education and Related Services – a description of the specialized instruction, supports, and services the child will receive for special education, including their frequency, duration, and location. That could involve resource room support, counseling, or occupational therapy. Accommodations and Modifications are important adjustments to how the child accesses the general curriculum (accommodations) or they asked to learn (modifications).

4. A child with attention difficulties, accommodations may include: preferential seating, extended time on tests, frequent breaks, use of graphic organizers, and the provision of lecture notes (DuPaul & Stoner, 2014).

5. Participation with Non-Disabled Peers: An explanation of the extent to which the child will not participate in the general education classroom and activities.

6. Transition Planning: For older students, plans for post-secondary education, employment, and independent living.

Formal IEPs are slowly becoming mainstream implementation in special schools in India, as well as in inclusive classrooms, mostly in private and some government-aided institutions, but widespread systematization remains a complex issue (Das, 2021). In reality, a successful IEP can transform lives for children suffering from ADHD. It moves the focus from the child's deficits to a strengths-based, legally accountable plan for success. It offers teachers a roadmap for teaching and demands that the system provide the necessary supports. Since the IEP is making accommodations like movement breaks or chunked assignments, it is now focusing more immediately on ADHD's neurological basis from a learning perspective in the educational context, reducing academic barriers to enabling the child to present as truly able as possible. That is why the IEP is more than an administrative act: It is the vehicle through which the idea of educational equity and customized instructions.

1.12 INDIVIDUALIZED PHYSICAL EDUCATION PROGRAM (IPEP):

It is called the IPEP since it acts as a key extension of the ideals behind the Individualized Education Program (IEP), and directly translates that philosophy of personalization and adaptation into the field of physical education and motor development. An IPEP is a formal, will design individualized goals, modifications, instructional methods, and assessment procedures to address a student with a disability in physical education (Lieberman

& Houston-Wilson, 2017). The wants to provide an academic level of discipline to achieve the physical education needs of students with Attention-Deficit/Hyperactivity Disorder (ADHD) where physical achievement is limited by co-occurring motor skill deficits and behavioral dysregulation is the basis for this; the curricular structure of generalized physical education, typically developed in a similar manner to traditional classroom teaching, may also become an overly challenging the subject's learning curve (Fliers et al., 2008).

A school IPEP is developed in a manner closely associated with an IEP, involving the physical educator, special educator, parents, relevant service providers (i.e., occupational or physical therapist) and when applicable the student. The central elements are adapted to convert general education entitlements into specific gym or playground programs:

1. Present Levels of Motor and Functional Performance (PLMFP): This is the raw data that details the student's specific challenges around physical activity. For a child with ADHD, these would be assessments of gross motor skill proficiency (e.g., with the Test of Gross Motor Development-3) and health-related fitness components; sensory processing impairments impacting movement; social interaction when engaged in games; and behavioral issues in unstructured, high sensory-stimulating environments (impulsivity while involved in team sports, turn taking challenges).

2. Annual Measurable Motor and Participation Goals: Goals are based directly on the PLMFP and are SMART (Specific, Measurable, Achievable, Relevant, Time-bound). Instead of broad goals like "get better at sports," an IPEP goal for a child with ADHD might be: "Given visual cues and peer modeling, the student will successfully perform a two-hand chest pass to a stationary partner from 5 feet away, in 4 out of 5 trials, semester's end," or "Using a self-monitoring timer, the subjects can engage in a cooperative small-group game for 10 minutes without leaving the designated area, in 3 out of 4 weekly sessions."

3. Specially Designed Physical Education Instruction: This details the how of teaching. It specifies the instructional methodologies, prompts, and reinforcement strategies most effective for the individual student. For ADHD, this may include: using visual schedules and task cards to sequence activities; implementing consistent routines and clear, concise verbal instructions; employing peer tutors or paraeducators for support; and using immediate, specific, and positive feedback.

4. Accommodations and Modifications: These are the operational core of the IPEP showing how the activity, equipment, rules or environment have changed, so that meaningful access will be achieved. Based on the frameworks established in TREE (Teaching style, Rules, Equipment, Environment), one of the adaptations for a child with ADHD could be:

Equipment: Using larger, softer, or lighter balls; lowering the basketball hoops; using beanbags instead of balls.

Rules: Simplifying game rules; allowing for "multiple lives" or do-overs; focusing on personal best rather than competition.

Environment: Using cones to clearly define boundaries; reducing team sizes; minimizing auditory and visual distractions; designating a "calm-down" space within the activity area.

Task Demands: Chunking complex skills into smaller steps; reducing the duration of sustained activity with built-in movement breaks; offering choice in activities to increase motivation.

5. It will assess the student's growth in relation to his objective area of motor goals and how that is measured is to be based not on normative comparisons against peers, but through adapted, criterion-referenced assessments.

For young persons with ADHD, the definition of the IPEP is not a mechanism of exclusion but an inclusion tool with a supportive framework. This approach transforms physical education from a potential source of failure or anxiety into a focused, predictable, and successful environment for learning. The IPEP directly targets an area of greatest need by focusing on the development of gross motor skills through adapted instruction, which in turn fosters physical competence necessary to improve self-confidence and lifelong engagement in physical activity. To all researchers, the IPEP principles underlie the need to develop targeted, replicable, and ethically oriented PA, which are targeted on a personal/institutional basis, as the present study will be.

1.13 MOTOR SKILLS

These are learned sequences of intentional movements that support successful navigation of the environment. These skills can be seen as the neurobehavioral conversion of intention to action, and involve the interplay of the nervous, muscular, and skeletal systems (Haywood & Getchell, 2019). Mastering and developing motor skills is as much an aspect in every child's development — cognitive, social, emotional and perceptual — and not just for the sake of bodily performance. According to Schmidt and Lee (2019), motor learning refers to a relatively permanent change in the capacity to perform a skill through practice or experience, constituting a fundamental aspect of human development that profoundly influences everyday functioning and quality of life. Motor skills themselves divide into two primary types: gross motor skills (GMS), involving large muscle groups, and fine motor skills (FMS), involving smaller, precise movements.

Gross Motor Skills: Involve the coordinated use of large muscle groups and the movement of the whole body or major limbs. These foundational skills are the primary focus of this study and include locomotor skills (e.g., running, jumping, hopping, galloping), object control/manipulative skills (e.g., throwing, catching, kicking, striking), and stability skills (e.g.,

balancing, bending, twisting). Proficiency in gross motor skills is a prerequisite for participation in play, sports, and many activities of daily living (Gallahue, Ozmun, & Goodway, 2012).

Fine Motor Skills: Involve the precise, coordinated use of the small muscles of the hands, fingers, and wrists, often in synchrony with the eyes (visual-motor coordination). Some tasks such as for writing, drawing, buttoning, using utensils, and manipulating small objects depends on these skills.

1.13.1 SPECIFICITY OF MOVEMENT PATTERN

Discrete Motor Skills: These have a distinct start and finish, and they tend to be relatively short (e.g., throwing a ball, pressing a button, kicking).

Serial Motor Skills: A series of discrete movements strung together in an organized sequence (e.g., performing a gymnastics routine, tying shoelaces, the sequence of a tennis serve).

Continuous Motor Skills: Have no recognizable beginning or end; the action is cyclical and repetitive (e.g., running, swimming, cycling).

The evolution of motor competence is a fairly predictable, but not fixed, trajectory, from simple to complex, and from gross to refined, dictated by an interaction of constraints (Newell, 1986). These include:

Individual Constraints: Such as neurological maturity (such as prefrontal cortex development for planning) or cognitive features (attention or motivation) or physical structure (height, strength, muscle tone). The restrictions of ADHD in children include core deficits in executive function (planning, inhibition), and often, underlying patterns of neurodevelopmental delay influencing motor coordination (Fliers et al., 2008).

Environmental Constraints: The external factors of the environment; space, surfaces, equipment; sociocultural context (play opportunity, parent encouragement), task rules.

Task Constraints: Those related to the goals and rules of the activity itself (e.g., size of a ball, distance to a target).

In children with ADHD, the acquisition of motor skills is frequently impaired. The distinctive inattention of this inattentive quality can disrupt the type of observational learning and concentration that is necessary for processing demonstrations and feedback. Impulsiveness may result in incomplete planning of movement and insufficient execution. Hyperactivity can present as clumsy, poorly modulated force and rhythm. Thus, a significant subset (30 percent to 50 percent) is diagnosed as having Developmental Coordination Disorder (DCD), a condition that shows significant motor dysfunction and thus is severe enough to disrupt normal activities of daily living, as well as academic performance (APA, 2013; Kaiser et al., 2015). This motor deficit is not a side problem; it sets off a downward spiral of negative consequences. Poor motor skills lead to avoidance of sport, reduce practicing time in sports, lower physical fitness, decrease self-efficacy and socializing opportunities, and increase sedentary habits—all factors that increase ADHD symptoms and accompanying problems (Cairney, Hay, et al., 2005).

We need to understand motor skills—the categorization, the pattern of development, and the special barriers that children with ADHD face. It explains why an intervention, such as training curricula for physical exercise, must explicitly focus on how to become proficient with gross motor skills. Achieving this foundational “trainable” domain is essential in the effort to halt the cycle of motor incompetence and promote overall physical, social, and psychological well-being.

Gross Motor Skills: The Cornerstone of Physical Literacy and Daily Function. Gross Motor Skills (GMS) encompass the coordinated movements of the major muscle groups of the body—the arms, legs, and torso—to produce actions essential for mobility, stability, and object interaction. These skills form the core "movement vocabulary" upon which all complex physical activities, sports, and many everyday tasks are constructed (Gallahue, Ozmun, & Goodway, 2012). Understanding the importance of GMS is the very basis for physical literacy—the drive, assurance, physical skills, cognizance, and recognition to appreciate and assume responsibility for engagement in physical activities throughout life (Whitehead, 2010). Developing these capabilities is not an automatic matter of maturation—it needs many opportunities to practice, learn, and practice within supportive environments. Generally, GMS can be grouped into three interrelated groups:

Locomotor Skills: These skills move the body through space from point A to point B. They underpin nearly all play and athletic movement.

- Running: A gait pattern incorporating an aerial phase—a brief period when both feet leave the ground.
- Jumping: A movement involving takeoff from one or two feet, followed by a landing on both feet.
- Hopping: Propelling off and landing on the same foot.
- Galloping & Sliding: A forward (gallop) or sideways (slide) step-close pattern.
- Skipping: An alternating step-hop pattern, a more complex rhythmical combination of a step and a hop (Haywood & Getchell, 2019).

Object Control/Manipulative Skills: These skills include applying force to objects (throwing, kicking, striking, etc.) or receiving force from objects (catching, trapping, etc.). They are vital for game play and participation in sports. Essential skills include:

- Two-hand Underhand Throw & Catch
- One-hand Overhand Throw
- Kicking a Stationary/Moving Ball
- Dribbling a Ball with Hands or Feet
- Striking with a Bat or Racket

Stability (Non-Locomotor) Skills: Balance and control of the body in place. They form the postural basis for every other movement.

- Static Balance: Holding a stationary position (e.g., standing on one foot).
- Dynamic Balance: Maintaining equilibrium while moving (e.g., walking on a balance beam, cycling).

Axial Movements: Bending, twisting, stretching, and turning while stabilized.

The progression toward GMS ability takes a sort of general chronological and hierarchical approach, from simpler to more advanced (most commonly divided according to phases: first stage (awkward, uncoordinated attempts), then elementary (improved control and rhythm), and mature (efficient, coordinated, and mechanically sound performance) (Gallahue et al., 2012). Achieving the mature stage in basic activities by primary school age (6-8 years) is an important milestone, and, in this sense, it allows the child to complete the complex games and sports prevalent in middle childhood.

The achievement of GMS skills in children with Attention-Deficit/Hyperactivity Disorder (ADHD) is highly complicated. Their core symptoms have an immediate effect on the motor learning process. Inattention disrupts the ability to observe, process, and remember motor demonstrations and verbal instructions. Impulsivity causes poorly planned and hurried movement executions without proper sequencing or force modulation. Hyperactivity leads to excessive, poorly regulated movement, resulting in clumsy and inefficient skill patterns

(Harvey & Reid, 2003). Neurologically, these children may exhibit disparities in cerebellar function and connectivity, as well as prefrontal-striatal circuits linked to motor planning and timing—systems essential for smooth, coordinated movement (Kaiser et al., 2015). Therefore, children affected by ADHD report significantly poorer performance on standardized tests of GMS, including the Test of Gross Motor Development (TGMD), greater impairments particularly pronounced in object control skills which involve precise timing and visual-motor integration (Fliers et al., 2008). The consequences of low GMS are drastic and far-reaching, leading to a devastating developmental sequence:

Low Participation: As children feel unable to perform physical tasks, they refrain from doing them which results in reduced practice, diminished fitness, and increased sedentary behavior (Cairney et al., 2005).

Social Difficulties: Failure to engage competently in playground games results in peer rejection, social isolation, and missed opportunities to develop social skill competence.

Decreased Self-Esteem: The repetitive failure of one's play during the highly visible arena of physical play lowers self-confidence and perceived self-efficacy.

Academic and Functional consequences: A lack of postural control and coordination may influence classroom behaviors (sitting still and handwriting).

Targeted intervention for GMS improvement, then, is not a luxury of children with ADHD but rather a central therapeutic goal of this population. This core area of deficit can be directly remedied through a structured physical activity program that provides explicit instruction, corrective feedback, and plenty of successful practice of fundamental motor skills. These approaches, by establishing GMS competence, aim to interrupt the negative cascade leading to enhanced physical activity, social inclusion, and positive self-concept — and in so doing, target several areas of impaired performance from a single, foundational point.

1.14 INDIVIDUALIZED PHYSICAL ACTIVITY PROGRAMME (IPAP)

The Individualized Physical Activity Programme (IPAP) is a systematic, prescriptive framework for designing, implementing, and assessing IPAP for individuals with unique needs, as described in the textbook *Principles and Methods of Adapted Physical Education and Recreation* (Roth, Zittel, Pyfer, & Auxter, 2017). The Individualized Physical Education Program (IPEP) is specific to school-based curricular adaptations, but IPAP is a broader concept that can be utilized in clinical, community, recreational, or research contexts to structure therapeutic or health-oriented physical activity. The IPAP process operationalizes the core principle of "individualization," ensuring that movement programming is not generic but is precisely tailored to the participant's assessed abilities, goals, and contextual constraints. Based on Roth et al. (2017), the development of an effective IPAP follows a cyclical, data-driven process consisting of four key phases:

Assessment and Evaluation: This initial step can maintain with collecting thorough, unbiased info regarding the individual. For the child with ADHD, like this we add higher than a medical diagnosis:

Evaluation of Motor Proficiency: Use of formal assessment tools—e.g., Test of Gross Motor Development (TGMD-3) or Bruininks-Oseretsky Test of Motor Proficiency (BOT-2)—to establish a baseline for locomotor and object control skills.

Health-Related Fitness: Cardiovascular endurance; muscular strength and endurance; flexibility; body composition

Cognitive-Behavioral Factors: Attention span, compliance as required, responses to reinforcement, frustration tolerance, and social interactions in physical activities.

Ecological Assessment: The environmental contexts of being in (home, school, and community), in which physical activity will be conducted, and the available resources,

supports, and limitation to PA in such conditions (Roth et al., 2017). This phase is how the program is constructed on a profile of strengths and needs, not assumed.

1.14.1 PROGRAMME PLANNING AND GOAL SETTING:

Through assessment information, the practitioner then assembles the written IPAP document. This includes:

Long-Term Goals (Objectives): High-level, The outcome are connect to physical is in the individual's needs (e.g., "Increase general motor competence and allow participation in community soccer" or "Increase weekly minimul to maximul PA to meet WHO guidelines").

Short-Term Instructional Objectives: Specific, measurable, and time-bound performance targets that help guide to long-term goals. For gross motor skills in ADHD, an example of an objective might be: "Given verbal and visual cues, the child will demonstrate a mature overhand throwing pattern (step with opposition, follow-through) for 4 out of 5 trials in three consecutive sessions" (Roth et al., 2017).

Activity Selection & Adaptation: Adapt and choose activities using frameworks such as TREE (Teaching style, Rules, Equipment, Environment) and STEP (Space, Task, Equipment, People) to ensure appropriate success. For ADHD, these could be the use of visual schedules (Teaching), simplifying rules, adding softer or larger balls (Equipment), and reducing distractions (Environment).

1.14.2 IMPLEMENTATION OF IPAP:

This is the teaching and coaching phase, where the planned programme is put into action. Key principles from adapted physical education emphasize:

Systematic Instruction: Using clear demonstrations, task analysis (breaking skills into components), and consistent cueing.

Prompting and Fading: Providing the necessary assistance (physical, verbal, visual) to ensure success, then gradually removing prompts as skill and independence increase.

Positive Behavioral Support: Structuring the environment and using reinforcement strategies to manage off-task and impulsive behaviors proactively, rather than relying on punishment (Roth et al., 2017).

Data-Based Decision Making: Continuously recording performance on short-term objectives to monitor progress.

1.14.3 REVIEW AND REVISION OF IPAP:

IPAP is a dynamic document. Progress is formally assessed in comparison with the established objectives at pre-set intervals (e.g., every 8 to 12 weeks).

Re-assessment: The primary evaluation measures are re-administered to identify and measure change.

Programme Analysis: The team examines what worked and what did not. Were the activities appropriately challenging? Was reinforcement effective?

Revision: The IPAP is revised on the basis of the review data. Goals may be updated, teaching approaches modified, or new activities introduced to continue to sustain student engagement and growth (Roth et al., 2017). This ensures that the programme remains responsive to the individual's evolving needs and abilities.

1.15 IPAP APPLICATION TO ADHD & GROSS MOTOR SKILL RESEARCH:

In an investigation of PA on subjects with ADHD, the IPAP guide gives researchers the methodological rigor needed for study validity in the intervention group. It mandates:

Baseline examination: Before the intervention, use a tool such as the TGMD-3 to determine pre-intervention motor skill levels.

Individualisation within group design: Research may have a group protocol such as “Fundamental Movement Skill Training”: The IPAP model would advocate for pacing of a study, feedback and support provided to students over time through similar group protocol to match different skill and attention levels.

Systematic Progression: Planning sessions for clear, increasingly difficult tasks according to tenets of motor learning.

Objective Measurement of Outcomes: The same standardized assessment used following the intervention for evaluation of effectiveness.

Basing the intervention on the IPAP process will enable both researchers and practitioners to shift away from a one-size-fits-all ‘exercise prescription’ and towards a customised, personalised, accountable, and evidence based programme of movement based interventions. This approach is necessary for recognising and responding to the many and varied needs of children with ADHD and for producing evidence that is meaningful and capable of being replicated on such phenomena as the impact of PA on certain outcomes such as gross motor skill development.

1.16 PURPOSE OF THE STUDY

The primary purpose of this study is to evaluate the efficacy of two distinct 24-week structured movement interventions Individualized Physical Activity Programme (IPAP) and Yogic practices (YP) programme on improving gross motor skill development in children aged 4–8 years diagnosed with ADHD-Combined Type (ADHD-C) within the Chennai metropolitan region.

1.17 NEED FOR THE PRESENT STUDY

Basic physical skills such as running, jumping, and catching often present challenges for children with ADHD. These motor problems are usually overlooked in India, where

treatment focuses mainly on attention and behavior. While exercise is known to help, parents and doctors in Chennai lack clear guidance on what type of activity works best—regular physical games or Yogic practices and how to run it effectively at home over a long period. This study is needed to fill that gap by testing two practical, 24-week home programs to see which one most improves children's movement skills.

Chennai also lacks sufficient research in this area using trusted tests like the TGMD-3 to measure these skills. Most programs are copied from Western countries and aren't adapted for local families. This study will provide clear, local evidence to help parents, therapists, and schools choose the right activity program. This study will also assess whether a parent-led, home-based model proves viable. Such an approach could make support more affordable and accessible for Chennai families requiring assistance with their child's overall development.

1.18 RATIONALE OF THE STUDY

Gross motor deficits are common among children with ADHD-C in Chennai. Yet these difficulties remain largely unaddressed, underscoring the need for this study. These disabilities hamper physical activity, social participation, and holistic development. Physical activity and Yogic practices are both advocated, however, there is no comparative evidence to determine whether an Individualized Physical Activity Programme (IPAP) or Yogic practices (YP) is more effective in remediation for motor skills. A long term, parent-assisted home model is also untested locally at this time. The current study would specifically fill these gaps with a home based, 24-week intervention. The results will offer important, evidence-based insights for clinicians and they must allowed by family to offer targeted, accessible assistance to help motor competence and overall well-being in this population at high risk.

1.19 HYPOTHESES OF THE STUDY

- H₁: The Individualized Physical Activity Program (IPAP) was expected to produce significant improvements in selected gross motor skills among children with ADHD.
- H₂: Yogic practices were expected to produce significant improvements in selected gross motor skills among children with ADHD.
- H₃: The Individualized Physical Activity Program (IPAP) was expected to produce more substantial improvements in selected gross motor skills among children with ADHD than Yogic practices.
- H₄: Children with ADHD participating in the IPAP were expected to show significantly greater improvement in gross motor skills than those in the control group.
- H₅: Children with ADHD participating in Yogic practices were expected to show significantly greater improvement in gross motor skills than those in the control group.
- H₆: Children with ADHD participating in the IPAP were expected to show significantly greater improvement in gross motor skills than those participating in Yogic practices.

1.20 SIGNIFICANCE OF THE STUDY

Motor skills for ADHD: This study will assess gross motor skills in children with ADHD, including fundamental movements like running, throwing, and catching. The findings will offer valuable insight into their motor capabilities.

Guide Physical Education Teachers: Findings will assist physical education teachers in designing games and activities tailored to children with ADHD, ensuring both engagement and developmental benefit.

Support Special Educators: The results can be used by special educators to identify the appropriate type of physical activities in each child's learning plan (IEP).

Motor Skill Profiles of Children with ADHD: This research will generate detailed profiles of movement strengths and challenges in this population.

Improve Quality of Life: Through enhanced motor skills, we want to reduce frustration so that children might be more confident and participate more in play, leading to a happier, better life.

Create a Path to Sports: The first step in playing games is to build basic motor skills. This project could aid in identifying and training future athletes for events such as the Special Olympics.

1.21 LIMITATIONS

Limitations are variables in study design that the researcher cannot control and can influence the findings.

1. Small sample size: Only 45 boys (15 in each group). It also makes small differences harder to spot and results may not generalize to all children with ADHD in Chennai.
2. Parent-Led Intervention: The program is family-centered and administered by parents, supported by remote monitoring. Program delivery quality and consistency may differ greatly among family households in light of parental knowledge, motivation, and commitment, which may affect fidelity and success of the intervention.
3. Parent Involvement Not Standardized: Parents will help during sessions, but each parent may help differently. This difference will make change how much each child benefits.
4. Possible Unblinding: The motor skills assessor remains unaware of each child's group allocation. However, children or parents may unintentionally disclose this information during testing sessions.

5. **Specific Content of Intervention:** Only selected physical activities and Yogic practices were included in the 24-week training period. Other forms of physical activity or any kind of exercise were not screened for.
6. **Limited Population:** Participants were assessed only in children diagnosed with ADHD-Combined Type. Participants diagnosed with other subtypes of ADHD or coexisting physical/mental disability were not included, thereby restricting the generalizability.
7. **Uncontrolled Lifestyle Factors:** During the study period, factors such as diet, general lifestyle, personal habits, daily motivational level, and daily activities were not controlled or measured.
8. **Baseline Differences Not Controlled:** The prior fitness level, socioeconomics of the children, and the family situation socioeconomic status were not assessed or controlled.

1.22 DELIMITATIONS

Delimitations are decisions the researcher makes to establish guidelines for the study as a whole.

1. **Duration:** The intervention period was strictly 24 weeks for both the physical activity and Yogic practices groups.
2. **Diagnostic Specificity:** Children with ADHD-Combined Type diagnosis represented the inclusion criteria. Children with other forms of ADHD or additional disabilities were excluded.
3. **Study Outcomes:** The primary outcome measured was gross motor skills.
4. **Assessment Method:** A pre-test/post-test design consisted of two measurement points (before and immediately after the intervention).
5. **Measurement Tool:** Outcomes were evaluated by the Test of Gross Motor Development (TGMD-3). Other motor assessment tools or behavioral measures were not included.

6. Intervention Specificity: The interventions compared were a structured physical activity program and a structured yogic program.
7. Control Group Design: Those assigned to the control condition did not receive any intervention and functioned solely as a waitlist comparator.

1.23 DEFINITIONS OF TERMS

1.23.1 Attention-Deficit/Hyperactivity Disorder (ADHD)

ADHD is defined as a neurodevelopmental disorder involving persistent patterns of inattention and/or hyperactivity-impulsivity that impair functioning or development (American Psychiatric Association, 2013).

1.23.2 ADHD-Combined Presentation (ADHD-C)

The combined presentation of ADHD is diagnosed when an individual meets the full diagnostic criteria for both inattention and hyperactivity-impulsivity. (American Psychiatric Association, 2013)

1.23.3. Gross Motor Skills (GMS)

Coordinated movements of the large muscle groups of the body to produce foundational actions for mobility, stability, and object interaction, including locomotor, object control, and stability skills. (Gallahue, Ozmun, & Goodway, 2012)

1.23.4. Physical Activity (PA)

Physical activity refers to skeletal muscle-driven movement that elevates energy expenditure above resting levels (Caspersen et al., 1985).

1.23.5. Fundamental Movement Skills (FMS)

The basic, learned motor skills that form the foundation for more advanced, sport-specific movements, categorized as locomotor, object control, and stability skills. (Gallahue et al., 2012).

1.23.6. Inclusive Physical Activity (IPA)

A philosophy and practice ensuring equitable access, participation, and success in physical activity for people of all abilities by adapting activities, rules, equipment, and environments. (Kasser & Lytle, 2013)

1.23.7. Yogic practices

A holistic mind-body discipline integrating physical postures (asanas), controlled breathing techniques (pranayama), and meditative awareness (dhyana) to foster self-regulation and integration. (Khalsa & Butzer, 2016)

1.23.8. Individualized Education Program (IEP)

An IEP is a legally mandated written plan for students with disabilities detailing goals, services, accommodations, and modifications to ensure FAPE (Yell, 2019)

1.23.9. Individualized Physical Education Program (IPEP)

A tailored plan that adapts the physical education curriculum, instruction, and assessment to achieve the unique motor, cognitive, and behavioral needs of disabled subjects. (Lieberman & Houston-Wilson, 2017)

1.23.10. Individualized Physical Activity Programme (IPAP)

A systematic, prescriptive framework for designing, implementing, and evaluating personalized physical activity interventions in clinical, community, or research settings. (Roth, Zittel, Pyfer, & Auxter, 2017)

1.23.11. Executive Functions (EFs)

Executive functions—working memory, inhibitory control, and cognitive flexibility—are higher-order cognitive processes essential for goal-directed behavior and commonly impaired in ADHD (Diamond, 2013)

1.23.12. Moderate-to-Vigorous Physical Activity (MVPA)

Physical activity performed at an intensity that is moderate (e.g., brisk walking) or vigorous (e.g., running) in nature, often correlated with greater cognitive and health benefits. (World Health Organization, 2020)

1.23.13. Brain-Derived Neurotrophic Factor (BDNF)

A protein that supports the survival, growth, and differentiation of neurons; its expression is upregulated by physical activity and is associated with improved learning and memory. (Huang & Reichardt, 2001)

1.23.14. TREE Modification Framework

A model for adapting activities by modifying Teaching style, Rules, Equipment, and the Environment to promote inclusion. (Australian Sports Commission, 2020)

1.23.15. Psychoeducation

The process of providing education and information to individuals and families about a disorder, its management, and coping strategies. (Barkley, 2015)

1.23.16. Cognitive Engagement (in exercise)

The extent to which a physical activity requires concurrent mental effort, such as strategizing, remembering sequences, or making rapid decisions, which may amplify cognitive benefits. (Pesce, 2012)

1.23.17. Heart Rate Variability (HRV)

The variation in time intervals between heartbeats, considered an indicator of autonomic nervous system flexibility and resilience to stress; often improved through Yogic practices. (Brown & Gerbarg, 2005)

1.23.18. Dose-Response Relationship

In exercise science, the relationship between the amount (dose) of physical activity (frequency, intensity, time) and the magnitude of the resulting effect (response). (Howley, 2001)

1.23.19. Task Analysis

The process of breaking down a complex skill or behavior into smaller, sequential, teachable components. (Roth et al., 2017)

1.23.20. Prevalence

The proportion of a population found to have a condition (e.g., ADHD) at a specific time. (Venkata & Panicker, 2013)