EFFECTS OF YOGIC PRACTICES AND PHYSICAL ACTIVITIES ON CHILDREN WITH AUTISM SPECTRUM DISORDERS

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CERTIFICATE

Certificated that the thesis entitled **"EFFECTS OF YOGIC PRACTICES AND PHYSICAL ACTIVITIES ON CHILDREN WITH AUTISM SPECTRUM DISORDERS"** submitted by me for the award of the Degree of Doctor of Philosophy in Arts at Jadavpur University is based upon my work carried out under the supervision of **Professor Gopal Chandra Saha**, Department of Physical Education and Sport Science, Vinaya-Bhavana, Visva-Bharati, Santiniketan and co-supervisors **Professor Mallika Banerjee**, Professor & Dean Department of Psychology, Techno India University, Honorary Director, Pradip: Center for Autism Management, Kolkata, West Bengal, Emeritus Professor, SNCW, WBSU and **Dr. Asish Paul,** Associate Professor, Department of Physical Education, Jadavpur University that neither this thesis nor any part of it has been submitted before any degree or diploma anywhere/elsewhere.

Countersigned by the

Supervisors: Candidate:

Dated:

Dated:

Dedicated to

My beloved teacher, Prof. Sumita Banerjee,

Prof. Sambhunath Bhattacharya and my loving mother

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PREFACE

In the present study, researchers made an attempt to justify the effectiveness of yogic practices and physical activities on person with autism spectrum disorders (ASD) with scientific data and logical explanations. The thesis report as presented here with five chapters. The first chapter (I) deals with Autism Spectrum Disorders, the significance of yoga and physical activity to manage ASD, the objectives, hypothesis and significance of this study. Related scientific literature is discussed in the second chapter (II). Methodological details followed during this study are explained in the third chapter (III). Results, analysis of the data and reasonable interpretations are incorporated in the fourth chapter (IV). Summary, conclusions, application of the study, strength of the study and recommendations are presented in the fifth chapter (V). A list of references, seminars, workshops, publications, appendices and other supplementary materials are also presented at the end of the thesis report.

The present study will be successful, if this research work can contribute some light to the field of ASD, yoga and physical activity.

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Abstract

Background:

Autism spectrum disorders (ASD) is a complex neurodevelopmental disorder with an unknown etiology and a higher increasing rate. Researchers around the world are working hard to find a reasonable solution to reduce the severity and complexity of ASD. Several study outcomes showed positive indications of using yoga and physical activity intervention for healing and managing ASD and other disabilities. But the literature on ASD is insufficient and limited, so further comprehensive research is needed.

Aim of the study:

To investigate and analyze the effects of yogic practices and physical activities on problem behaviors of children with autism spectrum disorders.

Design of the study:

A randomized controlled pre-post experimental design was opted for this study. The study conducted in a non-residential autism school in Kolkata, West Bengal, India.

Subjects:

For this study, 24 children already diagnosed with ASD and satisfying inclusion criteria from Pradip Center for Autism Management, Kolkata, West Bengal, India, were selected as samples for this study and equally divided in yoga group, physical activity group and control group. The inclusion criteria included diagnosis of autism according to the Indian Scale for Assessment of Autism (ISAA), age 8–14 years initially and participants with average physical health.

Intervention:

In this study non-residential structured yoga and physical activity (PA) intervention program were implemented for six months. The structured yoga modules followed a sequence of 7 components- 1. Prayer, 2. Loosening exercises (Standing, sitting & dynamic), 3. Asanas/Postures (Standing, sitting, supine & prone), 4. Pranayama/Breathing exercise, 5. Relaxation, 6. Chanting

and 7. Closing prayer. The structured physical activity session included four phases; A. Preparatory phase, B. Specific activity phase, C. Minor game phase and D. Cooling down phase. All selected participants attended yoga and PA sessions regularly and positively.

Assessments:

The assessments for this study were done by parents of the ASD children, class teachers of the special school and two clinical psychologists. The data were collected thrice; during the pre-test or baseline test (two weeks before beginning of the interventions), mid-test (after 3 months of interventions) and a post-test (after 6 months of interventions). For assessment of problem behavior of participants with ASD, the Problem Behavior Checklist (Banerjee et al., 2013) was used.

Results:

Findings of the study showed in the yoga group, there was significant reduction in the mid-session (after three months) followed further by a significant reduction in most of the parameters by the end of yoga intervention in post-test (after six months). For the physical activity group, there was significant reduction in the mid-session (after three months) followed further by a significant reduction in most of the parameters at the end of physical activity intervention in post-test (after six months). In the control group no significant improvement in different PB were seen.

Conclusion:

The school-based non-residential regular structured yoga and PA interventions are beneficial and effective to reduce different problem behaviors of participants with moderate levels of ASD.

Kye words:

Autism Spectrum Disorder, Yoga, Physical activity, Problem behaviors.

Chapter I

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Chapter -I

Introduction

1. General Introduction

There has been a tsunami of evolution in the 20th century. Rapid advancements in science and medicine have improved living standards and made lifestyle more comfortable. Because to advancements in surgical procedures, it is now feasible to transplant critical organs. These technological advancements imply that modern humans ought to be extremely content and joyful. But there is another side to life. The environment has become more polluted, foods we take are more contaminated, and water we take not dependable. The whole atmosphere is not so pleasant. Today, a lot of individuals don't seem happy or feel pleased; rather, they appear defeated, exhausted, depressed, or nervous, and they depend on medicines to help them fall asleep, move the intestines, and stay peaceful. These artificial means of treating symptoms only offer short-term fixes rather than long-term solutions. but not permanent solutions. Science is progressing and different problems are also increasing. Among these problems, some have solutions and some not. That is why the searching for solutions, searching for happiness is going on.

In this study, the investigator has chosen an area, where searching for a solution is going on around the world. The unresolved area is autism spectrum disorders (ASD), a prevalent complicated neurodevelopmental illness that is growing more and more widespread and frequently has catastrophic effects on the affected person and their family. In the present investigation, the researcher aimed to determine the impact of two potential and well-liked complementary and alternative medicine (CAM) therapies on problem behavior of people with ASD: Yoga & Physical activity). Yoga and physical activity (PA) affect us more directly and substantially, but how it works on ASD, we should know that in detail.

1.1. Disability

One in six of us, or 1.3 billion people, or 16% of the world's population, is estimated to live with a major impairment worldwide. Due to extended lifespans and a rise in noncommunicable illnesses, this number is increasing. More focus should be given to disability as a health outcome than has been done at this point (WHO, 2023). According to Raggiu et al.

(2010), disability is the inability of a person with a health condition to function at the level of their body, person, or society in a variety of ways while interacting with external circumstances. The World Health Organization (WHO) defines a person with restricted participation as someone who has issues with their health or structure, an activity limitation, and/or challenges carrying out a task or action. Persons with impairments

In India, the increasing rate of the disabled population is a serious issue. From a recent survey report, 2.21% (2.68 Cr.) of disabled people are living in India, out of which 56% (1.5 Cr.) are male and 44% (1.18 Cr.) are female (PCNSSO, 2016). Many factors, including a rise in noncommunicable illnesses and longer lives, are contributing to this growing number of people.

1.1.2. Types of disability

Persons classified as disabled may have chronic physical, mental, intellectual, or sensory disorders that, when combined with additional challenges, may prevent them from fully and equally participating in society. various kinds of impairments are: 1. Visual Impairment 2. Hard of Hearing or Deafness 3. Mental Health Issues 4. Mental Illness 5. Physical Infirmity 6. Progressive Brain Damage 7. Kids with Cognitive Impairments 8. Autism Spectrum Disorder (WHO, 2018).

1.2. Autism Spectrum Disorder (ASD)

The autism spectrum disorder (ASD) is an intricate neurodevelopmental disorder that affects the whole lifetime of an individual. The American Psychological Association (2013) describes it as a collection of neurodevelopmental disorders characterized by restricted and repetitive behavior, poor verbal and nonverbal communication, poor social interaction, and interests. ASD is an umbrella term, including autism, childhood disintegrative disorders and Asperger's syndrome. It is seen as a complex neurological condition that lasts the entirety of a person's life (WHO, 2021). The severity and range of autism may vary from person to person (CDC, 2018). Highly sensitive autistic children may experience significant distress, at times even excruciating pain, from noises, textures, scents, or visual stimuli that appear normal to others (APA, 2013). The scientific community worldwide is working hard to discover the best possible definition and explanation of the symptoms, possible causes, treatment and management.

1.2.1. Prevalence of ASD

Autism spectrum disorder (ASD) is broadly defined as a neurodevelopmental illness that is difficult to treat and is common. Millions of youngsters worldwide are impacted by its high incidence rate. Over the previous several decades, there has been a significant global increase in the occurrence and understanding of ASD. The proportion of youngsters receiving a diagnosis has increased from 1.1% to 2.5% during the past few decades. Christensen et al. (2016) claimed that 1 in 68 school-age children had an ASD diagnosis; the CDC (2023) then reported that 1 in 54 children had an ASD diagnosis.

Several studies were conducted worldwide to explore the occurrence of ASD, considering the variations in geographic, ethnicity, cultural, and socio-economic factors. It was reported that before 2000s the ASD rate was less than 1% and in the 2000s it was 1%, but in the 2020s it was 2%. The prevalence rate is now increasing very fast (Taylor et al., 2020). The frequency of ASD in the US was about 1.70 -1.85%, United Kingdom (1.53-1.92%, in children and adolescents respectively), China (3.923%), Arab Gulf countries (0.14% - 2.9%) and Korea (2.64%) (Qiu et al., 2019; Zeidan et al., 2022). All studies presented that the occurrence rate of ASD was higher in males compared to females. Boys are almost 4.5 times more inclined than females to have ASD (Christensen et al., 2016). Recent research on prevalence rates revealed an increased rate of ASD in Asia (Qiu et al., 2019).

ASD is becoming more common in India; estimates place the number of afflicted children at 1.7–2 million, with a higher proportion of affected children (0.11) in urban regions compared to 0.09 in rural areas (Chauhan et al., 2019; Mahapatra et al., 2019). Unfortunately, because there are no standardized assessments procedures for ASD that take into consideration the country's culturally diverse and multilingual population, India currently lacks an accurate figure of the incidence of autism (Rudra et al., 2017). Despite these barriers to the increasing rate of ASD in children, it remains the most common developmental disease in India (Juneja & Sairam, 2018).

1.2.2. History of ASD

For years, psychologists and psychiatrists have tried to come up with a reasonable list of psychological disorders. Several different classification systems have been tried, each with various disorders named, defined and grouped into categories. One purpose was (and is) to give precise meaning to terms that are tossed around in our everyday language. Giving clear

definitions of such terms is important because they are often used in making crucial decisions. (Morgan et al., 2007).

The term "autism" has been utilized to refer to a variety of mental health issues since the early 1900s. Approximately a century has passed since the Greek term "autos," which means "self," was first used to translate the word "autism." The phrase refers to circumstances in which a human being is cut off from social contact and thus feels alone. The word was introduced by the Swiss psychiatrist Eugen Bleuler. About 1911, he began using term to define a set of symptoms associated with schizophrenia (Bleuler, 1911). Researchers in the United States started referring to youngsters with emotional or social difficulties as having autism in the 1940s. It was used by Johns Hopkins University physician Leo Kanner to characterize the withdrawn behavior of some of the pupils he recognized (Kanner, 1943). He mentioned in a paper ‘early infantile autism’ encompassing from early infancy with proposals of possible genetic disorders (Pearce, 2005). Kanner found echolalia, pronoun reversal, mutism, and unusual prosody in those children, but the distinct features were lack of social communication and rigidity of sameness, which are important and even applicable in the present understanding of autism (Rosen, Lord, & Volkmar, 2020). Simultaneously, German scientist Hans Asperger discovered a related disorder that is now known as Asperger's syndrome, which later came out to be a High Functioning Autism (CDCP, 2015).

In 1952, the Diagnostic Statistical Manual (DSM-II) mentioned autism as a psychiatric disorder with detachment from reality (Rapoport et al., 2009). Even until the 1960s, many researchers continue to believe that autism and schizophrenia were connected. It was only then that medical professionals began to have a distinct considerate of autism in children. The author, Rimland, developed a checklist to assess various symptoms of autism (Rimland, 1964; Rimland, 1968).

During the 1960s and 1970s, the focus of research on autism treatments was on electric shock, and drugs like LSD. The letter relied on pain and punishment. The use of highly regulated learning settings and behavior therapy became the mainstays of treatment for many kinds of autism along with problems during the 1980s and 1990s. In 1980 the DSM-III came to highlight the diagnosis procedure for autism with three features; pervasive lack of interest or response to people, impaired communication, and peculiar replies to the environment (DSM-III; APA,1980).

Then DSM-III-R came and included impaired social interaction, social communication, restricted and repetitive interests to assess autism (APA, 1987).

Rett's disorder, Asperger syndrome, and childhood disintegrative disorder were all classified somewhat differently in the International Classification of Diseases, 10th edition (ICD-10) of the World Health Organization (Volkmar et al., 2014). A range of conditions, such as Rett's disorder, Asperger's disorder, childhood disintegrative disorder (CDD), and Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS), were added to the categorization of autism with the introduction of the DSM-IV (1994). The DSM-5 used the term 'spectrum' as an 'umbrella term' and provided priority to social deficits, language impairments, and other accompanying medical and psychiatric conditions.

Over the years, several concepts have developed with various perceptions to comprehend ASD. Currently, the keystone of autism therapy is behavior therapy. Other treatments are additional as needed. (Shunmuganathn et al., 2012).

1.2.3. Symptoms of ASD

The connected symptoms of ASD are usually manifested in individual in the first 3 years of age. The core symptoms are namely (1) Impairment of social behaviors, (2) Communication difficulties and interaction, (3) Repetitive and stereotyped behaviors. Children with ASD also showed some other symptoms such as atypical sensory behaviors, problematic behaviors, executive functioning difficulties, intellectual disability, attention-deficit hyperactivity (ADHD), social anxiety disorders, epilepsy, poor motor proficiency, gastrointestinal distress, and sleep disorders; having an overreaching effect on their adaptive functioning (Mannion et al., 2014; Masi et al., 2017). The persons with ASD show a varied range of abilities, from having fewer abilities to genius with exceptional skills. Hughes et al. (2018) defined autistic 'savants' as those with extraordinary skills in particular areas instead of overall normal functioning and are unique to many on the spectrum.

Apart from its primary diagnostic characteristics that establish its severity, ASD symptoms span a continuum from moderate to severe and are characterized by differing degrees of functional impairments (Cassanova, 2020; Ousley & Cermak, 2014). Because the symptoms of autism vary greatly from person to person, ASD is a spectrum condition with a wide range of severity. Children as young as 18 months old may exhibit symptoms, and their distinctive

characteristics differ from those of usual development and a number of different developmental contexts (Zeidan et al., 2022).

As a summary of observed signs and symptoms, which interfere with day-to-day activities are inability to identify people or things specifically, lack of response when calling by name, aimlessly repeating the same act over and over, exhibiting affinity towards any particular object, engaging in the same activity for hours are all symptoms of autism. Behavioral characters such as hesitating to make friends, lack of interest in participating in discussions, indifference towards acting creatively, projecting on to certain habits, being adamant can be found in them. Intellectual inferiority, inability to concentrate, idleness, aggression, abnormal eating habits, mobility disorder can also be seen in autistic people in varying proportions (Hazen et al., 2014).

1.2.4. Etiology of ASD

A serious public health problem is ASD. Autism may be caused due to environmental acquaintance or genetically inherited disorder; however, no conclusive or universally habitual reasons are known for ASD. This makes the issue equally challenging and demanding. Numerous neurotransmitters that support brain development, such as brain-derived neurotrophic substances, have a positive relationship with ASD and other neurodevelopmental disorders (AlOlaby et al., 2017). The results of the study showed a correlation between the frontal and prefrontal cortex and other brain areas and the behavioral signs of ASD (Bremer et al., 2020; Wass, 2011). Another study suggests the autistic population came out to have a high risk of erroneous development in the area of mental state identification and attribution (Maw & Haga, 2018).

There are some scholars who have proved a correlation between genetic factors and ASD, but the identification of the exact gene still remains unknown. Genetic issues are assessed to contribute 40 to 80 percent of ASD menace. The incident of Autism for identical twins (monozygotic) is more prone to developmental disorder. Not all genes but some hereditability and genetic variation are responsible for the gender ratio of ASD, i.e., 4:1 (Male: Female), and the possibility of an ASD diagnosis is four times higher in boys than in girls. The chromosome abnormalities and single gene syndrome may relate to causative factors of ASD (Woodbury, Smith, M., & Scherer, S. W. 2018). The development of the brain is influenced by several of the genes connected to ASD. The synthesis, proliferation, and arrangement of nerve cells are among

many features of development in the brain that have been affected by the proteins generated from these genes (Hodges et al., 2019).

Air pollution, organic toxicants, seasonal conditions, psychological stress, migration, birth order, gender, and diet are some of the non-genetic or environmental factors that raise the risk of ASD. These factors may also have significant connections to ASD. Although this field of study has made significant strides in the last few decades, many issues remain unanswered. More research is required to completely understand and identify the impact that the environment and related elements play in the development of ASD (Liu et al., 2016).

The quest for etiologic factors of ASD is wide-ranging. Although the precise origins of ASD are unidentified, a number of genetic and non-genetic parameters are thought to be contributory for the development, either separately or in combination. Syndromic ASD is correlated with genetic factors such as chromosomal abnormalities manifesting as Rett's syndrome, Fragile X syndrome, and MECP2 duplication syndrome (Sauer et al., 2021). Non-syndromic ASD etiology is still comparatively unknown due to genetic heterogeneity. A combination of prenatal and postnatal environmental factors and genetic de novo mutations contribute to this condition. ASD is commonly viewed as a complex inheritable condition.

The genetic role in ASD, as an inheritable condition, came up in the mid-1970s. The non-genetic factors increasing the risk of ASD include environmental factors such as parental age, maternal status in terms of nutrition, metabolic condition, infections, stress, drugs, exposure to toxins, and heavy metals. Few studies showed that certain infectious illnesses in pregnancy, such as German measles, can increase the risk of ASD. Maternal immune responses are known to activate inflammation in the fetus leading to gene dysregulation (Bölte et al., 2018). Parental age can increase the risk of genetic mutations. Improper nutrition during pregnancy with excess or deficient micronutrients can impact the fetus's brain development, leading to neurodevelopmental impairments. Folic acid deficiency has a greater chance of developing ASD in children. Intake of certain medications for treating conditions like depression, epilepsy, valproic acid, and thalamide in pregnancy is known to elevate the risk of ASD (Sauer et al., 2021).

1.2.5. Interventions for ASD

For individuals with ASD, numerous treatments have been developed during the past few decades. The most often utilized therapies today include psychological, educational, behavioral,

developmental, social relational, pharmacological, and complementary and alternative medicine (CAM) in order to improve social, behavioral, and adaptive ability in children with ASD (Hyman et al., 2020). All of these interventions are primarily supported by substantial empirical evidence. A rising range of complementary and alternative medicine (CAM) modalities are showing promise as therapies for children with ASD, including dance, music, art, and acupuncture (Brondino et al., 2015). Yoga and other physical activities are becoming more and more well-liked as a readily available, risk-free, and non-harmful intervention for individuals with ASD.

1.3. Yoga

Yoga is the classical holistic wisdom of India. It is a logical, systematic, and pragmatic technique that helps humanity realize its limitless potential. We get yoga in the form of the Living Tradition, which was codified by the great Sage Patanjali in 200 BC in the form of Yoga Sutras, commonly known as ‘Ashtanga Yoga’. He (Patanjali) defined yoga as a conscious process of gaining mastery over the mind. The word ‘yoga’ means to ‘unite,’ ‘coordinate,’ or ‘energize.’ It is a systematic process that promotes the fusion of the body, mind, and soul. Yoga is meant to be a part of daily life since it is the science of moral living. It affects every facet of the individual, or "Pancha kosha," including the vital, mental, emotional, psychic, and spiritual (Swami Satyananda Saraswati book).

Yoga has existed since the Vedic era, with its description mentioned in several important ancient scriptures. The greatest of our philosophical epics, the Bhagavad Gita, declares yoga as a ‘skill in action’ comprising techniques for improving the skill of body, mind, and emotions in an integrated manner, thus providing a complete philosophy of living. The Upanishads mention yoga as an indispensable pathway for attaining happiness through control of the mind directed by intellect with further control of the senses, leading an individual to accomplish the spiritual goal successfully. Sir Aurobindo, the great yogic philosopher, acclaimed yoga as a methodical process that could awaken the latent potentialities of an individual, nurturing overall personality development. The unique tools of the human body, the mind, body, breath, and speech, are used in yoga to transform one’s life (Shashidhara, 2020).

Practically speaking, yoga helps to balance and harmonize the body, mind, and emotions. Asana, pranayama, mudra, bandha, shatkarma, and meditation are the tools by which this is achieved. Union with the greater reality cannot occur until this is done. In this sense, yoga isn't only about doing physical poses; rather, it helps people adopt a new lifestyle that respects both

their inner and outward reality. However, this method of existence is an experience that cannot be comprehended logically; practice and experience are the only ways in which it may become live knowledge.

The therapeutic value of yoga is immeasurable. The International Association of Yoga Therapy (IAYT) mentions that yoga is a scientific method of self-investigation, self-transformation, and self-realization that includes all aspects of breath, body, mind, intellect, and emotions. The therapeutic results of yogic practices empower one to relax both in body and mind, inducing quality sleep, promoting digestion, and activating circulation for improved physical & psychological health, inner peace & harmony, and well-being (Nagarathna & Nagendra, 2011).

1.3.1. Yoga for ASD

Yoga has therapeutic and preventative advantages. Yoga is a spiritual science that supports the full and harmonious development of a person's mental, physical, and spiritual selves. For kids with ASD and other neurological diseases, yoga is becoming more and more well-liked as a comprehensive complementary and alternative medicine (CAM) treatment (Gwynette et al., 2015). It's convenient for individuals with ASD because yoga treatment is safe and might not hurt them immediately. The ASD children are unique and have some complex features. Yoga may assist children with ASD with a wide range of requirements as a mind-body intervention. According to recent research reports, Yoga helps people's physiological and psychological systems regain to normal by regulating disruptions before they have the potential to become catastrophic. Yoga affects us in ways that are more direct and substantial than just about any other stimulus. It has been mentioned by researchers that the intervention of yoga may influence neurobiological and cognitive processes of children with ASD. Yoga is perceived as a holistic movement therapy that teaches children to quieten their minds, foster focus, and build balance, flexibility, and strength (Rosenblatt et al., 2011).

The systematic approach of yoga helps children towards effective self-regulation and well-being through its postures, breathing, and relaxation, nurturing mindfulness and bringing forth physical, emotional and mental harmony in children with special needs (Goldberg, 2013). The Neuroplasticity theories, especially activity-dependent plasticity of the brain, Yoga has important effects on learning, memory, healthy growth, and brain injury regeneration. (Pascual-Leone et al., 2012; Ganguly & Poo, 2012; Carey et al., 2019). Evidence of the impact of yoga on

the brains or neural plasticity is well recognized by neuroscientists. Regarding problem behavior, sociability, sensory and cognitive awareness, behavior, health and immune system, and autism severity in children with ASD, the majority of the evaluated research have indicated that yoga has some good effects. Kids diagnosed with ASD are predisposed to high stress hormone levels, which can lead to vagal dysregulation and anxiety. Yoga works well for children with ASD by encouraging different gross motor imitations of postures (Kenny, 2002).

Though numerous positive effects of yoga on children with ASD have been noticed, the literature is not sufficient and more research is needed with randomized control trial design, with appropriate sample size, common control groups and systematic reporting of aggregate results, etc.

1.4. Physical activity

Physical activity (PA) is any skeletal muscle-driven physiological action that improves or preserves physical fitness as well as general health and welfare. The aim of exercise includes enhancing growth and development, delaying aging, improving cardiovascular health, strengthening muscles, improving athletic performance, losing or maintaining weight, and just for fun. Children who engage in physical activity lose more body fat and have better cardiovascular health (Lumeng & Julie, 2006). Regular physical exercise decreases risk factors of cardiovascular diseases (Grondard et al., 2005). Moderate exercise has a major positive impact on the human immune system, according to epidemiological studies. According to research, it reduces the risk of dementia (Hunsberger, 2007).

Our brain function is also greatly affected by physical exercise. For example, it increases blood and oxygen flow to the brain, stimulates neurogenesis, creates new neural pathways and synaptic plasticity, improves short- and long-term memory, memory retention, information processing, and cognition, and increases activity of the parasympathetic nervous system and decreases activity of the sympathetic nervous system (Hale et al., 2023). Exercise is essentially an inexpensive, dependable, and advantageous way to achieve more and better sleep (Josefsson, 2014). Aerobic exercise in particular has been shown to be an effective long-term antidepressant. Exercise may help reduce some of the harmful effects of juvenile and adult obesity. Physical activity also maintains or increases positive self-esteem, enhances mental health, preserves fertility, keeps the stomach moving, eases gas and constipation, and improves fertility (Mahindru et al., 2023).

1.4.1. Physical activity for ASD

Autism is a complex neurobehavioral condition characterized by inflexible, repetitive behaviors along with difficulties in language and communication development, social interaction, and communication. There is a wide range of abilities, symptoms, and degrees of impairment associated with the illness. Its severity varies from a mild handicap that slightly restricts an otherwise normal existence to a severe condition that could require institutional care. Although the precise origins of ASD are unknown and there isn't yet a proven therapeutic therapy for the disorder, a number of target-oriented early treatments have been demonstrated to be successful when implemented (Hyman et al., 2020). According to Kaplan and McCracken (2012) and Medavarapu et al. (2019), the interventional techniques are mostly behavioral and educational. They are often implemented as organized and supervised programs (Christensen et al., 2016).

Exercises that are designed to promote or maintain physical fitness, general health, and well-being are repeated, organized, structured, and have a final or intermediate goal. Children with ASD have particular requirements, abilities, and difficulties (Hyman et al., 2020). Most autistic individuals lead a sedentary lifestyle, which not only makes them inefficient in motor skills, but also resists many other developments (Green et al., 2009). Studies have shown that ASD is frequently linked to disruptions and deficits in motor abilities. The major objectives of managing autistic children are to improve quality of life and functional independence while reducing related deficiencies and family stress.

As a therapeutic strategy, PA works well for managing ASD. Not only may PA help children with ASD better their physical problems, but it also helps them develop good behavior, social skills, self-esteem, and a healthy lifestyle for the future (Liang et al., 2022). The potential advantages of physical exercise intervention as a complementary and alternative medicine (CAM) therapy for persons with ASD have drawn a lot of attention over the past several decades (Ji et a., 2023). But the literature on effective guidelines for PA programs for children with ASD is not yet completed and comprehensive enough. Therefore, further investigations are needed.

1.5. Statement of the problem

The aim of the present study was to examine and evaluate the effects of yogic practices and physical activities on children with autism spectrum disorders.

1.6. Objectives of the study

i. To evaluate the impact of a non-residential, six-month yoga intervention training program on the problematic behavior patterns of individuals with ASD.
ii. To evaluate the effectiveness of a six-month non-residential physical activity training programme on Problem behavior patterns of children with ASD.
iii. To compare the effect of a physical activity intervention program and yoga on the problematic behaviors exhibited by individuals with ASD.
iv. To determine whether yoga and physical activity interventions are possible to conduct in the institutions for people with ASD.

1.7. Hypothesis for the study

i. It was hypothesized that there would be significant change in the effects of six-month non-residential yogic practice intervention on Problem behavioral patterns among children with ASD.
ii. It was further hypothesized that there would be significant change in the effects of six-month non-residential physical activity intervention on Problem behavioral patterns among individual with ASD.
iii. . It was further hypothesized that six months of non-residential Yoga and physical activity interventions would not result in any significant differences in group-wise (two experimental groups: Yogic practices, or Group-A, and physical activity, or Group-B, and one control group, or Group-C) comparison on behavioral patterns of ASD.
iv. Further it was hypothesized that Yoga and Physical activity practices would be possible to teach children with ASD in different special institutions for autism.

1.8. Delimitations of the study

i. The study only included 24 children and adolescents with autism spectrum disorders (ASD) from an admired ASD school.
ii. The Indian Scale for Assessment of Autism, or ISAA, confirmed the autism diagnosis, which was confirmed by two clinical psychologists.
iii. Children and adolescents with moderate levels of ASD comprised the sample groups for the study.
iv. Children and adolescents with severe ASD were not included in this study.
v. The chronological ages of the samples (Male and Female) were 8 to 14 years.

vi. In addition, the study included one control group and two experimental groups: Group-A (8 people practicing yoga) and Group-B (8 people participating in physical activity).

vii. The samples belonging to experimental groups were followed by a six-month non-residential Yoga and Physical activity training programme. And the selected control group went through their usual special school/ institutional curriculum.

1.9. Limitations for this study

Research is a challenge for researchers. These challenges sometimes go beyond the control of the researchers and invite some restrictions, such as, selection of subjects, time bounding, limited funding, selection of research design and statistical model restraints, or other factors. These restrictions are considered as limitations or potential weaknesses for a research study.

I. The external factors such as dietary habits, individual differences, self-motivation, socio-economic conditions, training mood, lifestyle issues, daily routine and environmental factors etc., are beyond the control of the researcher.

II. Some of the students undergo some special therapeutic programme other than the Yoga, Physical activity training programme with regular special school/institutional curriculum was considered as a limitation.

1.10. Definition and explanation of the terms

AUTISM SPECTRUM DISORDERS (ASD)

Autism spectrum disease (ASD) is a neurological disorder characterized by difficulties with restricted interests, verbal and nonverbal communication, repetitive behavior, and social interaction. Unusual reactions to sensory stimuli, as well as a fixation on consistency or rigorous adherence to routine, are other typical indicators.

YOGA

Yoga is a practical, methodical, and systematic practice that helps people realize their limitless potential. It is an ancient holistic knowledge from India.

PHYSICAL ACTIVITY

Any voluntary movement of the body made possible by the skeletal muscles and requiring the use of energy is referred to as physical activity.

PROBLEM BEHAVIOR

The current researchers have agreed that there is something more other than attention problems, sensory problems, and communication problems etc. and only that propels them (ASD children) to behave inappropriately. ASD children frequently struggle with a range of emotional and behavioral issues that impede their ability to develop, function, interact socially, and form relationships. These issues are typically referred to as "problem behaviors." (PB) (McGuire, 2016).

1.11. Significance of the study

I. This study may provide lots of information and knowledge about the psychological and behavioral state of individual with ASD.

II. Differentiating and understanding how yoga and physical activity therapies impact the behavioral patterns of kids and teens with ASD will be made easier by the study's findings.

III. The findings may help to prepare suitable yoga and physical activity modules for children/ adolescents with ASD.

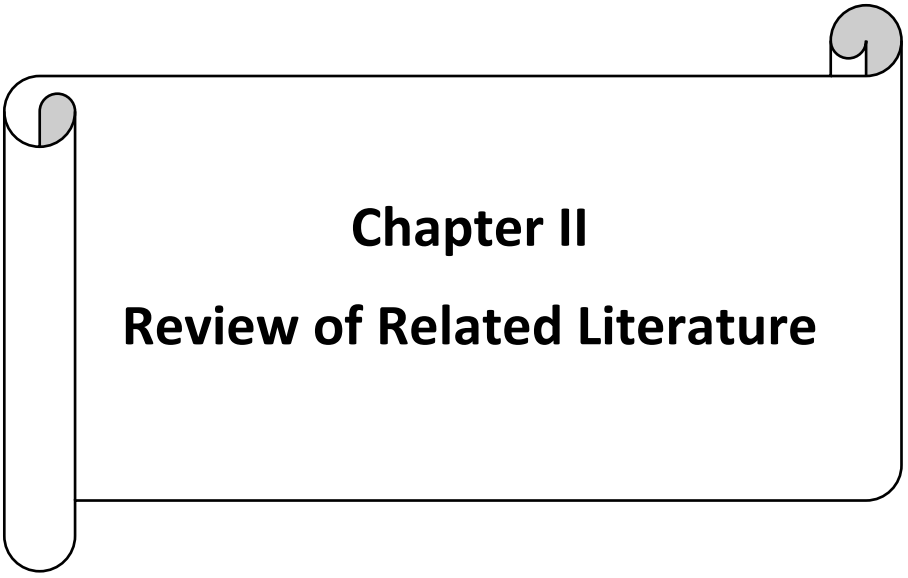
IV. The study may open a new dimension to special educators, physical education teachers, and parents or caregivers for management and rehabilitation of children/ adolescents with ASD.

V. The present investigation would also be helpful to provide some additional knowledge and larger awareness about children/ adolescents with ASD.

VI. The research would emphasize the value of exercise and yoga for kids with ASD.

VII. The study will also offer knowledge, understanding, and awareness of safety measures for people with ASD who wish to take part in yoga and physical exercise programs.

VIII. It might be beneficial to compare the advantages of yoga and physical activity intervention training programs, as well as any possible impacts on the behavioral patterns of individuals diagnosed with ASD.



Chapter II

Review of Related Literature

2.1. Sources of evidences

2.2. Inclusion and Exclusion criteria

2.3. Selection procedures of review articles

2.4. Interventions for Autism Spectrum Disorders (ASD)

2.5. Complementary and Alternative Medicine for Autism Spectrum Disorders (ASD)

2.6. Yoga for Autism Spectrum Disorders (ASD)

2.7. Yoga and Problem Behavior of ASD

2.8. Physical activity for Autism Spectrum Disorders (ASD)

2.9. Physical activity and Problem Behavior of ASD

2.10. Review Summery

2.1. Sources of evidences

The literature review chapter comprises with a wide base of information collected from several research sources connected to the research questions in this study. The literature survey provides opportunities to explore, identify and support various possibilities on a particular research topic. It also affords an evaluative description on the existing literature pertinent to any research study. In this review chapter, the researcher has given an overview on understanding of available literature on yoga, physical activity and autism. The researcher of present study has done a comprehensive literature searching by using different online searching techniques for acquisition of evidences. Majority of the databases were retrieved from different electronic sources; such as PubMed (Biomedical), Google Scholar (Scholarly index and bibliographic database), Web of Science (Science, social science, art and humanities), Scopus (Life science, social science, physical science and health science), Shodhganga (UGC Inflibnet), Medline (Medicine), PsycINFO (Psychology), IndMED (Biomedical) DOAJR (Peer reviewed open access).

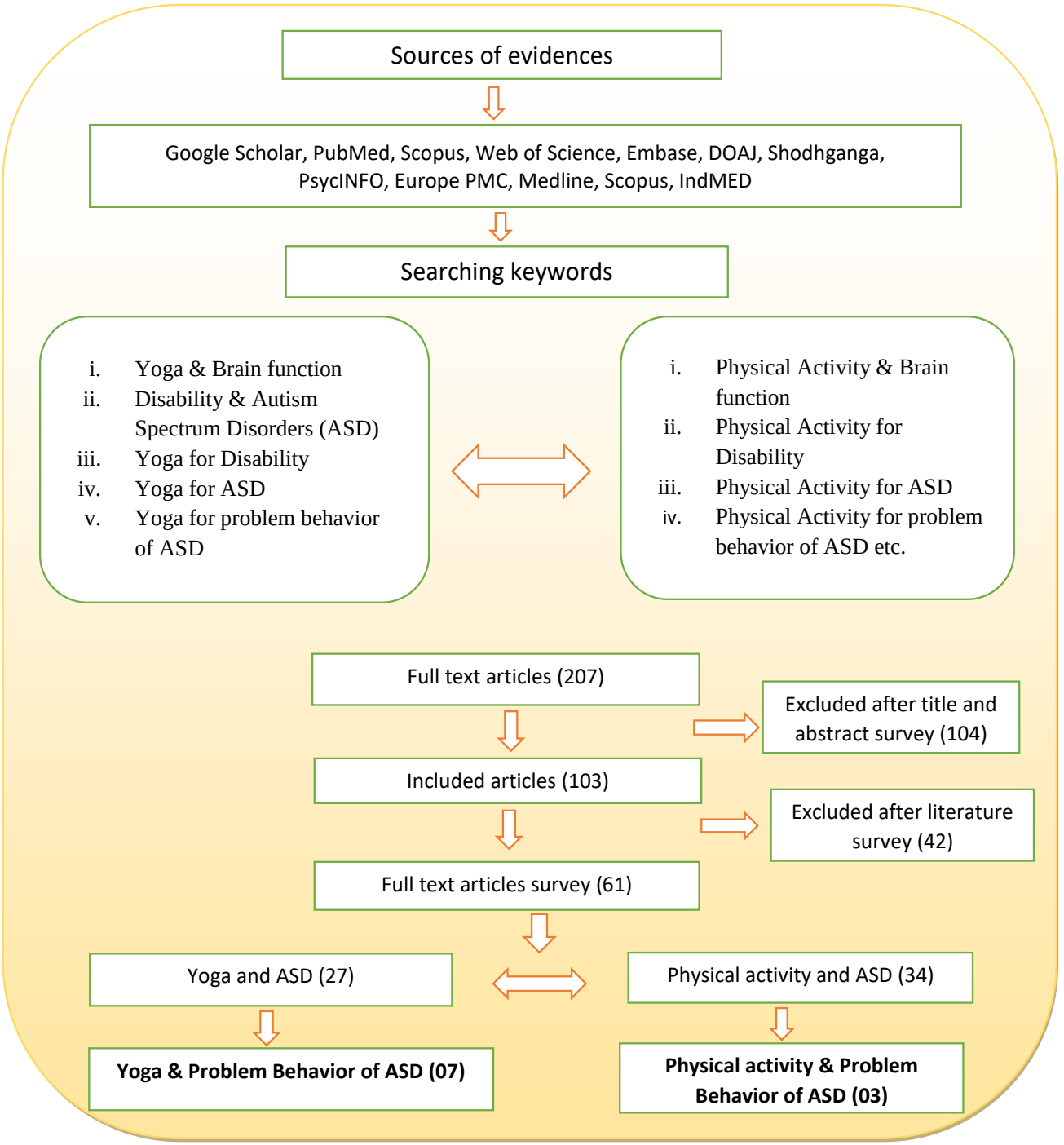
2.2. Inclusion and Exclusion criteria

The researcher has included and excluded the review studies on the basis of the objectives of the present research initiatives. The research works that were directly or partially related to the fundamental aim and objectives of this study were selected and included in the literature survey and other studies were excluded. The inclusion criteria were based on the research areas of Disability & Autism Spectrum Disorders (ASD), Yoga for Disability, Yoga for core and other symptoms of ASD, Yoga for problem behavior of ASD, Physical Activity for Disability, Physical Activity for core and other symptoms of ASD and Physical Activity for problem behavior of ASD etc.

2.3. Procedures for selection of review articles

The literature review searching procedure for this study was based on the aim and objective of the study. The researcher stratified all the searched research article and found out those studies which are directly or partially fulfilling the inclusion criteria of this study. At beginning total 207 tittles were selected and finally 61 full texts studies were evaluated strictly on the basis of eligibility criteria. All the review selection procedures are mentioned in the following flowchart (Figure-2).

Figure 1: Flow chart of Literature review procedure



2.4. Interventions for Autism Spectrum Disorders (ASD)

These ASD deficiencies include restricted and repetitive behavior, self-harm, expressive and receptive speech, social communication and interaction, and a variety of problem behaviors (APA, 2022). Children diagnosed with ASD have unique needs, skills, and difficulties. Several therapies are emerging to address the distinct requirements of the autistic community, taking into account obstacles, comorbidities, heterogeneity, and the special demands and needs of ASD children (Hyman et al., 2020).

The autism is an unresolved issue for whole world. Over the decade scientists, philosophers are working tirelessly to evolved different interventions for children with ASD. To understand the ASD completely several perspectives and philosophies are building up. Empirical studies showing early intervention was considered effective for achieving better progress and most early interventions showed younger children gain more benefits with positive long-term outcomes than children who starts at older ages (Corsello, 2005).

Parental participation in early therapies for young children with ASD showed excellent effects in reporting a variety of concerns related to autistic spectrum disorders (Rojas-Torres et al., 2020). According to Healy et al. (2018) and Caputo et al. (2018), the current therapies for children in various age groups are designed to lessen the intensity of symptoms and enhance functioning as well as overall quality of life. For autism no single unique intervention has attained universal efficiency on all children having ASD. There is significant evidence-based empirical research on the range of therapies for children with ASD to reduce the severity of autistic symptoms (Hyman et al., 2020). Such interventions are given as therapies extend from clinically established and emerging therapies with promising results to new therapies still evidence-based validation is needed (Renzo et al., 2020).

Educational, pharmaceutical, behavioral, developmental, social relational, psychiatric, and complementary and alternative (CAM) therapies are among the several therapy modalities available for children diagnosed with ASD. These interventions cover a range of outputs that may intersect with one another in different areas (Hyman et al., 2020). The substantial empirical evidences supported that mainly, behavioral and developmental interventions formed the primary treatment approach to progress social, behavioral, and adaptive functioning in people with ASD.

2.5. Complementary and Alternative Medicine (CAM) for ASD

Complementary and Alternative Medicine (CAM) is a set of separate therapeutic healthiness practices from conventional medicine. The use of CAM is increasing for both adults and children (Levy & Hyman 2008). CAM are most common and frequently used therapeutic intervention in children with ASD. CAM are basically being used as complementary adjunct therapies provided along with conventional medicine and other medical management. As there is no single etiology for management of ASD, therefore, various alternative interventions are available (Höfer et al., 2017). These complementary and alternative medicine (CAM) therapies—such as dance, acupuncture, yoga, music, and physical activity—are showing promise as therapy for individuals with ASD (Brondino et al., 2015). Over the past decade, there has been a lot of research being conducted in the positive impacts of yoga and physical exercise interventions on children with ASD.

2.6. Yoga for ASD

Saxena et al., 2023, examined the potential benefits of yoga for young people and adolescents with mind-body issues. The principal focus of this particular research work was to determine the utilization and benefits of Yoga as a supplemental psychopharmacological and psychotherapy treatment. Healthy youths and young adults with psychiatric disorders, such as mood disorders, attention deficit/hyperactivity disorder, oppositional defiant disorder, learning disabilities, autism spectrum disorders, trauma-related disorders, substance abuse disorders, and eating disorders, were chosen by the researcher in order to achieve the goals of this manuscript. The study found that yoga had some notable benefits for both healthy individuals and those suffering from mental health issues. Although the research paper found positive effects of regular yoga practices, the study also indicates further required research with larger sample sizes, randomized control groups, prolonged and quality yoga training, and follow-up evaluations.

An experimental investigation was done by Raj et al. (2023) to evaluate the “effect of yoga therapy on teaching oral hygiene practice and tooth brushing skills in patients with Parkinson's disease”. The purpose of the study was to assess qualitatively how yoga practice is effective to people with Parkinson's disease responded to instruction in oral hygiene and, in turn, how to wash their teeth. For that purpose, the researcher included 100 patients (67 female and 33 male) as sample for this study. All the subjects were taught yoga exercises by a qualified yoga

instructor for 6 months. For statistical analysis, paired student 't-tests' were applied using SPSS Version 20.0. The findings demonstrated that yoga practice has been found to enhance dental hygiene and toothbrushing abilities in persons with Parkinson's disease.

Shankar and Pradhan (2022), assessed the "effect of a group yoga program on motor proficiency of children with ASD and the feasibility of its inclusion in special schools". This study's main goals were to investigate how a 12-week yoga intervention program affected the motor skills of kids with ASD and if yoga might be used in special education classrooms. This study's methodology divided the 43 ASD students from four special schools into two groups: the 23-person yoga group and the 20-person control group. The subjects were chosen using random sampling procedures. For twelve weeks, the yoga group adhered to a prescribed yoga schedule. Each class lasted forty-five minutes. The whole intervention programme was guided and delivered by potent and well-trained yoga teachers. Both the pre- and post-intervention groups took the Bruininks–Oseretsky Test of Motor ability, Second Edition, to evaluate the motor ability of children with ASD. Data analysis revealed that yoga improves the motor competence of children with ASD, particularly the large motor skill compared to the fine motor skill. The result of this study also concluded that yoga is a feasible group intervention activity to deliver in special school settings.

Maheswari et al., (2022) reported “the effects of a pliable yoga module on dexterity among autistic children”. The study's methodology involved twenty Chennai-based autistic children who were divided into two groups: the Control group and the Pliable Yoga Module group. All the participants in the yoga group practiced six days a week for sixteen weeks, practicing flexible yoga practices. Data on dexterity was collected in a setting that was pre-posttest. Desrosiers J. (1997) assessed the children's dexterity using the Minnesota Manual Dexterity Test. The significant difference in dexterity was found using the Analysis of Covariance (ANCOVA), which was assessed at the 0.05 level of significance. Based on the study's results, the researcher discovered that, when compared to the control group, the bendable yoga module group was successful in helping autistic children's dexterity.

Archoudane et al. (2021) evaluated a block randomized controlled trial study on children with ASD. Where the researchers found yoga had therapeutic effects on children with ASD and reduced the severity in autism symptoms. Over two weeks, the yoga group in this study participated in yoga therapy sessions, while the control group attended their regular special

education courses. When comparing the yoga group to the control group, which engaged in usual school activities, the parents of individual with ASD observed a statistically significant decrease in the severity of autism.

Tanksale et al. (2021), investigated on “effects of a weekly six-session pilot yoga-based group program mixed with third-wave cognitive behavioral therapy features on self-regulation in children with autism spectrum disorders”. Executive functions as a set of intellectual skills can be described as the mental processes that aid in controlling one's behavior, emotions, attention, and cognitive impulses within a specific context that extends to support an individual's adaptation to the environment. A pilot yoga program consisting of six sessions per week was implemented for sixty-one children with ASD (ages 8 to 12) who were randomly assigned into two groups. The significant primary results included parent-reported improvements in the children's executive functioning. The authors suggested that *yoga* as an adjunct mind-body practice beneficially complements other conventional therapies for children with ASD. However, the author mentioned some limitations and recommended for further research study.

Ahemaitijiang et al. (2020), intended to assess the “effects of Meditation on the Soles of the Feet (SoF) on the Aggressive and Destructive Behaviors of Chinese Adolescents with Autism Spectrum Disorders”. This study was primarily concerned with examining the effects of meditation on children with autism spectrum disorders. The study's sample consisted of three autistic children and their parents. This study used a multiple-baseline design with three individuals to investigate the impact of meditation (SoF) practices on verbal aggressiveness, physical aggression, and destructive behaviors. This study included three experimental phases: baseline, SoF training and practice, and a one-year follow-up period. According to the study, the three youths' verbally abusive, physically aggressive, and destructive actions significantly decreased when they practiced meditation (SoF). To determine SoF practice's value for Chinese children with ASD, more investigation is needed.

Vidyashree et al., (2019) investigated an experimental study focused on the “effect of yoga intervention on short-term heart rate variability (HRV) in children with ASD”. A randomized pre-post approach was employed in the investigation. 50 young people with ASD—38 boys and 12 girls—were selected for this specific study project from the Swabhimaan Trust in Palavakkam, Chennai. Using a simple lottery system, all 50 samples were split into two groups: the control group (n=25) and the yoga group (n= 25). For three months, the participants in the

yoga intervention group practiced yoga alongside their usual special education curriculum. Additionally, the control group persisted in receiving their usual occupational treatment in special schools, which included speech, language, and other occupational training. Short-term HRV study was performed using a 15-minute electrocardiogram (ECG) as the evaluation tool. Lead II was used to record a seated posture using a simple analog amplifier. The study's findings showed that children with autism who had lower LF (n. u), an indication of sympathetic activity, and higher mean RR, SDNN, RMSSD, and HF (n. u), a measure of parasympathetic activity, showed a significant improvement after receiving a yoga intervention. According to the study's findings, yoga therapies can help children with ASD develop parasympathetic dominance.

Ramanathan et al. (2019) were investigated on the "effects of yoga on Auditory Reaction Time (ART) and Visual Reaction Time (VRT) of children with autism spectrum disorders". In order to participate in the study's methodology, 72 children with ASD were randomly allocated to a yoga group and a control group. The group received yoga instruction for a duration of 12 weeks. The study found that yoga can enhance the visual and auditory response speeds of kids with ASD. Reaction time is a cognitive process, which considered as an indicator of relation between central and peripheral nervous system, perception, motor processing and muscles activations. Improvement in Reaction time leads to improvement in focus, concentration, relaxation and broadly problem behavior of children with ASD.

Soccalingam et al. (2019) examined yogic tools for special children or Divine Children. They found yoga practice has multiple benefits for children with special needs. It was also mentioned that yoga tools are connected with various changes of brain tissues in short- and long-term state and leads to the formation of new neural synapses, resulting in tissue thickness and improved cognitive ability.

Semple (2019) conducted a review study on “efficacy of yoga and other mindfulness interventions on children with ASD”. Eight papers from electronic databases that matched the inclusion criteria were included in the research. The research revealed some remarkable barriers, such as restricted sample sizes, absence of fidelity metrics, and absence of control cohorts. On the other hand, research indicates that yoga-based therapies are doable and have the potential to enhance self-control, preoccupations, social motivation, social responsiveness, social communication, and quality of life. Significant decreases in aggressive behaviors, irritation, tiredness, social disengagement, and disobedience were also seen.

Litchke et al., (2018) reported the “Effects of Multimodal Mandala Yoga on Social and Emotional Skills for Youth with Autism Spectrum Disorder: An Exploratory Study”. This study essentially targeted male ASD youth. For four weeks, one hour yoga classes were held twice a week for five (5) male teenagers with autism spectrum disorders who were selected for the study. Multimodal Mandala Yoga includes six circular partner or group postures, coloring and drawing sheets, yoga cards, and rhythmic chanting. Scores from the Treatment and Research Institute for ASD Social Skills Assessment (TSSA) were collected before and during the eight yoga sessions. The Modified Facial Mood Scale was used to detect mood alterations before and after each yoga session (MFMS). The test results indicated significant improvements from the pre- to post-test in the affective understanding and perspective taking subscales ($t(4) = -5.171$, $P = 0.007$), initiating interaction ($t(4) = -8.5$, $P = 0.039$), responder to initiation ($t(4) = -3.726$, $P = 0.020$), and total TSSA ($t(4) = -5.744$, $P = 0.005$). Youth MFMS scores increased from 80% to 100% following eight yoga sessions, suggesting a happy or pleasant mood. A theme analysis of the narrative notes revealed three primary components that were associated with the yoga experience: (a) improved mood and emotional expression; (b) increased empathy for others; and (c) enhanced collaborative skills. The development of positive social and emotional skills is impacted by this multimodal Mandala yoga program for young individuals with ASD.

Deorari and Bhardwaj (2017), studied the “effect of yoga intervention on symptoms of autism spectrum disorders”. The method of this study included 30 children with autism. The age range was 5 to 16 years. All the subjects were from Abhiprerna Foundation, Haridwar for the study. Purposive sampling methods were used. The study implemented a 3-month yogic interventions program. The yogic practices include OM Chanting, Asanas and Pranayama. The design of this research work applied pre-post design, and assessment of autism symptoms was done by parents and caregivers using the Childhood Autism Rating Scale. The data that was gathered was calculated and analyzed using the paired sample t-test. At a 0.01 confidence level, the study's findings indicate that children's symptoms of autism significantly decreased following a three-month yoga intervention. The findings suggested that long-term, consistent yoga practice may aid youngsters with ASD symptoms.

Sotoodeh et al., (2017) intended to determine the “effect of yoga training program on the severity of autism in adolescents with High Function Autism”. Utilizing the autism treatment evaluation checklist (AETC), a widely used assessment tool, in conjunction with a control group in a pre/posttest research design allowed this study to accomplish its objectives. The DSM-V

criteria were utilized in this study's approach to diagnose autism in 29 teens, ranging in age from 7 to 15. Two groups of children were randomly assigned: a control group consisting of 14 children and a yoga group consisting of 15 children each. A total of twenty-four thirty-minute sessions made up the eight-week yoga training program. Three certified yoga instructors oversaw the whole training curriculum. Every ATEC sub-score, with the exception of ATEC I (speech/language/communication), showed significant differences between the two groups, according to the analysis's results. This study demonstrated that yoga reduced the severity of autism across a number of areas, including sociability, behavior, health, and sensory and cognitive awareness. The results justify the introduction of a yoga training program. However, no improvement was seen in the speech and communication domain post intervention.

Mochan (2017) observed the “benefits of teaching yoga to young children with special needs: developing an appropriate methodology”. Here, the researcher's primary focus was on proper and adequate approach for managing yoga interventions for students with special needs, particularly those with autism spectrum disorders. As a result, the researcher discovered that yoga is a thorough and successful supplementary treatment for the general management of a child's maladaptive behaviors, underlying symptoms, and other related problems.

Hourston & Atchley (2017), a systematic review was carried out by to assess the available data on mind-body treatments for individuals with ASD. They looked through PsychInfo, Pubmed, and Scopus for this study's materials, and sixteen research publications were found. This research focused on mindfulness, Yoga, Mei Yang Gong, and meditation as intervention techniques. According to the study's findings, yoga is now a potential complementary and alternative medicine (CAM) treatment for kids with autism spectrum disorders.

Sharma N & Sharma N (2016), conducted an experimental study to investigate “the effect of yoga and recreational activities on self-injurious and aggressive behavior of autistic children”. Twenty (20) autistic children between the ages of 8 and 14 as well as their parents and instructors from the Mini Bright Future Mentally Challenged School in Gosianpur, Punjab, India, participated in the study's methodology. Two years of yoga, recreational, and combined yoga and recreational programs were administered to the chosen samples. Before the intervention program started and after the treatments were finished, the researcher employed a self-made questionnaire to gather data. Analysis of Covariance (ANCOVA) was utilized to examine the data that had

been gathered. The study's findings confirmed that yoga and leisure activities significantly reduce children with autism spectrum disorders' aggressive and self-injurious behaviors.

Chan et al. (2013), conducted a study aiming to compare “the effect of a traditional Chinese Chan-based mind-body exercise, Nei Yang Gong, with that of the conventional Progressive Muscle Relaxation (PMR) technique in enhancing the self-control of children with ASD”. For four weeks, forty-six ASD children who were matched for age and IQ were randomized to either the PMR (Control group) or Nei Yang Gong (Experimental group) for twice-weekly group instruction. Three neuropsychological tests and parental judgments on standardized questionnaires were used to evaluate the participants' self-control, and the participants' brain EEG activity during an inhibitory-control task before and after intervention was utilized to explore the underlying neural process. Given that the experimental group significantly outperformed the control group in terms of self-control improvement, the results corroborate the reports from parents of reduced symptoms of autism and enhanced behavioral and temper control. In addition, the experimental group showed higher EEG activity in the self-control region of the anterior cingulate brain when compared to the PMR group. Based on current research, Chinese Chan-based mind-body exercises may be helpful as a cognitive therapy for those with self-control disorders.

Radhakrishna, S. et al., (2010) The work of this paper focuses on the impact of a uniquely developed integrated approach to the yoga therapy module on imitation, communication, and other social skills reported on an experimental investigation. Using precise inclusion/exclusion criteria, the researchers narrowed the sample of 42 children to 6 with ASD in order to achieve the study's goal. The sample's age range was 8 to 14 years old. ASD was diagnosed using the ICD-10 criteria. For two academic years, with a two-month summer vacation in between, the chosen kids got five hours of one-on-one yoga therapy (IAYT). Every yoga class was held in a spacious, verdant, and open environment. Parents and special educators assessed the students in a pre-mid-post environment. The study's findings indicate that integrated yoga therapy significantly improves behavior at home and in family interactions, as well as imitation, communication, and other social skills.

Boyajian et al. 2004, investigated on how parent can incorporate yoga in daily routine of children with ASD. Her findings suggest yoga may be combined with a child's preferred musical toys to serve as both a pleasurable and therapeutic exercise. She added that yoga fosters a strong

bond between parents and children with ASD. This study also shown that yoga can assist develop and maintain a calm mood. during the day, which is a well-earned present for children and adults.

2.7. Yoga for problem behavior of ASD

Joshi & Rathi 2019, evaluated the "effect of IAYT (Integrated Approach to Yoga Therapy) on Physical, Behavioral and social communicative functions in children with autism spectrum disorders". the indicated that by following IYAT has decrease autism severity and problem behaviors of ASD children. The researcher also found an improvement in the social and communicative skills in children.

Kaur & Bhatt, 2019 assessed "effect of yoga on motor skill and bilateral co-ordination of children with autism spectrum disorders". the researcher discovered that children with ASD who practiced yoga had widespread improvements in their bilateral coordination. The study suggests that yoga might be a helpful intervention for improving children with ASD's motor abilities. There was no discernible improvement in fine motor skills in the yoga group.

Narasingharao et al. (2017) reported on "structured yoga program for problem behavior of children with ASD". The method of this study included *yoga* program as a separate intervention and not integrated with other therapeutic modalities. Where the author found by implementing yoga in special school some problem behaviors decreased significantly; such as aggressiveness and self-injurious behaviors. The researchers also noted some improvement in attention span, sitting tolerance and relaxation abilities of the children. The study concluded that *Yoga* can contribute effectively to effective classroom management by positively impacting problem behaviors in classroom.

Scroggins, Litchke & Liu (2016), conducted a case study to determine the "effects of multisensory yoga on behavior in a male child with Apert and Asperger syndrome". A pre-post test experimental design was used in the investigation. A 7-year-old kid with Apert syndrome was the subject of this study. Apert syndrome is a rare genetic illness characterized by low cognitive quotient, acromegaly, speech difficulties, and anatomical deformities in the skull. The youngster had twice-weekly, 45-minute sessions of multimodal yoga intervention for four weeks. The findings of this specific study suggest that this young boy's behaviors linked to his physical, social, and emotional well-being both on and off the mat are positively impacted by multimodal

yoga intervention. The study recommends more research in the long term with bigger sample numbers and more yoga sessions in light of the successful and encouraging outcomes.

Porter, 2013 evaluated potential effects of yoga practice to successfully improve focus on tasks in children with ASD. This study reported a marked increase in the percentage of time to focus and fewer stimulus to direct its attention towards assigned academic tasks.

Koenig et al. (2012) intended to assessed the “effects of getting ready for a yoga program among children with autism spectrum disorders”. To evaluate the children with ASD, the study used an experimental pretest–posttest control group approach. The methods used in this study include an experiment and a control group. While the kids in the control group went about their usual morning routine without practicing any yoga, the children in the experimental group took part in the Get Ready to Learn (GRTL) classroom yoga program every day for 16 weeks. The Aberrant Behavior Checklist and standardized assessments were utilized to classify behaviors and evaluate problematic behaviors in the pre-test–post-test setting. The differences in gain scores on the dependent variables were assessed by the researchers using a between-groups analysis of variance. The results showed that instructors' evaluations of the experimental group's children's maladaptive conduct were substantially ($p < .05$) lower than those of the control group. The parents reported a decrease in problem behaviors following the intervention, despite the fact that there was no discernible difference in their report. The study found that daily yoga treatments in the classroom have a major impact on important classroom behaviors in ASD.

Rosenblatt et al., (2011) studied the effects eight weeks multimodal yoga program on problem behaviors, relaxation response and core symptoms of individual with ASD. The study was conducted on 24 ASD children, age ranged 3-16 years. It was found, significant reduction in problem behaviors, relaxation response and core symptoms in ASD children after following multimodal yoga intervention program.

2.8. Physical activities and autism spectrum disorders (ASD)

Li et al., (2023), an organized review and meta-analysis (NMA) was carried out to investigate "the efficacy of physical activity interventions on children with autism spectrum disorders." With this study protocol, we hope to learn more about the body of current literature and examine the effects of physical activity intervention strategies on cognitive skills in children diagnosed with ASD. In this review study, the researcher followed the PRISMA-NMA

(Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols for Network Meta-Analyses) statement. Nine bibliographic databases (APA PsycInfo, CENTRAL, Dimensions, ERIC, MEDLINE Complete, PubMed, Scopus, SPORTDiscus, and Web of Science) were extensively searched to identify eligible articles based on a number of inclusion and exclusion criteria. Of the 31 systematic reviews with or without meta-analysis that met the inclusion criteria, a total of 19 (61%) were found there. Despite various limitations, the study provides valuable insights into the effectiveness of PAIS in enhancing cognitive function in children diagnosed with ASD. Despite various limitations, the study provides valuable insights into the effectiveness of PAIS in enhancing cognitive function in children diagnosed with ASD. The results also highlight the need for additional research in this field, including larger-scale, carefully controlled trials to compare the efficacy of different physical activity interventions. Clinical professionals and legislators should consider incorporating physical activity into programs designed to enhance cognitive function in this population.

Ji et al., (2023), reported an organized review and meta-analysis to investigate "the effectiveness of exercise interventions in improving Fundamental Motor Skills in children with autism spectrum disorders". After searching 2696 publications across seven databases to look into the systematic review and meta-analysis, the researcher was able to include 13 (541 participants) that ultimately satisfied the inclusion and exclusion criteria for this study. Ten (297) of the 13 papers were subjected to a meta-analysis. The following criteria were established for inclusion: a. Children with ASD diagnoses from the Diagnostic and Statistical Manual of Mental Disorders (DSM-4, or DSM-5) who are at least 18 years old on average. a. Physical activity or exercise interventions. c. A randomized controlled trial design is required. d. Approved instruments were used to evaluate the outcome measures. f. Research papers must only be published in English. The results of this review research show that children with autism spectrum disorders can greatly benefit from exercise interventions to enhance their Fundamental Motor Skills. Additionally, it was shown that exercise had a moderate impact on social skills (SS) and object-catching skills (OCS).

Castaño et al., (2023) explored many positive effects of physical exercise. The aim of the research was to evaluate the impact of a regular and structured physical exercise regimen on the gross motor skills of children diagnosed with autism spectrum disorder (ASD). Twenty kids between the ages of four and seven took part in the research. They were split up into two groups: ten kids in the experimental group (n = 10) participated in three weekly, sixty-minute sessions of

an organized physical training program for eight weeks, while ten kids in the control group (n = 10) had regular physiotherapy. Gross motor skills were assessed both before and after the physical exercise program using the Abbreviated Development Scale-3. The study's conclusions show that, in comparison to the control group, the experimental group's gross motor skills considerably improved. This study suggests that structured physical exercise programs that improve gross motor skills may be beneficial for children with ASD.

Chandu (2023), conducted experimental research work to determine “the effects of creative movement and play-based interventions on motor skills of children with autism spectrum disorder”. This work evaluated the effects of general movement, creative movement, and seated play therapies on the motor abilities of children with autism spectrum disorders related to bilateral coordination, balance, and upper limb coordination. According to the research manuscript's methodology, 45 children consented to take part in the investigation. Three intervention groups—a. creative movement group, b. general movement group, and c. seated play group—were evenly split from the selected samples. Each participant received sixteen training sessions, spread over eight weeks, with two sessions every week lasting around one to one and a half hours each. Pre- and post-intervention data were gathered from the subjects. The study applied independent t tests to investigate differences between groups, and dependent 't' tests to assess changes in group performance from the pretest to the posttest. The study applied independent t tests to investigate differences between groups, and dependent 't' tests to assess changes in group performance from the pretest to the posttest. The findings revealed a statistically significant increase in bilateral coordination in both the general movement group and the creative movement group. The seated play group did not demonstrate any improvement on the bilateral coordination and balance subtests. No group showed statistically significant gains on the upper limb coordination subtest.

Marzouki et al., (2022) investigated “the Effects of Aquatic Training on gross motor skills of Children with Autism Spectrum Disorder (ASD)”. This study aims to assess and explore the effects of eight weeks on several aquatic training programs (e.g., Technical and Game-based) on the development of children with autism's motor skills, their ability to regulate their emotions, and their ability to move around. Pre-to-post assessment was done in this study using a randomized, parallel, and controlled approach. After being selected for the study, twenty-eight kids were randomized into three groups: the control group, the group engaged in game-based aquatic activities, and the group engaged in technical aquatic activities. Eight weeks of aquatic activity treatments were given to both experimental groups. The

Gilliam Autism Rating Scale (GARS-2), the Test of Gross Motor Development (TGMD-2), and the Emotion Regulation Checklist (ERC) were used to examine the participants. Each test was administered over a period of three days: anthropometric measures and the TGMD-2 on day one; GARS-2 on day two; and the ERC on day three. An analysis of variance with two replications was carried out using three conditions (group: TAT, GAT, or CONT) × time of measurement (T1 and T2) in order to evaluate the data and determine variations both within and across the groupings. Gross motor skills and stereotypy behavior in both experimental groups had a significant time-dependent influence. Gross motor abilities were improved in both experimental groups as compared to the control group. Emotional functioning showed a little pre-post-change effect in all groups. The experimental groups did not vary significantly on any of the measures that were examined.

Liang et al. (2022) carried out a meta-analysis and organized review to examine the existing empirical research and determine the impact of exercise therapies on executive function in children and adolescents. The authors of this study initially searched 259 research articles from different electronic databases, 15 studies which met the eligibility criteria were independently assessed. According to the study's findings, long-term exercise programs tend to improve children and adolescents with ASD's overall executive functions (little to somewhat), especially when it comes to cognitive flexibility and inhibitory control.

Sarabzadeh et al., 2019, assessed the “effect of Tai Chi Chuan training on the motor skills of children with autism spectrum disorder”. This study's methodology comprised choosing 18 autistic youngsters and using a random controlled trail design. Two equal groups—the experimental group and the control group—with ages ranging from six to twelve years old were created at random. For six weeks, the experimental group attended three days a week, 60-minute Tai Chi Chuan training sessions. The subjects' motor skill performances were assessed using the M-ABC-2 exam both before and after the training session. The validity and reliability of this test have been validated (Green et al., 2009; Wagner et al., 2011; Schoemaker et al., 2012), with an internal consistency of 0.90, test-retest reliability of 0.97 (WUANG et al., 2012), and a kappa statistic coefficient range of 0.92e0.98 (Henderson, 1992). Statistical methods such as dependent and independent T-tests were used to assess the six-week Tai Chi Chuan training program. The results of the study indicate that while the groups' manual agility scores did not significantly alter between the pretest and posttest, the balance and motion coordination scale did significantly differ.

Caputo et al., (2018) studied “Effectiveness of a Multi-system Aquatic Therapy for Children with Autism Spectrum Disorders”. Researchers in this study were primarily concerned

in evaluating how an aquatic program affected children with ASD's social behaviors, swimming abilities, and emotional adaptability. 26 ASD youngsters (n = 17 males and 9 females) who had never engaged in water activities before were included in this study's methodology. An RCT was used as the study design in this investigation. The selected participants engaged in an aquatic multi-system intervention for a duration of ten months. To assess the effectiveness of the aquatic program, data on functional adaptation (Vineland Adaptive Behavior Scales), emotional response, adaptability to change, and activity level (Childhood Autism Rating Scale) were collected both before and after the program. After doing a statistical analysis, the researchers found that the aquatic therapy group considerably outperformed the control groups on several dependent variables.

Healy et al., (2018) investigated a meta-analysis among children with ASD has an effected on physical activity interventional program. PRISMA method was used for this study and all the articles were retrieved through the electronic database, searching keywords were fixed in terms of autism, PA, ASD with PA, physical education, Intervention PA, and adapted physical activity. Inclusion criteria were chosen that (a) Articles must be selected through an electronic database. (b) coding procedure and (c) a statistical method was used. There are 29 articles included for summarizing and sampling size (n: 1009) out of 30 independent variables. The findings indicated that overall effect size (g=0.62) and most of the study revealed a moderate to large effect ($g \geq 0.5$). The result showed that physical activity intervention has been developed in several domains in terms of physical, physiological, psychological, and sociological improvement of individuals with ASD.

Ferreira et al., (2018) examined “the effect of Physical Exercise Programe (PEP) on Stereotyped Behavior, Metabolic and Physical Activity Profiles, Physical Fitness and Health-Related Quality of children with Autism Spectrum Disorders (ASD)”. The study set out to examine the multivariate associations between the health-related quality of life, metabolic profile, physical fitness, PA level, and symptoms of ASD in children. Additionally, a 40-week exercise program was evaluated for its effects on the metabolic profile, PA level, physical fitness, and health-related quality of life of children with ASD. The research employed an experimental design that was cross-sectional in nature. Using a 12-week evaluation program, the study paper's methodology first focused on three variables: biochemical variables (HDL, LDL, cholesterol, etc.), aerobic capacity (one mile run), and anthropometric measures (height, weights, BMI, etc.). Additionally, a 40-week physical exercise intervention period and an 8-week

evaluation program comprised the study's second phase. Strength and endurance exercises were both included in the physical exercise intervention plan. The research findings indicate that the physical activity program has a noteworthy impact on various dependent variables, including metabolic, anthropometric, aerobic capacity, grip strength, health-related quality, and socioeconomic status of children with ASD. Additionally, the program has been found to significantly alter symptomatic characteristics.

Yu et al., 2018, investigated to determine “the effect of a game-based exercise training program on promoting physical fitness and mental health in children with autism spectrum disorder”. This study examined the potential benefits of game-based exercise programs on the social interaction and communication deficits of kids with autism spectrum disorder (ASD). The investigation's randomized controlled trial approach included the evaluation of 112 ASD youngsters. The intervention group and the control group were randomly assigned to these children. The intervention group took part in a 16-week game-based physical activity training program. The children's physical and psychological characteristics were evaluated at three different points in time: before the program began (16 weeks post-intervention), during the program's 16 weeks, and 32 weeks afterward (follow-up). In order to close the gap between the psychological and physical states (traits) of children with ASD, an intervention was created specifically for this study. This main goal was to implement a game-based fitness program with varying degrees of difficulty that was created to provide kids with ASD the abilities they need to participate in and stay in team sports or perhaps professional sports training. The study's findings demonstrated that children with ASD can benefit from an enjoyable and stimulating fitness program that focuses on whole-person development through gaming.

In 2018, Stavrou et al. carried out an experimental investigation. The exercise intervention's impact on children with ASD's behavior and communication development was the main focus of the study. This study's methodology comprised a cross-sectional survey research approach on a 7-year-old child with an ASD diagnosis. Parents, the general class teacher, the parallel support teacher, and the physical education teacher assessed the development of behavior and communication using a pre- and post-intervention questionnaire. Three sessions each week, lasting between forty and forty-five minutes each, comprised the 12-week duration of the physical exercise intervention. The fitness program that was implemented comprised balance exercises, self-awareness activities, games for three to four people, lateral movement exercises, visual motor coordination exercises, and games for time and spatial orientation. The results of

the study showed that an exercise intervention program greatly enhanced the behavior, skills, and communication of a child diagnosed with autism spectrum disorder.

Zhao et al. 2018, investigated “the effects of structured physical activity programs on social interaction and communication of children with autism spectrum disorder (ASD)”. The technique of this investigation used a quasi-experimental approach. 50 school-age ASD children were divided into two groups at random for this study: the experimental group (n = 25) and the control group (n = 25). The experimental group participated in a structured 12-week regimen of physical exercise. Each daily session lasted for one hour. Before and after they finished 12 physical activity training courses, children with autism spectrum disorder were measured for social interaction and communication using the Social Skills Improvement System Rating Scales (SSIS-RS), ABLLS-R, and VOEQ. To compare, a two-way repeated measures ANOVA was used. The results showed that throughout the interim and posttest periods, there was a considerable improvement in the social skills, communication, teamwork, and social interaction of the experimental group. On the other hand, there were no notable variations seen in the control group.

Najafabadi et al., 2018, observed “the effectiveness of selected group exercise SPARK (Sports, Play and Active Recreation for Kids) on motor skills and behavioral skills of children with autism spectrum disorder (ASD)”. Repeated measurements were used in a quasi-experimental approach for the investigation. Finding out how certain group activities improved the motor and behavioral abilities of kids with ASD was the aim of the study. The study included 25 ASD children, aged 5 to 12, who had been diagnosed using the Fourth Edition of the Statistical Manual of Mental Disorders. The experimental group participated in skill development and beneficial physical exercise three times a week. A maximum of 40 minutes may be spent on each of the 36 sessions, which consist of 10 minutes for warm-up, 20 minutes for goal-directed activity, and 10 minutes for cooling down. The motor and behavioral skills of children with ASD were assessed using the Gilliam Autism Rating Scale, Second Edition (GARS-2), the Autism Treatment Evaluation Checklist (ATEC), and the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) in order to assess the effectiveness of the SPARK intervention. Under the guidance of an ANOVA, group differences were examined using the Paired t-test, which was also used to assess differences before and after. At the baseline/pre-test and post-test stages, the data was gathered. The outcomes demonstrated the SPARK program enhanced the social and physical abilities of children with ASD.

Zachor et al. 2017, investigated on "The effectiveness of an outdoor adventure program for young children with autism spectrum disorder: a controlled study". The study set out to assess the degree to which people with autism spectrum disorders (ASD) benefited from participation in outdoor adventure programs. The approach used in this study includes 51 participants, 40 of whom are male and 11 of whom are female, with ages ranging from 3 to 7 years and 4 months. From seven special education kindergartens in the same city that serve kids with ASD, participants were chosen at random. They all met the requirements outlined in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition Text Revision (DSM-IV TR) and had all previously been diagnosed with ASD based on psychological and medical evaluations. Each research participant was allocated into two groups: the Experimental group (30) and the Control group (21). The study used a randomized controlled trial design. The outdoor adventure program was followed by the intervention group for 13 weeks. Every training session lasted thirty minutes. The study's findings demonstrated that the outdoor adventure program significantly improved the social cognition, social drive, and autistic characteristics of children with ASD.

Movahedi et al. (2013), intended to assess “the effects of long-term Kata techniques training on social interaction of children with autism spectrum disorders”. In the method of this paper, the authors randomly included 30 children having autism (Male-26, Female-4). The participants ranged in age from 5 to 16 (M=9.13). Every individual was diagnosed with autism spectrum disorder (ASD), in accordance with the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR). There was no discernible change in the groups' baseline (pre-intervention) levels of social dysfunction, according to the results section. Repeated measurements were used to compute the post-intervention outcome. An analysis using ANOVA demonstrated a significant difference between participants ($F(1, 24) = 4.24$, $p < .001$, $\eta P2 = .15$) and a significant difference among participants ($F(2, 48) = 17.02$, $p < .001$, $\eta P2 = .42$). The study found that teaching children with autism spectrum disorders long-term Kata methods consistently reduces their social dysfunction.

Bahrami et al. (2012), evaluated “the effect of Kata techniques training on stereotypic behaviors of children with autism spectrum disorders (ASD)”. One of the three main characteristics used to diagnose autism is stereotypy. Thirty ASD youngsters were enrolled in the research at random (four female and twenty male). The youngsters ranged in age from five to sixteen. The Diagnostic and Statistical Manual of Mental Disorders, Fourth Revision ASD was

determined in the subjects using Text Revision (DSM-4; American Psychiatric Association). There were two groups of children: fifteen in the exercise group and fifteen in the control group, who did not exercise. Sixty-six sessions of Kata technique instruction were given to the exercise group. Pre-intervention, 14-week, and one-month post-intervention participant stereotypes were assessed in both groups. A mean difference of 42.54% was found between the participants' baseline levels of stereotypy in the children with ASD and the training in Kata techniques. It's important to notice that even after 30 days without practice, stereotypy in the exercise group stayed significantly lower than it was before to the intervention. The individuals of the control group remained mostly stereotypical. It was shown that giving children with ASD prolonged instruction in martial arts methods consistently reduces their stereotypical behaviors.

Fletcher et al. (2011), examined “the effects of equine-assisted activities on overall severity of children with autism spectrum disorder”. 41 participants satisfied the following requirements for this study's methodology: they had never engaged in equine-assisted activities previously, they were between the ages of 3 and 12, and they had a primary diagnosis of ASD with a Childhood Autism Rating scale (CARS) score of >30. While the other 22 participants fulfilled the qualifications for the waiting list period, twenty of these persons obtained the full six months (one 60-minute ride per week) of the horse assisted riding program. Data on the child's overall severity of autism was gathered using the 5-point Timberlawn Parent-Child Interaction Scale, which measures responsiveness, expressiveness, positive and negative respect, tone and mood, and empathy between parents and children. According to this study's findings, there was a significant improvement in the symptoms of autism after six months of having horse assisted riding. The researchers noted that there were few participants and that the same children served as both the experimental and control groups in the paper's limitations.

Nicholson et al., (2011) showed an experimental study on “the effect ts of antecedent physical activity on the academic engagement of children with autism spectrum disorder”. The principal focus of this study was to investigate the utility of the implementation of an antecedent physical activity program in a special school setting. The researcher chose four primary school students with ASD and implemented the physical exercise intervention in order to achieve the study's goals. Based on the study's findings, the researcher came to the conclusion that encouraging academic and other accomplishment in kids with autism spectrum condition might be facilitated by physical activity. The study also indicates that it is simple and accessible to incorporate physical activity for kids with ASD in elementary school. However, further

information and in-depth investigation are required in order to generalize the facts with precise evidence.

Bass et al. (2009), assessed “the effects of therapeutic horseback riding on social functioning in children with autism”. This article focused mostly on lower attention, distractibility, sedentary habits, sensory seeking, sensory sensitivity, and social motivation. The manuscript for this paper comprised 39 youngsters, aged 7 to 12, who were split into two groups: the Control group (N = 19) and the Control group (N = 15). For a duration of 12 weeks, therapeutic horseback riding served as the study's intervention. Parents of every participant filled out a baseline and post-intervention questionnaire created especially for this University of Miami study in order to gather data. The paper's results section revealed that children with autism who participated in therapeutic horseback riding activities with horses had increased sensory seeking, heightened sensory sensitivity, and increased social drive. Additionally, they showed reduced levels of inattention, distractibility, and sedentary habits. Based on the results of the study, therapeutic riding horses might be a beneficial therapeutic intervention for those with autism spectrum disorders.

Levinson et al. (1993), investigated to determine “the effects of exercise intensity on the stereotypic behaviors of individuals with autism”. The author mentioned here moderate and vigorous intensity exercises for autism. The method for this paper included three autistic participants (Male-2, Female-1), aged-11 years, who had attended an autistic school for 5 years. The diagnosis criteria for autism were done using DSM-III-R, 1987. For this study, the most important and focusing criterion was stereotypic behaviors. A standard questionnaire was used to gather data on stereotypical behaviors before, during, and 90 minutes after the exam. A multivariate analysis of variance was used to examine the data. The findings demonstrated that a rigorous exercise program is superior than a moderate exercise program in terms of reducing stereotypical behaviors in people with autism.

2.9. Physical activity for problem behavior of ASD

Lee, Vargo, & Porretta, (2018) investigated to determine “the effect of two physical activity interventions on stereotyped behavior of children with autism spectrum disorder”. Comparing the impact of object manipulation and locomotor activity on stereotyped behaviors was the aim of this study. Three autistic boys have been selected for this study's methodology. The study is a case study in nature. Each Physical activity intervention had three phases; pre-

activity, main activity, and post-activity and duration of each phase was 5 minutes. After assessment of each child and applying appropriate statistical techniques, it was found that locomotor activity (continuous motor activities) had a significant effect on reducing stereotyped behavior in comparison to object manipulation activity. The study's findings also demonstrated children with ASD might enhance their task management skills through locomotor exercise. Though a thorough investigation with the greatest number of participants is required in order to generalize the study's conclusions.

Tse, Pang, & Lee, (2018) conducted an experimental study on “Choosing an Appropriate Physical Exercise to Reduce Stereotypic Behavior in Children with Autism Spectrum Disorders: A Non-randomized Crossover Study”. This study's methodology comprised thirty ASD youngsters, particularly those who displayed hand-flapping and body-rocking behaviors. One experimental treatment included in the physical activity intervention programs was ball tapping for 15 minutes. For fifteen minutes, the samples were instructed to tap the plastic ball as often as they could. According to the study's findings, engaging in a physical activity intervention program significantly decreased stereotyped behavior, particularly hand-flapping.

Gabriels et al. (2012), evaluated “the effects of therapeutic horse riding (THR) on irritability, communication skills and Motor skills of children with autism spectrum disorders”. In this study, 42 subjects (36 male, 6 female) with nonverbal IQs (NVIQs) ranging from 44 to 139 (mean: 95.2) and diagnoses of autism or Asperger's syndrome were included. The participants were between the ages of 6 and 16 (mean age: 8.7 years). The 16 participants who participated in this study. The children received 10 weeks of therapeutic horseback riding treatment. Before (baseline measurement) and after (post-condition measurement) the intervention, all parents and legal guardians completed the questionnaires about irritability, communication skills and Motor skills.

The difference between the baseline and post-THR (therapeutic horse riding) intervention assessments was measured using paired t-tests for data analysis. According to the findings, therapeutic horseback riding may significantly improve a kid with autism's verbal praxis/motor planning skills, expressive language abilities, hyperactivity, lethargy, and stereotyped behavior.

2.10. Summary of literature review

According to recent research reports, it was found that the estimated statistics of autism spectrum disorder (ASD) is increasing rapidly all over the world, and why this number is increasing is not yet clear to the scientific community. There is no discovered established medical treatment or any other known etiology for ASD. Only we can make an attempt to reduce its symptoms through some therapeutic activities. There are many interventions and therapeutic activities for ASD. Among them, yoga and physical activity have been becoming popular in recent decades. The impact of yoga and physical exercise on the autistic population has attracted very little research in India, and it's likely that no research has been done in West Bengal in this area. The researcher for this study read through 69 original reviews of the literature and categorized them into four primary areas: yoga and ASD; yoga and ASD issue behavior; physical activity and ASD; and physical activity and ASD problem behavior. It has been noted that there is still relatively little yoga and physical exercise research that can be applied to ASD. According to certain study findings, yoga and physical activity can help with core symptoms as well as other ASD symptoms. However, there are incredibly few. Studies on how yoga and exercise affect the problematic behavior of individuals with ASD have not been conducted somehow. The possible effects of yoga and physical activity on problem behavior associated with ASD are now being studied by the scientific community. The present project aims to find out how yoga and physical activity impact the problem behaviors of individuals with ASD.

Chapter III

Methodology

3.Overview

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Chapter III

Methodology

3. Overview

The proposed research questions for this study have been framed out on the basis of identified research gaps, discovered by careful and critical analysis of existing traditional and scientific literature. The global increasing rate of children with autism and its consequences on individual and social life is really a growing challenge. To some extent manage this challenge, the research objective for this study was to examine the benefits of yoga and physical activity for individual with ASD.

The following section provides details about the methodology used for this study in order to answer the proposed research questions with results and a logical conclusion. In the methodological procedures the researcher explained here, locations of the study, selection of the subjects, Inclusion and exclusion criteria of the sample, Selection of variables and measurement techniques, Description of participants, Administration of Test, Experimental Design of the study and Administration of yoga and physical activity training protocol, Data collection tools and procedures and the method employed for statistical analysis for this study.

3.1. Selection of institution for study

The appropriate environment and atmosphere play a key role in conducting research work successfully. As ASD children have some special qualities and limitations, they need more extraordinary care and attention in special environments. The researcher has selected Pradip: Centre for Autism Management, 33A/1 Canal (South) Road, Kolkata-700015, West Bengal for conducting the pilot study (2018) and final study (2023). This institution is well known and famous for providing quality services to ASD children from way back. Students of this institution are basically coming from different zones of Kolkata and other districts of West Bengal. The researcher, with other experts, visited the institution several times before selecting it as an appropriate place for conducting the current research work. The researcher conducted the pilot study and the final study in two separate time periods. There are some reasons behind selecting these two different time zones.

The reasons are 1. The pilot study was conducted in 2018 for one (1) month, then researchers realized some modifications in the training schedule and data collection procedure

were needed. 2. To settle down that necessary modification, the researcher searched for experts' opinion and literature survey, it took a huge time. 3. Then the lock-down phase came because of Covid-19, so, it was very difficult to get ASD children as a sample and continue such a type of challenging research work though offline and online mode. 4. Thereafter, the Covid-19 period came over and a normal situation came. The researcher again contacted Pradip: Centre for Autism Management, 33A/1 Canal (South) Road, Kolkata-700015, West Bengal to conduct the final study in 2023.

3.2. Selection of subjects/Participants

The researcher has communicated with five special schools in Kolkata for this study. Among these schools, four schools expressed different participation constraints and one school agreed with positive interest in participating in the study. A number of factors, such as the parents' availability, motivation, and ability to understand their children or adolescents, were eventually taken into consideration when selecting 24 children who had previously received a diagnosis from the Pradip: Center for Autism Management in Kolkata, West Bengal, India, as research samples. Autism spectrum disorders were diagnosed with the use of the Indian Scale for Assessment of Autism (ISAA). Children with moderate level of ASD were selected as a research sample. For this reason, the purposive sampling technique was used, and both male and female children were included in the sample. The samples' mental ages were not taken into account for this investigation, while the participants' chronological ages ranged from 8 to 14 years. Only a sample of the students who had received special education instruction for at least a year was chosen.

3.3. Details of the subjects

As per the admission register, medical records of children admitted between the years 2015-2022 from Pradip: Center for Autism Management, Kolkata, West Bengal, India were examined and 24 children with ASD were selected as samples for this investigation. As per cooperation level of young ASD children/adolescents, the selected 24 male (15) and female (9) subjects were randomly divided into 3 groups (Yoga Group, Physical activity Group, Control Group) and each group comprises 8 children/adolescents (Male: Female=5:3). The details demography of the participants is mentioned below in Table no-1.

Table-1: Demographic Details of the Subjects

Sl. No	Group	Age Mean/SD	Sex M/F	SEB
1.	**Yoga Group (8)**	10/2	5/3	Middle class
2.	**Physical activity Group (8)**	9.5/.92	5/3	Middle class
3.	**Control Group (8)**	10.5/2.2	5/3	Middle class

SEB- Socio-Economic Background

The selected subjects were mostly from a middle-class socioeconomic background and the mean ages of the selected samples were Yoga group- 10+2 years, Physical activity group- 9.5+.92 years and Control group-10.5+2.2 years respectively.

3.4. Inclusion Criteria

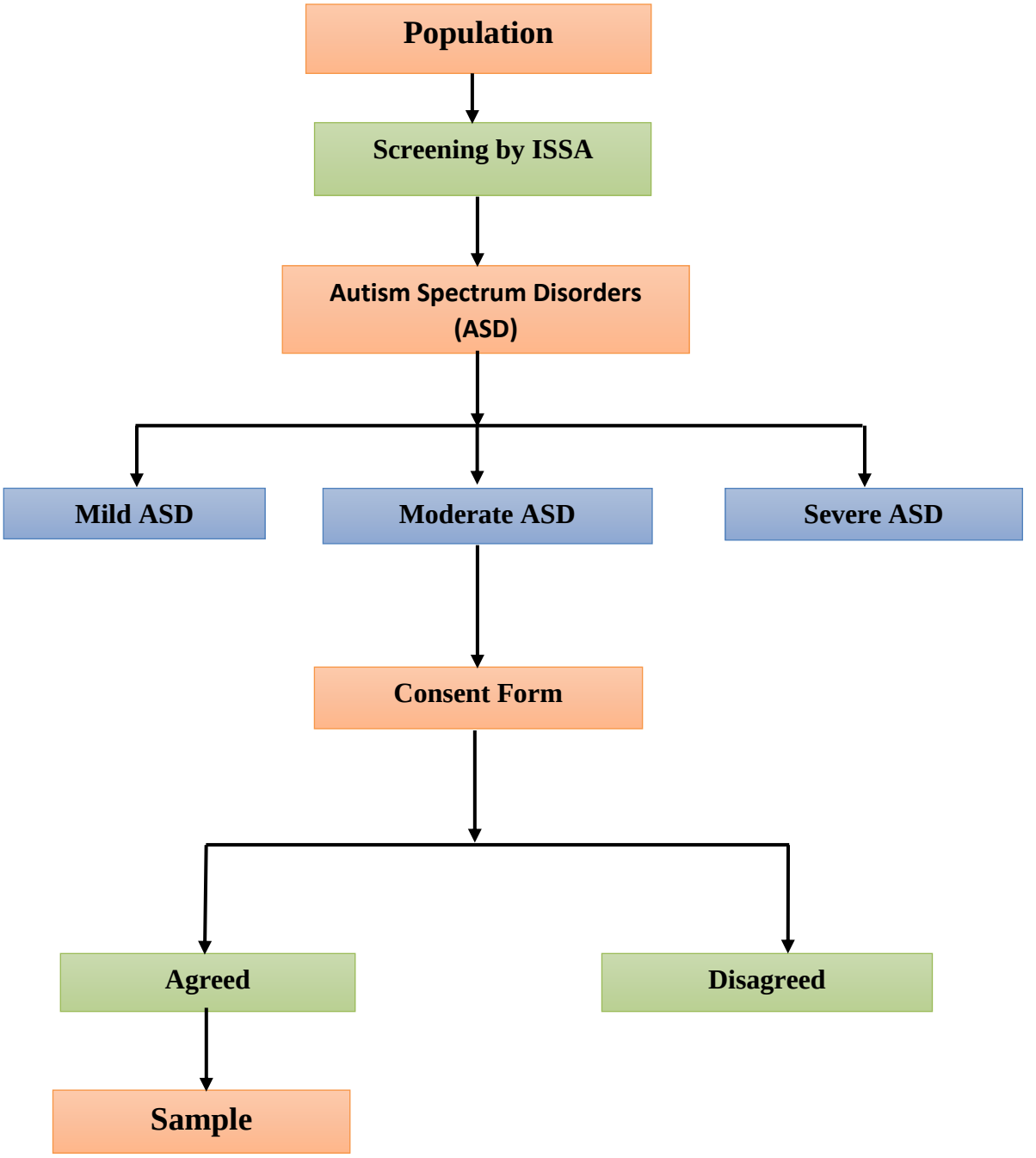
i. All the children/ adolescents were diagnosed with Autism Spectrum Disorders (ASD) by a rehab-psychologist/ clinical psychologist.
ii. The Indian Scale for Assessment of Autism (ISAA) was used to confirm the diagnosis of autism spectrum disorders (ASD).
iii. For this study, the moderate level ASD children were selected as subjects.
iv. The group sampled for the study consisted of both males and females.
v. The participating sample's initial chronological age range was 8 to 14 years.
vi. As per admission record records, the children/adolescents received at least one year of special school education at school/institution.
vii. After explaining the details of the study, an informed and signed consent form was obtained by the parents before initiation of the study.

3.5. Exclusion criteria

i. Any other pre-dominant disabilities have some features of autism.
ii. The individuals with ASD who have both mild and severe autism.
iii. Existence of any neurological conditions with an established cause.
iv. Having severe physical anomalies together with a sensory or motor disability.
v. Having epilepsy and mental retardation as the only related impairments.
vi. Experiencing any additional spectrum disorders, such as Aspergers, Retts, etc.
vii. A history of neurological conditions or head trauma.

viii. Significant medical problems or physical limitations that can have an impact on yoga and physical activity participation were present in the participants.

Figure-2: Flow Chart of Sample Selection



3.6. Ethical clearance and informed consent of the participants

Ethical guidelines are so important for conducting research on humans. For this study, the researcher has followed them firmly. The study was first verified and approved with some necessary suggestions, by the 'Departmental Teachers Committee', and the 'Board of Studies', the Research Board of Jadavpur University. Finally, the 'Institution Ethics Committee' for Human Research, Jadavpur University provisionally approved this study (Appendix-2). All the parents of the participants have given their signed and informed consent to participate in the study after understanding the details (objectives and procedures) of this research initiative. A sample copy of the informed consent form is enclosed in Appendix-3. This entire research experiment was ensured as non-injurious, not risky and had no side effects.

3.7. Selection of Variables

Autism spectrum disorder (ASD) is considered as heterogenous neurodevelopmental disorder contained by social deficits and restricted, repetitive patterns of behavior (APA, 2013). Core symptoms typically manifest as poor social-emotional reciprocity, impaired non-verbal communication, difficulty developing and maintaining social relationships, repetitive movements, intense fixations/interests, atypical sensory sensitivity and deficits in attention. In addition, a significant proportion of individuals with ASD exhibit a broader range of problem behaviors that extend beyond the core symptoms that define the disorder. The majority of the studies revealed that core symptoms and problem behaviors are highly correlated. For example, there is existing research to suggest that many individuals with ASD experience clinically significant internalizing and externalizing problems including anxiety, depression, somatization, rule-breaking, aggression, self-harm, inattention, hyperactivity, impulsivity, and abnormal thoughts. In this study, the term "problem behavior" encompasses any significant emotional or behavioral issue captured by the Behavior Check List (BCL) including problems with anxiety, depression, withdrawal, somatization, socialization, thought, attention, rule-breaking, and aggression.

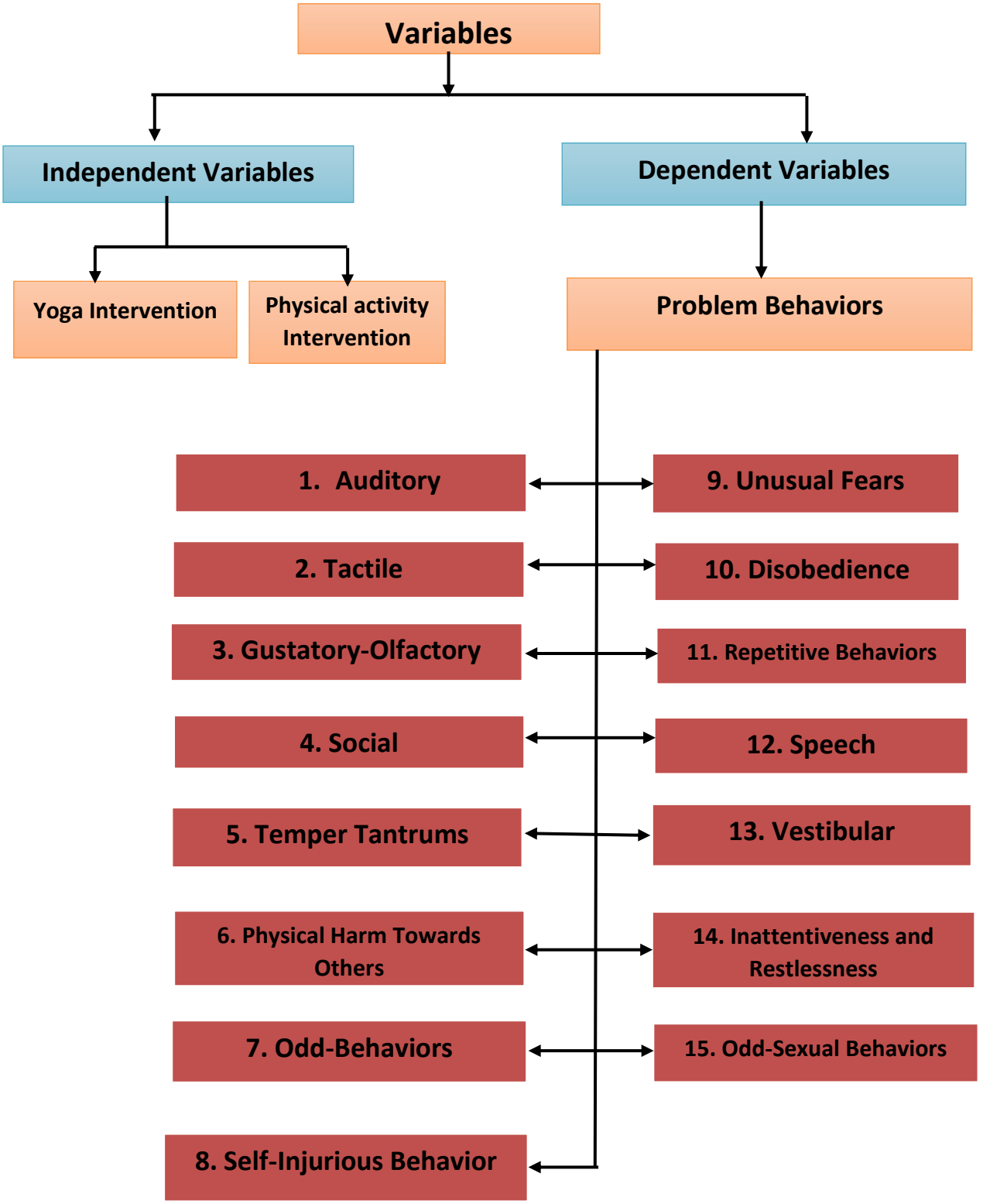
The researcher has retrieved almost eighty-one related articles from different electronic databases and analyzed those reviews with the help of supervisors and other experts. The researcher intended to study the practicability of yoga and physical activity in special school for children with autism spectrum disorders (ASD). Then **yoga and physical activities** have fixed as independent variables and **problem behaviors of ASD children** as dependent variables for this study. Description of detailed variables as mentioned below.

3.8. Problem behaviors of ASD children

The current researchers have agreed that there is something more other than attention problem, sensory problem, and communication problem etc. and only that propel them (ASD children) to behave inappropriately. Children with ASD commonly experience various emotional and behavioural challenges or problems, generally indicated as ‘problem behaviours’ (PB).

These PB generally include internalizing and externalizing behaviours such as physical aggression, temper tantrum, self-injury, inattention, hyperactivity, anxiety, depression, withdrawal, and self-stimulatory behaviours (Lindor et al.,2019; Williams et al., 2018). Social skills deficits can give rise to compensatory problem behaviours recognized as one of the main challenges associated with autism (Jones et al., 2017). Although not a core symptom of ASD, problem behaviours can be highly taxing on the parents and caregivers of children with ASD (Tathgur & Kang, 2021) and it alsointerfere with children’s optimal development, functioning, social interactions, and relationships (McGuire, 2016).

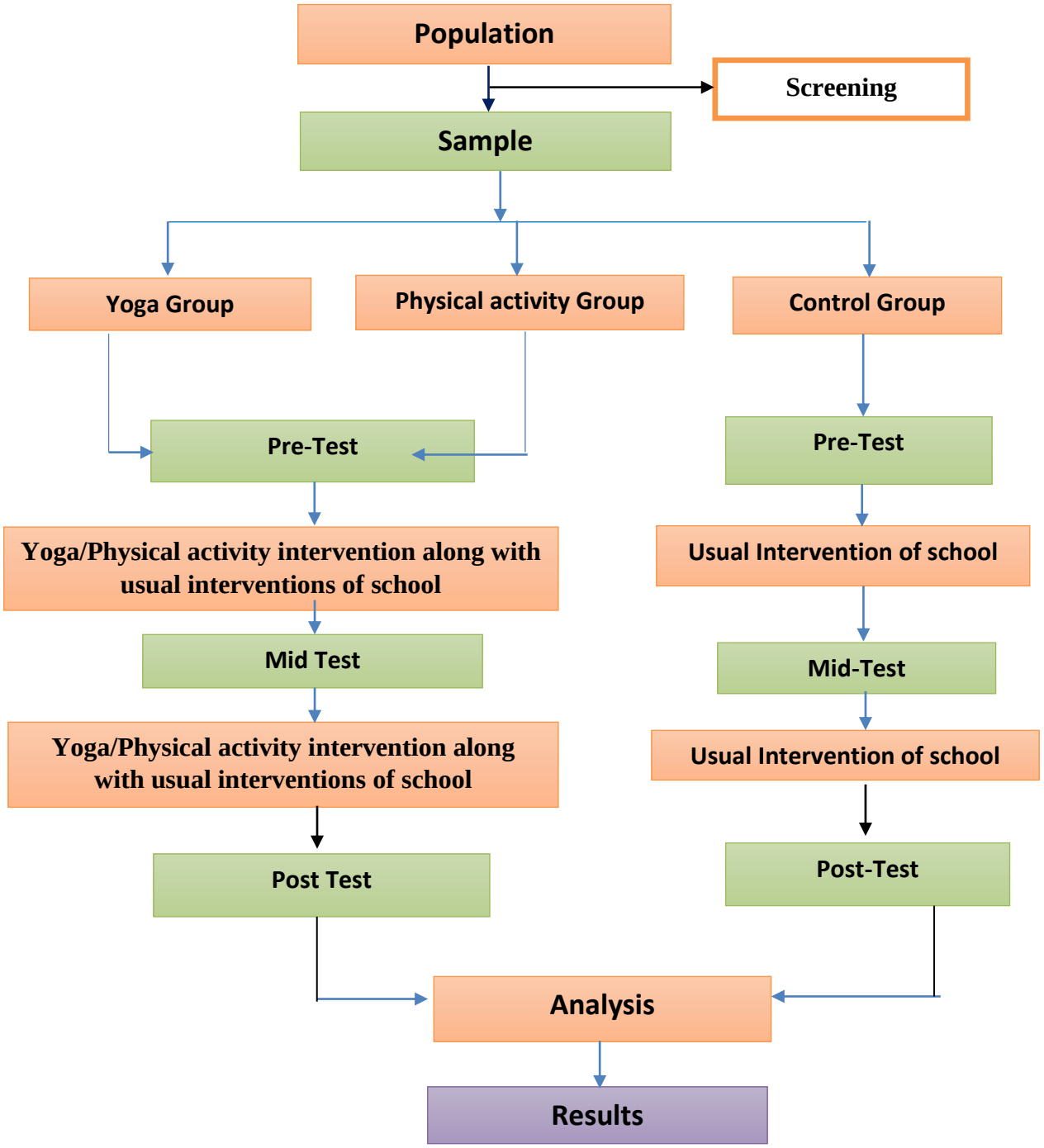
Figure 3: Flow Chart for Variable selection



3.9. Experimental Design of the study

A randomized controlled pre-post experimental design with a control group was employed for this study. The aim of the study was to explore the effect of yoga and physical activity intervention on children with ASD. The total of 24 selected subjects were randomly divided into three equal groups; A. Yoga group, B. Physical activity group, and C. Control group. Each group comprised eight (8) subjects (both; male:5 and female:3). All three groups were attending their regular classes on the special school's curriculum. Simultaneously, two experimental groups; A. yoga group and B. Physical activity group attended the yoga and physical activity intervention for six months. The control group did not participate in either yoga or physical activity interventions, they continued their assigned special schools' activities. The researcher fixed the total duration of intervention for six (6) months, 3 hours of interventions every week. The duration of each intervention session was approx. one (1) hour, from the beginning of school, from 11:15 am to 12:15pm. And before lunch break at 12:30 pm to 1:30 pm. Every session was place in the Pradip: Center for Autism Management's vacant hall in Kolkata, West Bengal, India. The control group solely participated in other school-related activities and their normal institutional classes. Throughout the whole study time, the researcher encouraged the parents of participants to keep their children's daily routines normal and avoid from enrolling them in any extra physical activity or exercise programs.

Figure 4: Flow Chart of Experimental Design



3.10. Intervention Programs

The study's primary goal was to ascertain how yoga and physical activity, both on an individual and group basis, impacted the problem behavior of participants who diagnosed with ASD and how these activities may be included into a child's everyday routine. Thus, the main goal of the research was to offer yoga and physical activities as an alternative therapy to alleviate some of the symptoms of ASD in children. The secondary aim of this study was to assess the applicability of yoga and physical activities to the special school curriculum. For that purpose, the study included two (2) intervention groups; and one (1) control group; all of them followed their regular special school curriculum activities. Apart from that, the yoga group and physical activity group have followed yoga and physical activity intervention protocol for 6 months additionally. For the control group, there was no intervention for this study. Key points of intervention are mentioned here.

- The yoga and physical activity intervention program for this study was framed by the researcher with the help of supervisors, physiotherapists, special education practitioners and on the basis of principles of therapeutic yoga and PA guidelines.
- The intervention program continued for a total of six (6) months, three days a week (Monday, Thursday, and Friday), and comprised 72 sessions, each spanning around sixty minutes.
- All the sessions were conducted at the activity arena hall of Pradip: Center for autism management, Kolkata. The hall was open, airy, away from noise and suitable for performing physical activities. The dimension of the hall was 18*12 meters square.
- Before the initiation of the yoga and PA intervention program, all the participants went through a medical examination by the school medical team. Children having any medical or physical problem were excluded from interventions.
- The researcher appointed four (4) yoga teachers for the yoga program and four (4) physical activity teachers for the PA training program, as research assistants for this study. Apart from those, two (2) physiotherapists, two (2) special education practitioners from the school (Pradip: Centre for Autism management, Kolkata) and parents of ASD children were assisted a lot to conduct the intervention program effectively.
- The scheduled time for the yoga intervention program was 11:15 am to 12:15 pm and the physical activity intervention program was before lunch, from 12:30 pm to 1:30 pm within the school timings. The researcher has assured equal opportunities to each participant to participate in the training program.

Table 2: Intervention module

Sl. No.	Treatment groups	Duration of each session	No of days in week	Time of the Intervention	Total duration of Intervention
1.	**Yoga group** (Total=8, Male-5, Female-3)	1 hour/Day	3 days (Mon, Thurs, Fri)	11:15am to 12:15pm.	6 months
2.	**Physical activity group (**Total=8, Male-5, Female-3)	1 hour/Day	3 days (Mon, Thurs, Fri)	12:30 am to 1:30pm.	6 months
3.	**Control group (**Total=8, Male-5, Female-3)	Other Intervention	Other Intervention	---	6 months

3.11.Yoga Intervention

3.11.1. Yoga

The gift of yoga to the civilized world is truly amazing. A person can realize their greatest self via the practice of yoga (Swami Gitananda Giri Guru Maharaj). Perhaps more than almost any other stimuli, yoga has a direct and significant effect on us. The practice helps one to focus inside and is soothing, offering a unique chance to disconnect from the outside world and find tranquility in our hectic life. Yoga is a spiritual science that aims to improve our physical, mental, and spiritual selves in a harmonious and comprehensive way.

Yoga is growing in popularity as a beneficial therapy which may satisfy the requirements of special needs children and children with ASD. Several studies have revealed positive outcomes of regular yoga practice over different behavioral and physiological aspects such as anger, problem behaviors, attention, self-esteem, executive functions, psycho-motor abilities, and physical health of children with ASD (Mani et al., 2016; Narasingharao et al., 2017; Pise et al., 2018; Purohit & Pradhan, 2017; Sethi et al., 2013).

The yoga module used in this study was based on an ancient yoga text, to bring about an over-all development at physical, mental, emotional, social and spiritual levels. The structured yoga modules created for the research were modified based on a review of the literature to meet the needs and benefits of kids with ASD (Narasingharao et al., 2017; Goldberg, 2013; Radhakrishnan et al., 2010).

3.11.2. Details of Yoga intervention program

This study employed a group yoga intervention program that was based in a school. The organized yoga modules were created with the strengths, limits, and contraindications of children with ASD in mind, in order to meet their unique requirements. Table 3 summarizes the yoga program that has been developed specifically for this investigation.

The sequences of yoga practices were the same for each child initially, and later they were personalized to the individual child. The principal focus of yoga modules was given to specifically address the social, behavioral and physiological issues of children, as all these issues are highly interconnected with problematic behaviors of ASD children. The yoga modules followed a repetitious structure of simple yoga practices with few reinforcing repetitions, maintaining predictability of tasks and new practices facilitating a gradual transition towards increasing complexity (Semple, 2019) and providing better comfort and ease to children (Janzen, 1996; Chissick & Peacock, 2019).

To help children with ASD practice yoga more comfortably and easily, a creative, customized, and weekly new yoga module is presented. It includes more repetitious as well as new activities. Children with ASD experience less anxiety when new tasks are presented to them when they are repeated and integrated into their routines (Janzen, 1996; Chrissick & Peacock, 2019). Throughout the course of the six-month intervention, the yoga poses in the modules increased in difficulty. To increase interest and performance confidence, repetitious yoga practices were continued even while new practices facilitated a gradual shift towards completing more postures throughout the sessions.

There was a sequence to the organized yoga modules of 7 components- 1. Prayer, 2. Loosening exercises (Standing, sitting & dynamic), 3. Asanas/Postures (Standing, sitting, supine & prone), 4. Pranayama/Breathing exercise, 5. Relaxation, 6. Chanting and 7. Closing prayer.

1. Prayer

'Om' and 'Shanti mantras' were said as the beginning and closing prayers of each yoga class. Prayer is an integral aspect of yoga sessions because performed chants like OM and shanti promote relaxation and attention through sound vibrations. (Lolla, 2017; Naidu et al., 2014).

2. Loosening exercises (Standing, sitting & dynamic)

The second part of the yoga intervention module was preparatory practices or loosening exercises. This phase is consisted with standing and sitting exercises (Neck exercises, upper

body exercises and lower body exercises). Furthermore, done before to yoga poses warmed the body, stimulated it, and made it easier for various joints to loosen up (Nagendra & Nagarathna, 2011). The loosening practices also enhanced fine motor skills. A combination of slow and fast yoga practices activated responses from the sympathetic and parasympathetic nervous systems fostering an inherent balance and regulation of the nervous system (Goldberg, 2013).

3. Asanas/Postures (Standing, sitting, supine & prone)

Yoga poses are certain bodily postures that have psycho-physiological effects by strengthening and extending muscles and joints (Woodyard, 2011). Four different types of posture: standing, sitting, supine, and prone—were included in each session based on the participants' initial positions and motivations.

4. Pranayama/Breathing exercise

To improve breath awareness and reduce stress, pranayama, or breathing exercises, included ordinary abdominal breathing and Bhramari (bee's breath humming) (Pellissier et al., 2019). Breathing exercises are deliberate motions of the body that enhance breath awareness (Nagendra & Nagarathna, 2011).

5. Relaxation

Children are in Shavasana, or corpse's posture, which is a complete state of relaxation that revitalizes the body and psyche (Bhogal et al., 2016), the Sukhasana in sitting position and Makarasana in prone position are also used for total mind-body relaxation of ASD children. Initially, children could never assume Shavasana with closed eyes, but after three months, they had started closing their eyes.

6. Chanting

At the beginning, chanting was an imaginary thing, but after three months of intervention, some of the children started chanting ‘OM’ and its syllables 'A', 'U,' 'M,' and short mantras, sometimes short phrases, or words.

7. Closing prayer

Each session was closed by OM chanting and praying with shanti mantra.

Table 3: Yoga practice protocol

Prayer (3-4 Mins)	Opening prayer with Namaskar mudra
Loosening exercise (7-10 Min)	**Standing/Sitting** **Neck exercise** Forward, Backward and sideward bending, Turning sideways, Half rotation (front/back) **Upper body exercise** Shoulder rotation, Wrist rotation, Hands up & down, Finger squeeze **Lower body exercise** Waist rotation, Forward, Backward and sideway bending, Squat, Ankle stretch, Toe squeeze
	Dynamic Exercises Walking (Slow/fast & backward) Jogging (Slow/fast & backward) Running (Slow/fast & backward running) Spot jump Side bending Jumping zag
Asanas/Postures (15-20 Min)	**Standing** Vrikshasana, Tadasana, Utkatasana, Trikonasana, Padahastasana, Ardhachakrasana, Ardhakatichakrasana, Veerabhadrasana, Parsochandrasana **Sitting** Paschimottasana, Sinha Mudra, Dandasana, Vajrasana, ParivrittaVajrasana, Sasankasana, Padmasana, Janusirasana, Bhadrasana, Ushtrasana, Gomukhasana **Supine** Pavanmuktasana, Setubandhasana, Paddothanasana, Utthanpadasana, ShavaUdarkarasana **Prone** Makarasana, Bhujangasana, Salvasana, Dhanurasana
Pranayama/Breathing exercise (8-10 Min)	Hand stretch breathing, Abdominal breathing, Bhramari pranayama
Relaxation poses (5-7 Min)	Sukhasana (Cross legged pose) Shavasana (Corpse pose) Makarasana (Crocodile posture)
Chanting (4-5 Min)	AAA UUU MMM OM Chanting
Prayer (3-4 Min)	Closing prayer with Namaskar Mudra

Picture 1: Yoga intervention


GPS Map Camera
Lat 22.559172°
Long 88.393545°
20/07/23 11:38 AM GMT +05:30
Google
PRADIP CENTRE FOR AUTISM MANAGEMENT
Lat 22.559172°
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33A/1 Canal (South) Road, Kolkata, West Bengal 700015
PRADIP CENTRE FOR AUTISM MANAGEMENT
Lat 22.559172°
Long 88.393545°
28/07/23 11:45 AM GMT +05:30
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3.12. Physical Activity intervention

3.12.1. Physical activity

Any systematic and planned bodily action that improves or maintains physical fitness as well as general health and wellness is referred to as physical activity or exercise (Kreko-Pierce & Eaton 2018). There are several possibilities and benefits to doing regular physical exercises, especially in physical, physiological and psychological systems. It has been scientifically proved and accepted that physical activity increases growth and development, strengthens muscles and the cardiovascular system, develops the immune system, maintains steady digestion, regulates fertility health, maintain body weight and prevents aging (Bouchard et al. 2007).

Physical exercise is also beneficial for human brain functions and psychology. It enhances blood and oxygen flow to the brain, improves spatial learning, promotes synaptic plasticity and neuro-genesis, increases growth factors that aid in neuro-genesis and synaptic plasticity, and creates new neural pathways to improve cognitive functioning (Chan et al. 2012). Enhancing short- and long-term memory; raising brain chemicals that support memory retention, information processing, and cognition, such as dopamine, glutamate, norepinephrine, and serotonin (Basso & Suzuki 2017); raising parasympathetic nervous system activity while lowering sympathetic nervous system activity (Corvey et al. 2016).

Exercise is also thought to improve cognition because it increases nerve growth factors, which are essential for the survival and proliferation of many neuronal cells. Therefore, it was assumed that physical activity could be able to reduce problem behavior of ASD children.

3.12.2. Details of Physical activity intervention

The selected participants (ASD children) for this study belong to the moderate level of autism group. That is why, one-on-one instruction was used to administer the intervention program. The planned physical activity training modules were developed with the unique requirements of the kids with ASD keeping in mind, taking into account their advantages, disadvantages, and medical conditions. There were four phases to every physical activity session: A) preparatory phase; B) Specific activity phase; C) Minor game phase; and D) Cooling down phase.

1. **Preparatory Phase**

   Good preparation makes the task easy. The preparatory phase helped the investigators and trainer to understand the mood and motive of ASD children before each session and made their tasks easy. This phase was made up of warming up activities and of stretching activities. Warming up activities included walking, jogging and running. The stretching activities were bending (forward bending, backward bending and side bending), rotating, pulling and pushing exercises. The duration of this phase was 5 to 15 minutes approximately.

2. **Specific Activity Phase**

   This phase included Calisthenics exercises with free hand or with some apparatus (Calisthenics exercises were 2, 4 and 8 count exercises), jumping exercises (Single leg, both legs, jumping while body in motion), Balancing exercises (Hurdle step over, bear crawling, knee bend standing), Objects holding exercises (Carrying ball and other objects by single and both hands). The duration of this phase was 20 to 30 minutes approximately.

3. **Minor game phase**

   The duration of this phase was approximately5 to 10 minutes. This phase was for taking part in different single or group minor games activities.

4. **Cooling down phase**

   Each session ended up with some guided light relaxation movement, which most of the time made the participants jubilant and happy. This phase was approximately 3 to 5 minutes.

Table-4: Physical activity training Protocol

Preparatory Phase		Specific Activity Phase				Minor Game Phase	Cooling Down Phase
Warm-up activity	**Stretching activity**	**Calisthenics/apparatus drills**	**Jumping exercise**	**Balancing exercise**	**Objects/Ball holding exercise**	**Single /Group games**	**Relaxation movements**
5-15 Minutes		20-30 Minutes				5-10 Mins	3-5 Mins
a.Walking (Slow/Brisk) b.Jogging (Slow/Fast) c.Running (Slow/Fast)	a.Bending b.Twisting c.Rotating e.Pulling f.Pushing exercises	2-count, 4-count, 8-count exercise. (Free hand and with apparatus)	a.Hopping (single & both leg) b.JumpingStanding & Dynamic.	a.Hurdle step over b.Bear crawls c.Knee bend standing	Carrying ball and other objects (by single &both hands)	a. Single games with balls. b.Peer group games c.Games with music	a. Light Walking movements. b. Light Sitting movements c. Light Lying movements (Supination/Pronation)

Picture 2: Physical activity intervention

3.13. Yoga and Physical activity Teachers' training for children with ASD

Four certified yoga and physical education instructors led a six-month yoga and physical activity intervention program for individuals with a moderate level of ASD. The researcher created a thorough curriculum for yoga and physical education teachers to use while instructing individuals with ASD. Within that curriculum, instructors were given essential information on ASD and the positive impacts of yoga and physical exercise for children with ASD by the

researcher, supervisor, and other professionals on ASD, yoga, and physical activity. The curriculum includes an overview of ASD and the range of difficulties that participants with ASD meet, including a variety of symptoms associated to the condition, basic diagnostic characteristics, deficiencies in social skills, problem behaviors, impaired motor ability, and sensory dysfunctions. Along with the advantages of yoga and physical exercise for children with ASD, it also contained comprehensive guidelines for leading these activities in a manner suitable for individuals with ASD. The teachers also discussed the various learning problems and preferences of the students. The yoga and PA modules developed for the study were discussed, along with the benefits and modifications of the chosen yoga practices and PA for children with ASD.

3.14. Pre-Intervention phase

The researcher spent more than three months in a special school to get acquainted with children with ASD, parents, special school teachers and the school environment. The appointed yoga and physical activity teachers for this study spent two weeks on observation in special school before the beginning of the interventions. During this period, the teachers see the children very closely, notice their differences in the class and off the class activities, reactions and response to those activities. These experiences teach a lot, to develop a familiarity and rapport with the children with ASD. Additionally, it facilitates teachers' comprehension of how students respond to various circumstances and instructions in various classroom activities.

The assignment of parents and class teachers of children into 3 groups—the yoga group, the physical activity group, and the control group—for the research was communicated to the school administration one week before to the intervention. The special school gave adequate time and permission to make the necessary modifications to their routine.

3.15. Data Collection procedure

Parents of children with autism spectrum disorders, instructors at the special school Pradip: Center for Autism Management, and two clinical psychologists conducted assessments for this study. The scholar distributed the questionnaire to all the evaluators from time to time as per the design of the study.

For the data collection, a pre-test or baseline test (two weeks before beginning of the interventions), mid-test (After 3 months of interventions) and a post-test (After 6 months of interventions) were used. The scholar explained each and every question of Problem Behavior

Checklist (Banerjee et al., 2013) to the parents, class teachers and clinical psychologist for better understanding and assessment of PB of participants with ASD. The researcher requested all the evaluators to provide correct responses and guaranteed them about confidentiality of data and their use for scientific research only. Enough time was given to fill out the questionnaires appropriately. All the data was collected in one week (7 days). The researcher kept in contact with parents, special school teachers and psychologists during the entire evaluation process.

Table-5: Data collection procedure

Sl. No.	Groups	Pre-test	Mid test	Post test
1.	**Yoga group (8)**	Before interventions (Two weeks)	After 3 months of interventions	After 6 months of interventions
2.	**Physical activity group (8)**	Before interventions (Two weeks)	After 3 months of interventions	After 6 months of interventions
3.	**Control group (8)**	Before interventions (Two weeks)	After 3 months without yoga/PA interventions	After 6 months without yoga/PA interventions

3.16. Problem Behavior checklist

The problem behavior of children with ASD was the dependent variable in this study, whereas yoga and physical exercise were the independent variables. The researcher evaluated the problematic behaviors of children with ASD using a standardized questionnaire. The questionnaire, comprising 52 questions total and 15 items, was developed by Banerjee et al. in 2013; for measurement of each item 1-5 points rating scale of responses were used. These 15 problem behavior items are; 1. Auditory,2. Tactile, 3. Gustatory-Olfactory-Elimination, 4. Social, 5. Temper tantrums, 6. Physical harm toward others, 7. Odd Behavior, 8. Self-injurious behaviors, 9. Unusual fears, 10. Disobedience, 11. Repetitive behavior, 12 Speech, 13. Vestibular, 14. Inattentiveness and restlessness and 15. Odd sexual behavior.

There were five responses for each question. The scoring of each response was a) Not at all relevant (1) b) Somewhat relevant (2) c) Moderately relevant (3) d) Very much relevant (4) e) Most relevant (5).

3.17. Administration of test

3.17.1. Assessment

Parents of children with ASD, teachers at the autistic school (Pradip: Center for autistic Management), and two clinical psychologists conducted assessments for this study. According to the objectives of this study, to obtain correct responses to problem behavior of ASD children during pre, mid and post-test, the researcher has chosen parents, class teachers and psychologists. These three stake holders have different time duration of engagement with the children, such as; parents almost 24 hours, class teachers approx. 3-5 hours and psychologists are like strangers to the ASD children. After collecting responses on different problem behavior items from these three assessors, the author got an average score on each item to obtain the exact responses for the final data.

Table-7: Assessors or Evaluators of this study

Sl. No.	Time of assessment	Assessors/Evaluators
A.	Pre-test (Two weeks before the initiation of the study)	1. Parents of the subjects 2. Teachers of autism school 3. Rehab-psychologist/ clinical psychologist.
B.	Mid test (After 3 months of interventions)	
C.	Post-test (After 6 months of interventions)	

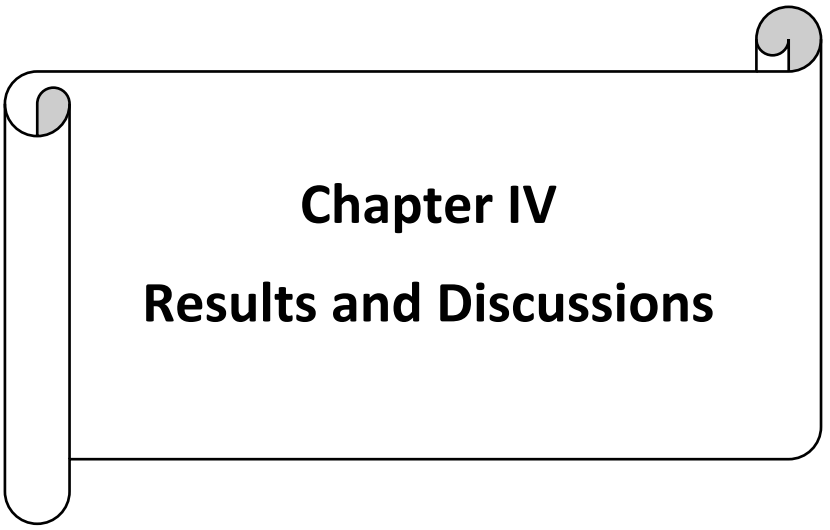
Picture-3: Assessment by Parent, Teachers, Clinical Psychologist

3.18. Reliability of Data

The researcher employed trustworthy methods to ensure the data for this study were consistent, such as usage of Reliable Instrument and Tools (Problem Behavior Checklist, Banerjee et al., 2013), Competency of the tester (Parents, Class teachers and Clinical psychologists), and reliability of the Test (Pre-Mid-Post-test). The investigator carefully administrated the testing procedure at exact time interval and the data was recorded accordingly.

3.19. Statistical Technique Employed

The collected data was analyzed using the following measures: Arithmetic Mean (M), Standard Deviation (SD), Levenes Test for Homogeneity, Shapiro-Wilk Test for Normality, Multivariate Analysis of Covariance (MANCOVA) to compare test results (Pre-Mid and Posttest) among groups, and Bonferroni post-hoc test for pairwise comparisons between groups. There was a 0.05 significance level. The statistical analysis was conducted utilizing Microsoft Excel and SPSS version 20.



Chapter IV

Results and Discussions

4.1. Pilot study results

4.2. Implementation of intervention & participation integrity

4. 3. Results & Discussions on problem behaviors

4.4. Testing of hypothesis

Chapter IV

Results and Discussion

The analysis of data gathered from research samples—participants with moderate levels of ASD—is covered in this chapter. The study set out to ascertain how yoga and physical activity affects challenging or problematic behaviors of children with autism spectrum disorders (ASD). Three times (pre-intermediate and post-test) were the data on problem behaviors (15 items) gathered from two experimental groups (physical activity and yoga group) and one control group.

The acquired data were examined utilizing the standard deviation (SD) and arithmetic mean (M) in descriptive statistics. **The Shapiro-Wilk Test** for Normality, the **Levenes Test** for Homogeneity, the **Multivariate Analysis of Covariance (MANCOVA)** to compare the test results or mean difference (Pre-Mid and Posttest) among different groups and **the Bonferroni post-hoc test** for pair wise comparison between the groups were applied. The significant level was at 0.05. All the statistical analysis was carried out using SPSS. 20 version and Microsoft Excel.

In the following sections, all the research outcomes are presented with tables, necessary graphs, figures and discussions. In order to better comprehend the effect of two different interventions (yoga & physical activity) on participants with moderate levels of ASD, the researcher discussed the outcomes with scientific evidence and references.

4.1 Results of Pilot study

The investigator conducted a pilot study on seven children (male-5, female-2) with moderate levels of ASD, age 8–14 years, from Pradip: Centre for Autism Management, 33A/1 Canal (South) Road, Kolkata-700015, West Bengal. The sample selection was based on the admission and medical records of the school. The duration of the pilot study was one month. The yoga intervention was given to selected samples for three days (Tuesday, Thursday and Saturday) in a week, each session was for 45–60 minutes. The problem behaviors assessment of participants was done by parents, school teacher and psychiatrist at before the beginning of the intervention (pre-test) and after one month of intervention (post-test). Because of the small sample size and short intervention period, the researcher conducted a qualitative analysis of the

data in collaboration with qualified professionals. The result of the qualitative analysis presented that giving instruction and managing children with ASD was so challenging, which need more supporting hands. Modification in yoga practice schedule was needed (according to interest and limitation of the sample group). The one-month intervention is very less for this kind of population and without building proper rapport with students giving yoga practice session is quite challenging. The pilot study's findings attracted the researcher's interest and ignited the desire to examine how long-term intervention influenced the problematic behavior of children with moderate level of ASD.

4.2 Implementation of intervention and participation integrity

The yoga and physical activity (PA) therapies were conducted in the institution for ASD for three days a week (Monday, Thursday, and Friday), with the exception of a few vacations caused by regional celebrations. For individuals with ASD to participate in the intervention effectively, frequent attendance and responses are seen as criteria. The attendance records were kept by yoga and PA teachers after every yoga and PA session. The attendance records of the participants are mentioned below.

Table-7: Percentage of Attendance (%) in Yoga and PA intervention

Sl. No.	Group	Total no of session	Attendance (%)
1.	Yoga group	68	90.3%
2.	Physical activity group	68	89.8%
3.	Control group	Attended regular institutional classes & activities	

4.3 Final study results & discussions on problem behaviors of participants with ASD

4.3.1 Auditory problem behavior

Challenge behavior, often referred to as problem behavior, is a term used to describe the emotional and behavioral issues that children with autism spectrum disorders (ASD) frequently display. Auditory issue behavior is the term used to describe problem behaviors associated with auditory stimuli (Banerjee et al., 2013).

The data acquired on Auditory problem behavior based on initial or baseline test, intermediate or mid test and post-test among two experimental groups (Yogic practices group,

i.e., Group-A, Physical activity group, i.e., Group-B) and one control group, i.e., Group-C belongs moderate level of children with ASD was statistically analyzed with different statistical techniques and the result are presented with table, graph and discussion with possible underlying mechanism.

Table-8: Normality and Homogeneity test of pre-test results of Auditory problem behavior

Tests of Normality				
	Control, Physical activity and Yoga Group	**Shapiro-Wilk**		
		Statistic	**df**	**p value**
Auditory PB Response Pre-Test Result	Control Group	.931	8	.527
	Physical Activity Group	.989	8	.993
	Yoga Group	.904	8	.314

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**'p' value**
Auditory PB Response Pre-Test Results	Based on Mean	1.325	2	21	**.287**
	Based on Median	.678	2	21	**.519**
	Based on Median and with adjusted df	.678	2	16.246	**.522**
	Based on trimmed mean	1.266	2	21	**.302**

P value <0.05 is defined as significant*

The **Shapiro-Wilk test** was used to determine if the data on Auditory PB were normally distributed. The results showed that all three groups' "p" values were greater than 0.05.

The sample data was determined to be homogeneous by performing **Levene's test,** as indicated by the 'p' value being greater than 0.05.

Since the homogeneity and normality tests have shown that the data is homogenous and normal, the researcher uses the one-way MANCOVA test to evaluate the hypothesis.

Table-9: Results of One-way MANCOVA with descriptive and adjusted means Auditory Problem Behaviour (APB)

Group		N	Mean	SD	Box's M			P	df	
Pre -Test	Control Group	8	7.94	2.43	M= 3.54, F= 0.51			0.80	6	10991.08
	Physical Activity Group	8	8.69	1.41	Wilks' Lambda = 0.55			P	df	
	Yoga Group	8	9.25	1.98	F = 3.29			0.02*	4	38
	Total	24	8.63	1.97	Partial Eta Squared = 0.26				Adjusted Mean of DV	
Intermediate test	Control Group	8	8.94	1.40	Intermediate Covariance				8.994	.442
	Physical Activity Group	8	7.94	1.15	F	0.38	df =1;20	P = 0.55	8.199	.440
	Yoga Group	8	8.25	1.03	Post-test Covariance				6.929	.419
	Total	24	8.38	1.23	F	1.13	df =1;20	P=0.30		
Post Test	Control Group	8	9.00	1.49	Intermediate test result				9.095	.429
	Physical Activity Group	8	6.94	0.82	F	1.56	df = 2;20	P = 0.24	7.726	.427
	Yoga Group	8	7.81	1.16	Post-test result				6.929	.419
	Total	24	7.92	1.43	F	6.59	df = 2;20	P=0.006*		

P value <0.05 is defined as significant*

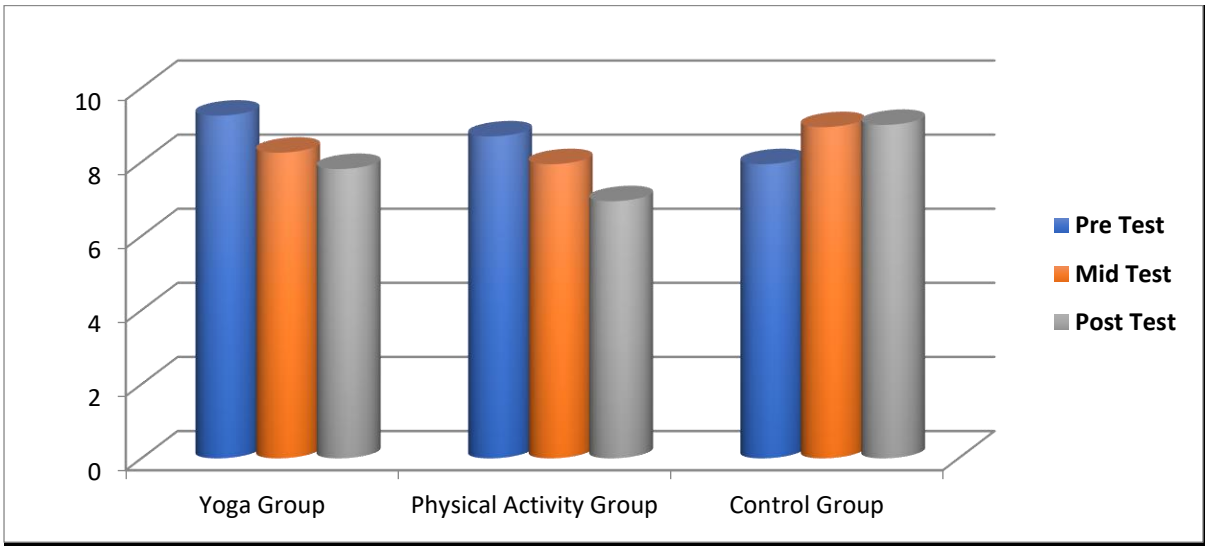


Figure 5: Comparison of means of Auditory PB among two experimental groups (Yoga group and PA group) and one control group of participants with ASD

The one-way Multivariate Analysis of Covariance (MANCOVA) was carried out with intermediate & post-test response as the dependent variables where pre-test results were used as the covariate. The result of the MANCOVA test showed that after regular yoga and physical activity intervention for three months, there was no significant difference in Auditory problem behavior among two experimental groups (Yogic practices group, i.e., Group-A, Physical activity group, i.e., Group-B) and one control group, i.e., Group-C belonging moderate level of children with ASD (Intermediate test result F=1.56 with df=2,20 & p= 0.24). But after six months yoga and physical activity training it was found that there was statistically significant difference among the groups (Post test result **(F=6.59 with df=2,20 & p=0.006*)**, at 0.05 level of significance.

Subsequently, the researcher utilized the Bonferroni post hoc test to ascertain the particular group mean difference between two experimental groups and one control group. The results are shown in the table below.

Table-10: The pairwise comparison between different training groups on Auditory Problem Behaviour

Dependent Variable	Group I	Group J	Mean Difference (I-J)	Std. Error	Sig.
Pre-Test	Control Group	Physical Activity Group	0.75000	.99216	1.000
		Yoga Group	1.31250	.99216	.600
	Physical Activity Group	Yoga Group	0.56250	.99216	1.000
Intermediate test	Control Group	Physical Activity Group	1.062	.619	.306
		Yoga Group	.796	.636	.676
	Physical Activity Group	Yoga Group	-.266	.616	1.000
Post Test	Control Group	Physical Activity Group	2.167*	.601	**.005***
		Yoga Group	1.370	.617	.114
	Physical Activity Group	Yoga Group	.797	.597	.591

P value <0.05 is defined as significant*

From Table 10, according to Bonferroni post hoc test findings, a statistically significant mean difference between the groups was not seen in the pre-test or intermediate test for Auditory PB. In the post-test, however, a significant difference was found between the control group and the physical exercise group; the "p" value was **0.005*,** indicating a confidence level below 0.05.

4.3.1.1. Discussion of findings on Auditory PB with possible mechanism

Children with ASD have some special qualities and limitations. Because of that, they often exhibit various emotional and behavioral challenges or problems, which are commonly known as challenge behaviors or problem behaviors (PB) (Williams et al., 2018; Lindor et al.,2019). According to McGuire (2016), children's optimum growth, functioning, social connections, and relationships are continually hampered by the problem behavior. These problematic behaviors include physical aggressiveness, self-harm, inattention, hyperactivity, anxiety, sadness, withdrawal, and self-stimulatory behavior and many others (Williams et al., 2018; Lindor et al.,2019).

There are some PB related to auditory stimuli, such as negative response to unexpected loud sounds, distraction from different sounds and sometimes self-enjoyment from strange sounds etc. are known as auditory problem behaviors (APB) (Banerjee et al., 2013; Grandisson et al., 2020). These PB are usually addressed by a number of different interventions of differing intensities (Myers and Johnson, 2007; Simpson et al., 2005). These interventions include pharmacological, educational, behavioral, developmental, social relational, psychological, behavioral, and complementary and alternative medicine (CAM), each of which addresses a number of outcomes that may cross over into other domains (Hyman et al., 2020).

According to Höfer et al. (2017), complementary and alternative medicine, or CAM, is a collection of discrete therapeutic health practices that are different from traditional medicine. It is most frequently utilized in conjunction with conventional therapy for children diagnosed with ASD. For individuals with ASD, there are a number of alternative therapies accessible, such as yoga, acupuncture, music, art, dance, and physical activities (PA). In recent days yoga and PA are becoming more and more acceptable therapies for person with ASD (Brondino et al., 2015).

In the last few decades, different study results concluded as yoga is now a holistic, effective, no-harm and promising CAM therapy showing several positive outcomes in children with ASD (Hourston & Achley, 2017; Semple, 2019). PA also, as a CAM therapy, showing increasing popularity to deals with ASD (Healy et al. 2018; Ji et al., 2023; Li et al., 2023).

The aim of the current study was to study the effects of six months of non-residential regular structured yoga and physical activity (PA) training intervention on different problem behaviors of participants with moderate levels of ASD. The final study result indicated that a regular and long-term yoga and physical activity (PA) training intervention program significantly decreases the auditory problem behavior (APB) of participants with moderate level of ASD. After three months of yoga and PA training, reduction in auditory problem behavior (APB) was observed, but statistically it was not significant. But after six months of yoga and physical activity training, a statistically significant difference was noticed between the groups. In the pairwise comparison, it was noticed that PA training is considered to be better effective for decreasing APB in children with moderate levels of ASD.

Yoga dramatically reduces APB in people with ASD, according to study data gathered from parents, educators, and psychiatrists. Yoga is a mind-body intervention that promotes children's overall well-being through breathing, movement, and relaxation. (Hagen & Nayar, 2014). According to studies on neuroplasticity (Pascual-Leone et al., 2012; Ganguly & Poo, 2012; Carey et al., 2019), learning, memory, and the recovery from brain injury can all be significantly impacted by these ideas, particularly the activity-dependent plasticity of the brain. Neuroscientists and other scientific groups have acknowledged the influence of yoga on neural plasticity or brain plasticity (Tolahunase et al., 2018), which might potentially corroborate this outcome.

In the present study, the yoga intervention program was conducted in a separate hall without any external distraction, for each participant on a one-to-one basis and better comfort in different social settings is provided. Yoga reduces sedentary behavior and anxiety, calms down hyperactivity (Radhakrishna, et al., 2010) and develops positive mood and emotional expression (Litchke et al., 2018). Yoga helps to decrease sympathetic activities and simultaneously increases parasympathetic activities (De & Mondal 2016) and improves focus ability and alertness ability (Porter, 2013), which may help them to identify and differentiate the nature of different sound or auditory stimuli. Yoga helps to reduce task anxiety (Narasinghaorao et al. 2017), smooth transition and initiation of new task from a work to another (Rosenblatt et al. 2011), which may lead to participants taking a pause before reacting against any stimulus. During yoga intervention in calm and quite environment participants received a lot of guided verbal and non-verbal instruction from yoga teachers such as names of yogic exercises (Prayer, Sukshma Vyama, Asanas, Pranayamas and Chanting), name of different body parts, body

alignments and position in yoga mat etc. may helped the students to get acquainted with different verbal sound or auditory inputs that leads to reduction in APB pf participants with ASD.

Yoga also provides quality relaxation and sleep for children through different holistic techniques (Rosenblatt et al.,2011), and it is known that quality relaxation and sound sleep is very essential for management of different symptoms and severity of ASD. This relaxed state of mind may lead to reducing the APB of ASD. The work by Ramanathan et al. (2019) supported that yoga can effectively improve auditory reaction time (ART). Studies headed by Ramanathan et al. (2019), Narasinghaorao et al. (2017), Joshi & Rathi (2019), Archoudane et al. (2021), Rosenblatt et al. (2011) and Deorari & Bhardwaj, (2014) mentioned positive effects of yoga on reduction of different PB and autism severity of person with ASD.

The current study also reveals that PA intervention significantly decreases APB in participants with moderate levels of ASD. Any physical activity that improves or sustains total health and wellness, as well as physical fitness, is considered as PA. (WHO, 2022).

The human brain and psychology benefit from exercise (Li et al., 2023). It enhances synaptic plasticity and neurogenesis by stimulating muscles and other bodily organs, and it improves cognitive performance by improving spatial learning. In addition to strengthening short- and long-term memory, additionally, exercise increases the brain's blood and oxygen flow., boosting growth factors that aid in neuro-genesis, synaptic plasticity, and the creation of new neural pathways. These processes enhance memory retention, information processing, and cognitive function. PA causes the brain's parasympathetic nervous system to become more active while the sympathetic nervous system becomes less active. These substances include dopamine, glutamate, nor-epinephrine, and serotonin. Regular PA training gives comfortable sensory stimulation to ASD participants, which may reduce APB. Several research outcomes also reported that different muscular contractions (isometric, isotonic) during PA exercises improve brain speed and central processing ability, which may be the same in ASD children too. PA is the alternative option for using language & verbal communication for ASD children, so this option positively impacts on listening to others.

Finally, from these findings it may be assumed that although both, the yoga and physical activity (PA) training program were having some positive effects on reduction of APB of children with moderate levels of ASD; however, the PA training program was found more effective to decrease APB in ASD children.

4.3.2 Tactile Problem Behavior (PB)

The obtained results on tactile problem behavior from two experimental groups (Yoga & PA) and one control group of children with moderate levels of ASD, after six months of non-residential regular yoga and physical activity training program have been analyzed through different statistical techniques and presented with tables, graphs, discussion and possible underlying mechanism of the findings.

Table-11: Normality and Homogeneity test of pre-test results of Tactile Problem Behavior

Tests of Normality				
	Control, Physical activity and Yoga Group	**Shapiro-Wilk**		
		Statistic	**df**	**p value**
Tactile Problem Behaviour Pre-Test Result	Control Group	.827	8	.056
	Physical Activity Group	.938	8	.590
	Yoga Group	.842	8	.079

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**'p' value**
Tactile Problem Behaviour Pre-Test Result	**Based on Mean**	.129	2	21	.879
	Based on Median	.041	2	21	.960
	Based on Median and with adjusted df	.041	2	17.99	.960
	Based on trimmed mean	110	2	21	.897

P value <0.05 is defined as significant*

The normality of the data collected on Tactile PB from three groups—Yoga, PA, and Control—was assessed using the **Shapiro-Wilk test**. The data was found to be normally distributed in each group where the 'p' value was larger than 0.05.

The homogeneity test on the data was conducted using **Levene's test**, and the findings indicated that the sample data was homogeneous since the 'p' value was greater than 0.05.

Table-12: Results of One-way MANCOVA with descriptive and adjusted means Tactile Problem Behaviour

Group		N	Mean	SD	Box's M			P	df	
Pre -Test	Control Group	8	16.31	2.56	M= 18.01, F=2.59			0.02*	6	10991.08
	Physical Activity Group	8	16.13	2.22	Wilks' Lambda = 0.47			p	df	
	Yoga Group	8	18.69	2.71	F = 4.36			0.01*	4	38
	Total	24	17.04	2.67	Partial Eta Squared = 0.32				Adjusted Mean of DV	
Intermediate test	Control Group	8	16.50	.93	Intermediate Covariance				16.32	.68
	Physical Activity Group	8	15.88	1.13	F	2.28	df =1;20	P =.15	16.66	.72
	Yoga Group	8	16.25	3.04	Post-test Covariance				15.10	.56
	Total	24	16.21	1.88	F	1.50	df =1;20	P=.24		
Post Test	Control Group	8	17.81	.88	Intermediate test				17.69	.56
	Physical Activity Group	8	15.25	1.83	F	.52	df = 2;20	P = 0.60	14.15	.59
	Yoga Group	8	13.88	1.81	Post-test				15.10	.56
	Total	24	15.65	2.24	F	10.20	df = 2;20	P=0.001*		

P value <0.05 is defined as significant*

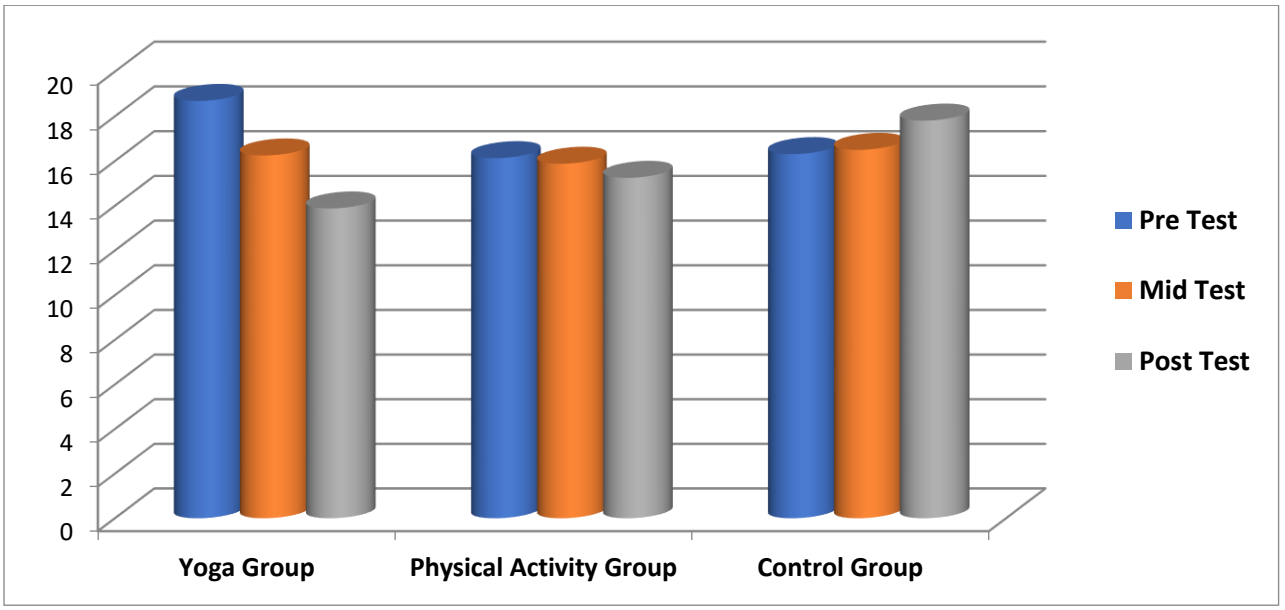


Figure-6: Comparison of means of Tactile PB among two experimental groups (Yoga group and PA group) and one control group of participants with ASD

In Tactile Problem Behaviors, after attending a regular non-residential yoga and physical activity training program, according to the results of the intermediate test, there was one control group, two experimental groups (yoga and PA), and no statistically significant difference between the groups (F=.52 with df=2,20 and p=0.60) i.e., after three months and significant difference among the group was found in post-test result **(F=10.20 with df=2,20 and p=0.001*)** i.e., after six months.

Table-13: The pairwise comparison between different training groups on Tactile Problem Behaviour

Dependent Variable	Group I	Group J	Mean Difference (I-J	Std. Error	Sig.
Pre -Test	**Control Group**	Physical Activity Group	0.75000	.99216	1.000
		Yoga Group	1.31250	.99216	.600
	Physical Activity Group	Yoga Group	0.56250	.99216	1.000
Intermediate test	**Control Group**	Physical Activity Group	.67	.94	1.00
		Yoga Group	-.34	1.02	1.00
	Physical Activity Group	Yoga Group	-1.01	1.03	1.00
Post Test	**Control Group**	Physical Activity Group	2.59*	.78	**.01***
		Yoga Group	3.54*	.84	**.001***
	Physical Activity Group	Yoga Group	.95	.85	.83

P value <0.05 is defined as significant*

In the intermediate test phase (after three months), pairwise comparison revealed no significant distinction between the groups. However, significant differences between the control group and the physical activity group **(Mean Difference=2.59*, Std. Error=.78, p=0.01*)** and between the control group and the yoga group **(Mean Difference=3.54*, Std. Error=.84, p=0.001*)** were discovered during the post-test phase (after six months).

4.3.2.1 Discussion on findings of tactile PB with possible mechanism

The goal of this study was to find out the effects of six months non-residential yoga and PA training program on different PB of participants with moderate level of ASD. In the past few decades, it was revealed by many researchers that regular yoga and PA training can soothe or calm down the symptoms and severity of ASD people. As mentioned earlier PB are emotional and challenging behaviours which negatively impact on everyday day-to-day activities of person with ASD.

The hyper or hypo emotional responses to tactile stimulation or touch, such as irritation from different touching, dislikes being touched unexpectedly, tends to examine objects by mouth or with hands etc. are known as Tactile Problem Behaviors (TPB) (Baranek et al., 1997, Kim & Cho, 2014).

Another important finding of this study reported by parents, class teachers and clinical psychologists/psychiatrists that regular yoga and physical activity (PA) practice significantly decreases the Tactile problem behavior (TPB) of participants with moderate level of ASD. After three months of regular yoga and PA training, reduction in tactile problem behavior (TPB) was observed, but statistically it was not significant. But after six months of yoga and physical activity (PA) training, there was a statistically significant difference was seen within the groups. In pair wise comparison, it was observed that Yoga and PA training, are both almost equally effective for reduction of tactile problem Behavior (TPB) in children with moderate levels of ASD.

The possible mechanism for effective reduction of TPB through structured yoga intervention on ASD participants, may be yoga creates a calming and therapeutic environment, that encourage the use of senses by stripping out the noise of life, that leads to expansion of internal sensory connection and improve focus (Porter, 2013). Another point may be yoga develop body awareness, helps to identifying body parts and control over body movements, develop social efficiency and motor proficiencies such as effective sensory integrations (Narasinghaorao et al., 2017; Sootodeh et al. 2017). It is also true that over 85% person with ASD have moderate to high level of tactile sensitivity (Salkic et al., 2022) and through practicing asanas, development in muscles strength, joints balance, bilateral coordination, core muscle strength and spine flexibility takes place, that may decrease TPB. During individual and group yoga practice session participants receives some support touches from yoga teachers and peers

such as for performing an asana (Beginning, holding in final state and coming into relax position), performing partner exercise or during group drill activities, these practices may help to cut TPB. Yoga reduces sedentary behaviors, calm hyperactivity (Koening et al., 2012), develop tolerance for group setting, eye contact (Radhakrishna et al., 2010), turn taking and better emotional expressivity (Scroggins et al., 2016), that may affects on development of better TPB of person with ASD. Yoga also includes multiple senses working together for its different practices, that may can influence the TBP toward positive directions.

The current study also reveals that PA intervention significantly decreases TPB of participants with moderate level of ASD. The children with ASD lead a sedentary lifestyle, which affect their overall health and reduce their social adaptability (Healy et al., 2018). The exercise is beneficial for the human brain and psychology (Mura et al., 2014). In this study structured PA training program was implemented by following a one-to-one method, based on the guidelines, recommendations of previous successful researches with special needs for children with ASD, which may bring significant development in TPB were seen. The possible reasons of the outcomes may be PA improve cognitive function through synaptic plasticity and neuro-genesis of ASD children. Another reason may be PA gives comfortable sensory stimulation to ASD participants, which reduce tactile over sensitivity. Another thing may be PA decrease irritability, aggression, social withdrawal and lethargy of participants with ASD (Gabriel et al., 2012). According to some research reports, PA are doable and may enhance prosocial actions in many domains, such as communication and imitation (Yu et al., 2018), self-control, social responsiveness, social cognition, motivation, and confidence (Bass et al., 2009), all of which may contribute to a reduction in TPB in ASD children.

From these findings it may be assumed that a regular yoga and physical activity (PA) training program may have almost the same significant positive effect on lessening of TPB in children with moderate levels of ASD.

4.3.3 Gustatory-Olfactory Problem Behavior

The data acquired on Gustatory-Olfactory problem behavior (GOPB)is based on initial or baseline test, intermediate or mid-test and post-test among two experimental groups (Yogic practice group, i.e., Group-A, Physical activity group, i.e., Group-B) and one control group, i.e., Group-C belongs moderate level of children with ASD was statistically analyzed with different

statistical techniques are result are presented with table, graph and discussion with possible underlying mechanism.

Table-14: Normality and Homogeneity test of pre-test results of Gustatory-Olfactory Problem Behavior

Tests of Normality				
	Control, Physical activity and Yoga Group	**Shapiro-Wilk**		
		Statistic	**df**	**p value**
Gustatory-Olfactory Response Pre-Test Result	Control Group	.824	8	.051
	Physical Activity Group	.975	8	.937
	Yoga Group	.912	8	.366

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**'p' value**
Gustatory-Olfactory Response Pre-Test Result	Based on Mean	1.962	2	21	.165
	Based on Median	2.192	2	21	.137
	Based on Median and with adjusted df	2.192	2	18.607	.140
	Based on trimmed mean	2.070	2	21	.151

P value <0.05 is defined as significant*

The data was found to be normally distributed in all three groups when the **Shapiro-Wilk Test** produced a 'p' value larger than 0.05 in the Normality test of Gustatory-Olfactory Problem Behavior (GOPB).

Using **Levene's test** for homogeneity, it was determined that the sample data evaluated on Gustatory-Olfactory PB is homogeneous as the 'p' value was larger than 0.05.

Table-15: Results of One-way MANCOVA with descriptive and adjusted means of Gustatory-Olfactory Problem Behaviours (GOPB)

Group		N	Mean	SD	Box's M			P	df	
Pre-Test	Control Group	8	12.19	1.31	M= 19.498, F=2.80			.01	6	10991.08
	Physical Activity Group	8	12.50	2.46	Wilks' Lambda = .70			P	df	
	Yoga Group	8	12.94	2.85	F = 1.83			.14	4	38
	Total	24	12.54	2.22	Partial Eta Squared = .16				Adjusted Mean of DV	
Intermediate test	Control Group	8	13.56	.68	Intermediate Covariance				13.55	.67
	Physical Activity Group	8	11.63	1.92	F	.02	df =1;20	P =.88	11.64	.67
	Yoga Group	8	11.63	2.47	Post-test Covariance				8.06	.60
	Total	24	12.27	1.99	F	.01	df =1;20	P =.94		
Post -Test	Control Group	8	9.44	.86	Intermediate test				9.44	.60
	Physical Activity Group	8	8.06	2.46	F	2.71	df = 2;20	P = .09	7.95	.60
	Yoga Group	8	7.95	1.21	Post-test Covariance				8.06	.60
	Total	24	8.48	1.73	F	1.9	df = 2;20	P =.18		

P value <0.05 is defined as significant*

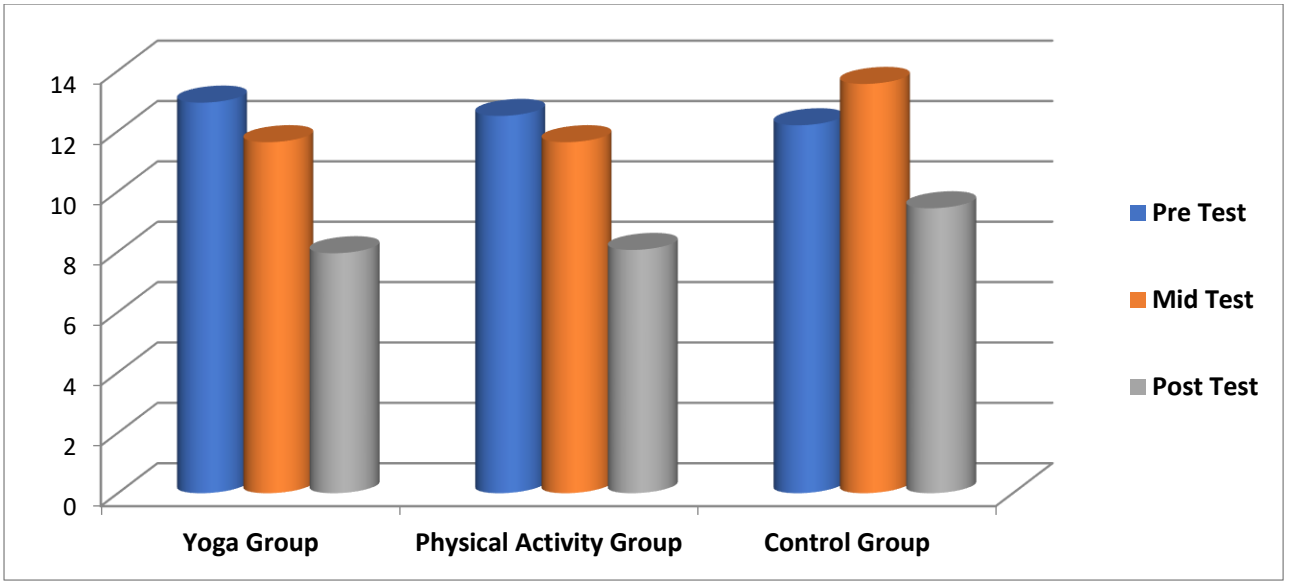


Figure-7: Comparison of means of Gustatory-Olfactory PB among two experimental groups (Yoga group and PA group) and one control group of participants with ASD

The Gustatory-Olfactory Problem Behavior (GOPB) one-way MANCOVA test results showed that, after three months, there was no significant difference between the subject groups in the intermediate test **(F=2.71 with df=2;20 and p=0.09),** and that the same trend continued in the post-test **(F=1.9 with df=2;20 and p=0.18),** which was after six months.

4.3.3.1. Discussion on findings of Gustatory-Olfactory problem behavior (GOPB)with possible mechanism

The Gustatory (Taste) and Olfactory (Smell) sensory systems, together known as Chemosensory systems, are directly associated with specific organs (Purves et al., 2001). This system works in a complex fashion. As a biomarker of neurodegeneration, gustatory-olfactory assessment has been the subject of some recent study (Hawkes, 2003). For ASD people, sometimes the complexity becomes greater and invites some emotional and challenging responses against Gustatory-Olfactory stimuli, which are known as Gustatory-Olfactory problem behaviors (GOPB), such as deliberately smell objects, unusual cravings for certain foods etc. In this study, one of the purposes was to assess and analyze the effectiveness of a non-residential regular yoga and PA training program on GOPB in children with moderate levels of ASD.

The final study result indicated that regular yoga and physical activity (PA) practice decreases the GOPB of children with moderate level of ASD. After three months of regular yoga and PA training, reduction in Gustatory-Olfactory problem behaviors (GOPB) was observed (from the mean value of experimental and control groups), but statistically it was not significant. And in the post-test, after six months of yoga and physical activity training, the same trend was followed and statistically no significant difference was seen among the groups.

Another important finding of this study reported by parents, class teachers and clinical psychologists/psychiatrists is that, due to regular yoga practice, reductions in GOPB were observed but statistically not significant. The regional organization and functions of the primary olfactory cortex, entorhinal cortex, hippocampus and para-hippocampal cortex, thalamus, hypothalamus, orbitofrontal cortex, insular cortex, inferior lateral frontal region, and the amygdala, among other brain regions, are physiologically dependent on the human brain's gustatory-olfactory function (Toledano et al., 2012; Albrecht & Wisemann, 2006; Wang, Eslinger, Smith, & Yang, 2005) and different yogic practices (Prayer, Sukshama Vyama, Asana, Pranayama, Chanting, Kriya and Meditation) have significant positive impacts in these brain regions. But for this development, long-term consistent, regular yoga intervention is needed. In

this study, the duration of yoga intervention was for six months only, which may not be sufficient. Another possible reason may be that yoga exercises bring multiple senses working together, such as auditory, tactile, visual and vestibular etc., so it may happen that with all the system made bound, the Gustatory-Olfactory system is developed and organized together, and as a result GOPB of ASD children have reduced. Structured yoga modules may improve body awareness, improve visual imitation, improve receptive skills, improve balance, coordination and motor proficiencies (Archoudane et al. 2021), which may directly or indirectly help to reduce the GOPB of participants with ASD.

For the PA group, a reduction in the mean value of GOPB in intermediate test and post-test was observed, but it was not statistically significant. The PA can decrease co-morbidities with regard to neuromuscular functions of children with ASD. It also helps to control emotions, attention, cognitive impulses within a specific context (Li et al., 2023). Exercises increase the attention span of ASD participants, improve bilateral coordination and motor skills (Balance & Coordination) (Bahrami et al., 2012). In different PA training, multiple senses work together, which positively affects brain regions that regulate the GOPB (Zachor et al., 2018). The physical exercises are activating muscles and other organs, through which they develop the cognitive, perceptive and motor processing of children with ASD. For understanding more details and minute changes in the brain region, through PA, further study is needed.

From these findings it may be assumed that a regular yoga and physical activity (PA) training program may have almost equally effective on lessening in Gustatory-Olfactory problem behaviors (GOPB) in children with moderate levels of ASD.

4.3.4 Social Problem Behavior (SPB)

The collected data on Social Problem behavior (SPB) based on initial test, mid or intermediate test and post-test from the yoga group, physical activity group and control group were statistically analyzed by means of Descriptive statistics (Mean, SD), the Multivariate Analysis of Covariance (MANCOVA) and pairwise comparison with the Bonferroni post-hoc test.

Table-16: Normality and Homogeneity test of pre-test results of Social Problem Behavior

Tests of Normality				
	Control, Physical activity and Yoga Group	Shapiro-Wilk		
		Statistic	df	p value
Social Problem Behaviours Pre-Test Result	Control Group	.89	8	.25
	Physical Activity Group	.95	8	.75
	Yoga Group	.93	8	.55

Test of Homogeneity of Variances					
		Levene Statistic	df1	df2	'p' value
Social Problem Behaviour Pre-Test Result	Based on Mean	.72	2	21	.50
	Based on Median	.62	2	21	.55
	Based on Median and with adjusted df	.62	2	15.68	.55
	Based on trimmed mean	.72	2	21	.50

P value <0.05 is defined as significant*

To ascertain if the data on social problem behavior (SPB) were normally distributed, **the Shapiro-Wilk test** was employed. The "p" values for each of the three groups were more than 0.05, according to the results.

The homogeneity test was carried out using **Levene's test,** and as the "p" value was greater than 0.05, the results indicated that the sample data was homogeneous.

Table-17: Results of One-way MANCOVA with descriptive and adjusted means

SocialProblem Behaviour

Group		N	Mean	SD	Box's M	P	df	
Pre-Test	Control Group	8	7.04	1.52	M= 15.63, F=2.25	.04	6	10991.08
	Physical Activity Group	8	7.50	2.02	Wilks' Lambda = .81	P	df	
	Yoga Group	8	7.63	2.22	F = 1.03	.41	4	38
	Total	24	7.39	1.93	Partial Eta Squared = .10		Adjusted Mean of	

Group		N	Mean	SD	Box's M			P	df	
									DV	
Intermediate test	Control Group	8	8.69	1.39	Intermediate Covariance				8.67	.60
	Physical Activity Group	8	6.21	2.05	F	.01	df =1;20	P =.94	6.36	.59
	Yoga Group	8	6.05	1.30	Post-test Covariance				5.76	.47
	Total	24	6.98	1.59	F	3.39	df =1;20	P = .08		
Post Test	Control Group	8	7.69	.65	Intermediate test				7.89	.48
	Physical Activity Group	8	4.65	2.14	F	.53	df = 2;20	P = 0.32	4.61	.48
	Yoga Group	8	5.11	.96	Post-test				4.86	.47
	Total	24	5.81	1.39	F	1.54	df = 2;20	P = .05*		

P value <0.05 is defined as significant*

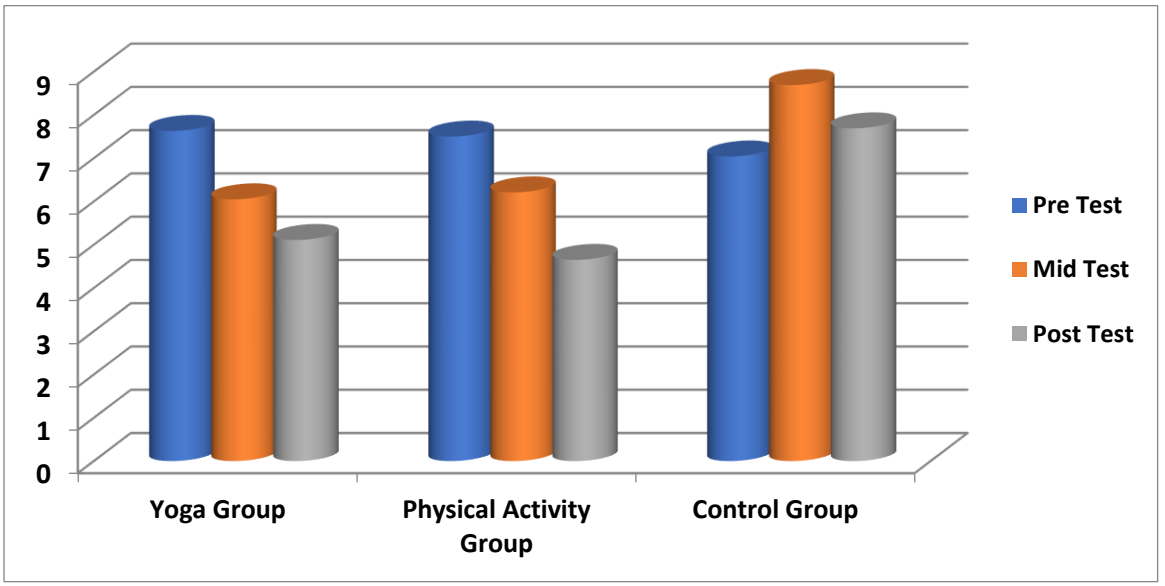


Figure-8: Comparison of means of Social PB among two experimental groups (Yoga group and PA group) and one control group of participants with ASD

The results of the one-way MANCOVA in social problem behavior showed that there was no significant difference between the subjects for the intermediate test **(F=.53 with df=2;20 and p=0.60)** and post-test **(F=1.54 with df=2;20 and p=0.24)** after six months of yoga and physical activity training.

Table-18: The pairwise comparison between different training groups on SocialProblem Behaviour

Dependent Variable	Group I	Group J	Mean Difference (I-J	Std. Error	Sig.
Pre-Test	**Control Group**	Physical Activity Group	0.75000	.99216	1.000
		Yoga Group	1.31250	.99216	.900
	Physical Activity Group	Yoga Group	0.56250	.99216	1.000
Intermediate test	**Control Group**	Physical Activity Group	.76	.85	.77
		Yoga Group	.32	.86	1.00
	Physical Activity Group	Yoga Group	-.54	.83	1.00
Post Test	**Control Group**	Physical Activity Group	2.23	.88	**.04***
		Yoga Group	1.39	.69	**.03***
	Physical Activity Group	Yoga Group	.47	.67	1.00

P value <0.05 is defined as significant*

The intermediate test phase (after three months) revealed no statistically significant difference between the groups based on pairwise comparison. However, significant differences between the control group and the physical activity group **(Mean Difference=2.23*, Std. Error=.88, p=0.04*)** and between the control group and the yoga group **(Mean Difference=1.39*, Std. Error=.84, p=0.03*)** were discovered six months subsequently (during the post-test phase).

4.3.4.1. Discussion on findings of tactile PB with possible mechanism

The current study's objective was to determine the impacts of a six-month non-residential yoga and PA training program on different PB of participants with moderate levels of ASD. In the last few decades, a few research outcomes claimed that there is a possibility of using yoga and PA interventions for reducing PB of people with ASD. As mentioned earlier PB are emotional and challenging behaviours which negatively impact on everyday day-to-day activities of person with ASD.

Social problem behaviors (SPB) were another PB criteria in this investigation. The social communication problems, inability to read social cues, lack of empathy, repetitive behaviors,

regular adherence, strong interests, and so on are some of the obstacles that persons with ASD experience in social situations. These are known as the SPB (Zhao et al., 2018).

Another important finding of this study reported by parents, class teachers and clinical psychologists/psychiatrists is that regular yoga and physical activity (PA) practice significantly decreases the social problem behaviors (SPB) of participants with moderate level of ASD. After three months of regular yoga and PA training, not significant results were observed. However, there was a statistically significant difference between the groups following six months of yoga and physical activity (PA) training. In pairwise comparison, it was observed that Yoga and PA training, are both almost equally effective for reduction of social problem Behavior (PB) in children with moderate levels of ASD.

For yoga group, significant improvement in SPB was seen. Similar findings were found in the previous study led by Scroggins et al., 2016; Narasingarao et al., 2017 & Porter, 2011, which showed that yoga is an effective tool to manage and advance the social behaviours of participants with ASD. The possible mechanism for the results may be regular yoga practice improve awareness (gross & subtle awareness), increase imitation skills and engagement in talk and interaction. During yoga sessions, tolerance for group setting was seen, better peer interaction and relations were formed, developed eye-to-eye contact and emotional expressivity were also noticed. The yoga training protocol included partner exercises and group activities, which also helped a lot to develop good social bonding with others.

The current study also revealed that PA intervention significantly decreases SPB of participants with moderate level of ASD. People with ASD are less likely to engage in physical activity and sports because of their social and communication impairments. The present study's results also align with those of three other research (Bass et al., 2009 & Pan, 2010), all of which shown the beneficial effects of physical activity on children with ASD's social interactions and behaviors. The structured PA training program, which was implemented one-on-one and was based on the guidelines and recommendations of earlier successful researches with special needs for children with ASD, may provide a plausible explanation for the study's results. It was observed that this program could lead to significant development in SPB. Another point may be participation in PA provides opportunities to communicate and interaction with others, which improves the SPB of person with ASD. It is also revealed that active participation in PA improves sharing of enjoyment and interest with others and simultaneously reduces destructive and aggressive attitudes (Healy et al., 2018). As ASD people are mainly born with social

disability, which lead them to live in their own world, to change those phenomenal characteristics, more research is needed.

From these findings it may be assumed that a regular yoga and physical activity (PA) training program may have almost the same significant positive effect on decreasing SPB in children with moderate levels of ASD.

4.3.5 Temper Tantrums Problem Behavior (TTPB)

The collected data on Temper Tantrums Problem behavior (TTPB) of participants with moderate level of ASD, based on initial test, mid or intermediate test and post-test from yoga group, physical activity group and control group were statistically analyzed with Descriptive statistics (Mean, SD), the Multivariate Analysis of Covariance (MANCOVA) and pairwise comparison with the Bonferroni post-hoc test.

Table-19: Normality and Homogeneity test of pre-test results of Temper tantrums Problem Behavior

Tests of Normality				
	Control, Physical activity and Yoga Group	**Shapiro-Wilk**		
		Statistic	**df**	**p value**
Temper Tantrums Response Pre-Test Result	Control Group	.93	8	.52
	Physical Activity Group	.94	8	.57
	Yoga Group	.95	8	.68

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**'p' value**
Temper Tantrums Problem Behavour Pre-Test Result	Based on Mean	2.23	2	21	.14
	Based on Median	1.26	2	21	.30
	Based on Median and with adjusted df	1.26	2	16.66	.31
	Based on trimmed mean	2.02	2	21	.16

P value <0.05 is defined as significant*

The normality of the data gathered on temper tantrums PB was assessed using the **Shapiro-Wilk test.** The data was found to be regularly distributed in all three groups, with "p" values larger than 0.05.

The homogeneity test was carried out using **Levene's test**, and as the "p" value was larger than 0.05, the results indicated that the sample data was homogeneous.

Table-20: Results of One-way MANCOVA with descriptive and adjusted means Temper tantrums Problem Behaviour

Group		N	Mean	SD	Box's M		P	df	
Pre-Test	Control Group	8	6.56	.94	M= 6.58, F=.95		.46	6	10991.08
	Physical Activity Group	8	6.23	1.45	Wilks' Lambda = .80		P	df	
	Yoga Group	8	8.69	1.87	F =1.14		.35	4	38
	Total	24	7.16	1.80	Partial Eta Squared = .11			Adjusted Mean of DV	
Intermediate test	Control Group	8	8.31	.65	Intermediate Covariance			8.21	.42
	Physical Activity Group	8	7.50	1.49	F	.96	df =1;20 (P = .34)	8.38	.49
	Yoga Group	8	8.13	1.19	Post-test Covariance			5.43	.53
	Total	24	7.98	1.17	F	.004	df =1;20 P = .95		
Post Test	Control Group	8	6.81	.92	Intermediate test			6.81	.51
	Physical Activity Group	8	5.44	1.66	F	1.47	df = 2;20 P = 0.25)	6.33	.59
	Yoga Group	8	6.31	1.44	Post-test			5.43	.53
	Total	24	6.19	1.44	F	1.91	df = 2;20 P = .17		

P value <0.05 is defined as significant*

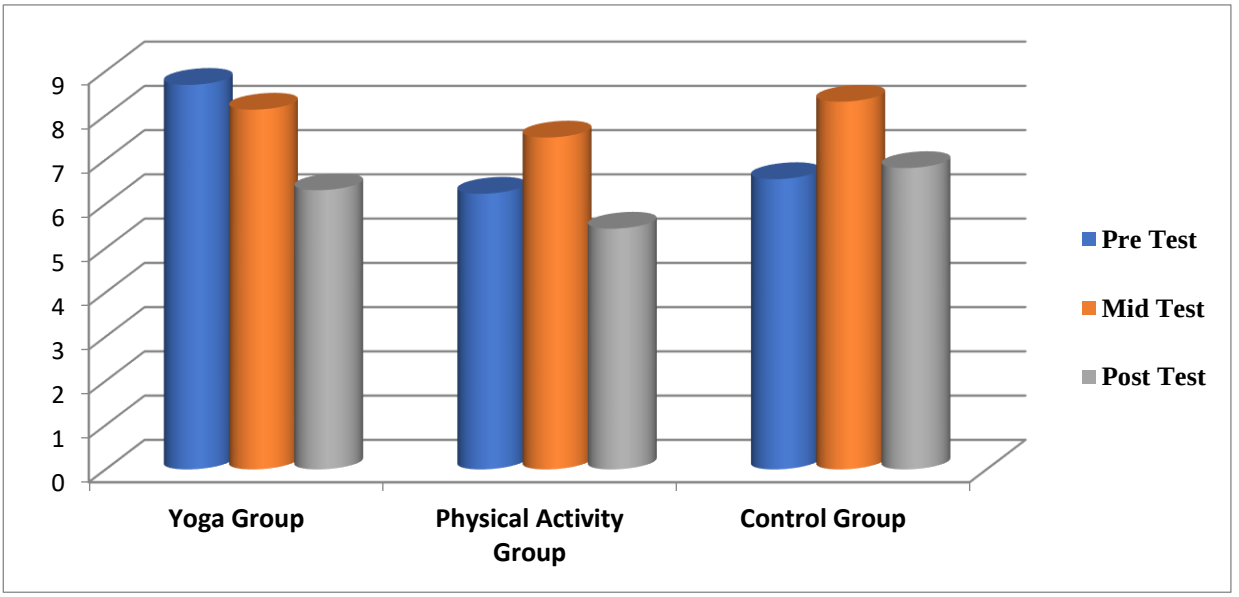


Figure-9: Comparison of means of Temper tantrums PB among two experimental groups (Yoga group and PA group) and one control group of participants with ASD

The results of the one-way MANCOVA test showed that there was no significant difference between the subjects for the intermediate test **(F=1.47 with df=2;20 and p=0.25)** and post-test **(F=1.91 with df=2;20 and p=0.17)** in temper tantrum problem behavior following six months of yoga and physical activity training interventions.

4.3.5.1. Discussion on findings of Temper tantrums Problem Behaviour (TTPB) with possible mechanism

The current investigation's goal was to examine the impacts of a six-month non-residential yoga and PA training program on different problem behaviours of participants with moderate levels of ASD. For this study another important problem behaviours variable was Temper tantrums Problem Behaviours (TTPB). Autistic temper tantrums or meltdowns are an involuntary response to sensory or emotional overload and overwhelm which is associated with or leads to some interference in daily activities (Beauchamp-Châtel et al., 2019). It might occur very frequently for children (Matson, 2009). The common tantrum behaviours are like hitting, kicking, pulling/pushing away, screaming, shouting, crying, whining, falling down, etc. (Potegal & Davidson, 2003). Temper tantrums are the result of irritability and frustration (APA, 2013).

The final study result, reported by parents, class teachers and clinical psychiatrists, reveals that regular yoga and physical activity (PA) practice has an insignificant effect on decreasing the TTPB of children with moderate level of ASD. After three months of regular yoga and PA training interventions, no improvement in mean value of experimental groups (yoga & PA) were found but after six months of training improvement in mean value were observed, although statistically it was not significant.

For the yoga group, improvement in TTPB was observed in post-test only, i.e., after six months of regular structured yoga interventions. The possible reason may be that yoga improves the quality of life, but it takes time to reshape the whole physical, physiological and psychological structure of an individual (Archoudane et al., 2021). ASD is a complex neurodevelopmental abnormality started in the womb, so it may need more long-term intervention, for six months of intervention is not enough. Temper tantrums can coexist with other difficult behaviors in children with autism, such as aggressiveness, self-harm, anxiety, selective eating, sleep issues, and impatience (Rzepecka et al., 2011) and yogic practices like prayer, Sukshmavyama, asanas, breathing exercises of Pranayamas, chanting and meditation etc. can reduce and manage all these behaviours (Radhakrishna et al., 2010, Rolenblatt et al., 2011; Narasingharao et al., 2017)

For the PA group, improvement in the mean value of TTPB was observed in post-test only but statistically not significant difference was there. Similar results were reported by Stavrou et al., 2018. The possible reason for these results may be that most ASD people lead a sedentary lifestyle, and through regular structured PA, improvement in quality of life can be achieved, but it may need long-term consistent interventions. Another point may be different PA types and phases (Preparatory phase: Warming up Stretching; Specific activity Phase: Calisthenics, Jumping, Balancing and Objects/ball managing exercise; Recreation games and Relaxation phases) are associated with various changes in brain tissue in short- and long-term state and leads to formation of new neural synapses, resulting in tissue thickness and improved cognitive ability in participants with ASD (Li et al., 2023). The PA program helps to reduce social and communication defects, improve receptive skills and imitation skills in ASD children, which may provide an effective medium to control TTPB, but again, it is a matter of reconsideration, and to reach a concrete discussion, further research is needed.

From these findings it may be assumed that a regular yoga and physical activity (PA) training program may have almost the same positive effect as managing TTPB in participants with moderate levels of ASD, although further study is needed.

4.3.6 Physical Harm Towards Others Problem Behavior (PHTOPB)

The collected data, reported by parents, teachers and psychiatrists on Physical Harm Towards Others Problem Behavior (PHTOPB) of participants with ASD, based on initial test, mid or intermediate test and post-test from yoga group, physical activity group and control group were statistically analyzed by using Descriptive statistics (Mean, SD), the Multivariate Analysis of Covariance (MANCOVA) and pairwise comparison with the Bonferroni post-hoc test.

Table-21: Normality and Homogeneity test of pre-test results of Physical harm towards others Problem Behavior (PHTOPB)

Tests of Normality				
	Control, Physical activity and Yoga Group	Shapiro-Wilk		
		Statistic	df	p value
Physical Harm Towards Others PB Pre-Test Result	Control Group	.84	8	.07
	Physical Activity Group	.87	8	.16
	Yoga Group	.94	8	.63

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**'p' value**
Physical Harm Towards Others Response Pre-Test Result	Based on Mean	3.94	2	21	.04
	Based on Median	3.87	2	21	.04
	Based on Median and with adjusted df	3.87	2	13.93	.05
	Based on trimmed mean	3.92	2	21	.04

P value <0.05 is defined as significant*

Applying the **Shapiro-Wilk Test,** the normality of the collected data on physically harming others was examined. It was discovered that all three groups had "p" values larger than 0.05, indicating a normally distributed set of data.

Utilizing **Levene's test,** the homogeneity test was conducted. The results showed that the sample data evaluated is homogenous since the 'p' value is larger than 0.05.

Table-22: Results of One-way MANCOVA with descriptive and adjusted means Physical harm towards others Problem Behaviour

Group		**N**	**Mean**	**SD**	**Box's M**				**P**	**df**	
Pre -Test	**Control Group**	8	1.44	.42	**M= 2.62, F= .38**				**.89**	**6**	**10991.08**
	Physical Activity Group	8	1.81	.80	**Wilks' Lambda = .80**				**P**	**df**	
	Yoga Group	8	2.38	1.09	**F =1.10**				**.37**	**4**	**38**
	Total	24	1.88	.88	**Partial Eta Squared = .104**					**Adjusted Mean of DV**	
Intermediate test	**Control Group**	8	2.25	.38	**Intermediate Covariance**					2.24	.19
	Physical Activity Group	8	1.94	.62	**F**	**.05**	**df =1;20**	**P =.83**		2.23	.19
	Yoga Group	8	2.31	.46	**Post-test Covariance**					1.62	.19
	Total	24	2.17	.50	**F**	**.04**	**df =1;20**	**P =.85**			
Post Test	**Control Group**	8	2.06	.50	**Intermediate test**					2.05	.20
	Physical Activity Group	8	1.63	.52	**F**	**1.27**	**df = 2;20**	**P = 0.30**		1.89	.21
	Yoga Group	8	1.88	.58	**Post-test**					1.62	.19
	Total	24	1.85	.54	**F**	**1.23**	**df = 2;20**	**P =.31**			

P value <0.05 is defined as significant*

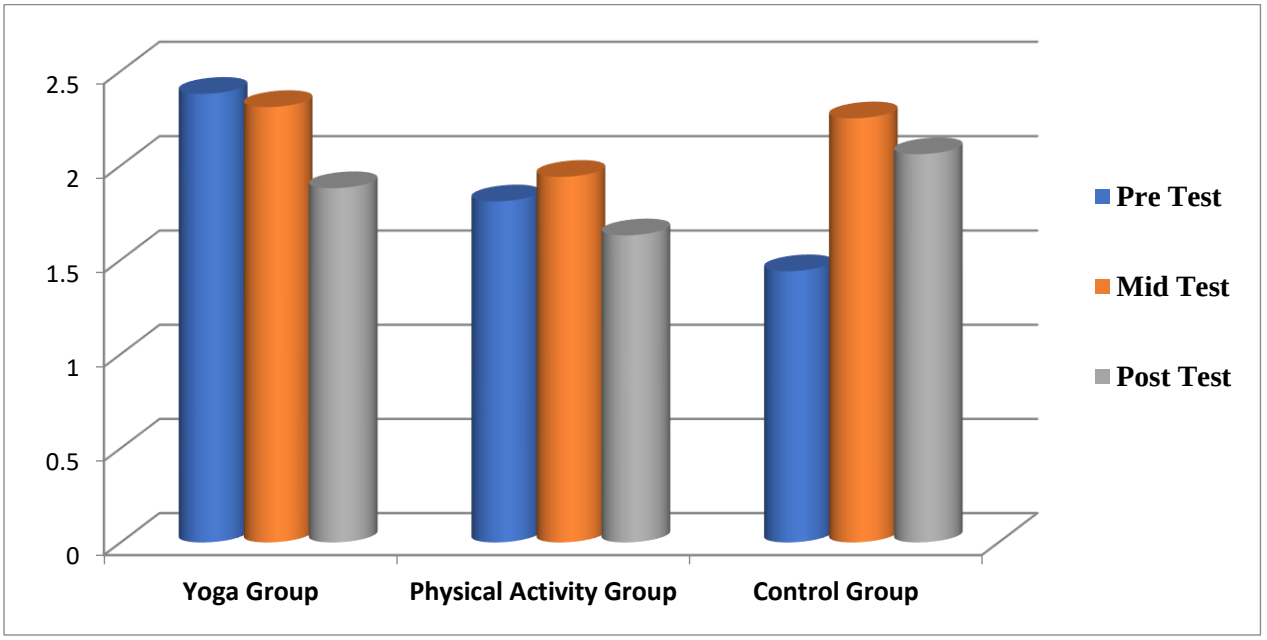


Figure-10: Comparison of means of Physical harm towards others PB among two experimental groups (Yoga group and PA group) and one control group of participants with ASD

Following six months of yoga and physical activity training, the results of the one-way MANCOVA test showed that there was no significant difference between the subjects in either the intermediate test ($F=1.27$ with $df=2;20$ and $p=0.30$) or the post-test ($F=1.23$ with $df=2;20$ and $p=0.31$) for the problem behavior of physical harm towards others.

4.3.6.1. Discussion on findings of Physical harm towards others Problem Behavior (PHTOPB) with possible mechanism

The focus of the current work was to study the effectiveness of six-months non-residential yoga and PA training program on different problem behavior of participants with moderate levels of ASD. In this work another important problem behavior variable was Physical harm towards others problem behavior (PHTOPB) (Banerjee et al., 2013).

The presentation of core and related symptoms varies greatly across people ASD. These symptoms cause various issues and frequently result in significant impairment of functioning (Card and Little, 2006; Zahn-Waxler et al., 2005). Physical aggressiveness seems to be the most troublesome of these related issues, and it can occasionally cause harm to others (Lecavalier et al., 2006; Tomanik et al., 2004). This autistic behavior is known as physical harm towards others problem behavior (Banerjee et al., 2013;).

The final result on PHTOPB, reported by parents, class teachers and clinical psychiatrists, reveals that regular structured yoga and physical activity (PA) practice has an insignificant effect on decreasing the PHTOPB of children with moderate level of ASD. After three months of regular yoga and PA training interventions, no improvement in mean value of experimental groups (yoga & PA) were found but after six months of training improvement in mean value were observed, although statistically it was not significant.

For the yoga group, improvement in the mean value of PHTPB was observed in post-test only, i.e., after six months of regular structured yoga interventions. The possible reason may be that yoga provides a calm, noiseless and therapeutic environment, which encourages internal calmness in the senses and builds a hassle-free internal stability in the thought process (Rosenblatt et al., 2011). Yoga practices also expand internal sensory connections and improve focuses, which may reduce irritability and frustration in the ASD person (Koeing et al., 2012). Because of that, PHTPB may decrease. Yoga also provides better comfort in different social settings, improves relaxation time (Radhakrishna et al., 2010), reduces sedentary behavior and significantly helps to manage hyperactivity, develop better control over own body and mind (Litchke et al., 2018). All these developments may bring a reduction in PHTPB of ASD children.

The outcomes of the PA group indicate there was some reduction in PHTPB in ASD participants during the post-test only. The possible reason behind the result may be PA reduces destruction, aggression, irritability and frustration in children with ASD (Tsc, Pang & Lee et al., 2018). Another point may be participation in regular PA provides opportunities to dissolve individual rigidity, communication and interaction with others and sometimes physical exercises become the alternative option for using language and verbal communications (Archoudane et al., 2021). It is also found that PA participation induces emotional expressivity, improves the share of enjoyment and develops interest in peers and other people (Bahrami et al., 2012).

From these findings it may be assumed that a regular yoga and physical activity (PA) training program may have almost the same significant positive effect on lessening of PHTPB in participants with moderate levels of children with ASD. And the result indicates long-term intervention may produce more positive results.

4.3.7 Odd Behaviors Problem Behavior (OBPB)

The collected data, reported by parents, teachers and psychiatrists on Odd behavior Problem Behaviors (OBPB) of participants with ASD, based on initial test, mid or intermediate test and post-test from yoga group, physical activity group and control group were statistically analyzed by using Descriptive statistics (Mean, SD), the Multivariate Analysis of Covariance (MANCOVA) and pairwise comparison with the Bonferroni post-hoc test.

Table-23: Normality and Homogeneity test of pre-test results of Odd Behaviors Problem Behavior

Tests of Normality				
	Control, Physical activity and Yoga Group	**Shapiro-Wilk**		
		Statistic	**df**	**p value**
Odd Behavior Pre-Test Result	Control Group	.92	8	.47
	Physical Activity Group	.96	8	.78
	Yoga Group	.93	8	.51

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**'p' value**
Odd Behavior Response Pre-Test Result	Based on Mean	2.04	2	21	.16
	Based on Median	1.85	2	21	.18
	Based on Median and with adjusted df	1.85	2	19.06	.18
	Based on trimmed mean	2.06	2	21	.15

P value <0.05 is defined as significant*

The obtained data on odd behaviors and problem behavior (PB) were analyzed using the **Shapiro-Wilk test** to see if the data were regularly distributed. The "p" values for each of the three groups were more than 0.05, according to the results.

The homogeneity test was conducted using **Levene's test**, and the findings indicated that the sample data was homogeneous since the "p" value was higher than 0.05.

Table-24: Results of One-way MANCOVA with descriptive and adjusted means Odd Behaviors

Group		N	Mean	SD	Box's M			P	df	
Pre-Test	Control Group	8	12.69	1.28	M= 11.68, F= 1.68			.12	6	10991.08
	Physical Activity Group	8	11.88	2.23	Wilks' Lambda = .79			P	df	
	Yoga Group	8	15.00	2.58	F = 1.21			.32	4	38
	Total	24	13.19	2.42	Partial Eta Squared = .11				Adjusted Mean of DV	
Intermediate test	Control Group	8	12.56	1.02	Intermediate Covariance				12.63	.63
	Physical Activity Group	8	12.50	1.91	F	.54	df =1;20	P =.47	12.69	.70
	Yoga Group	8	12.94	2.08	Post-test Covariance				10.54	.65
	Total	24	12.67	1.67	F	1.57	df =1;20	P =.23		
Post Test	Control Group	8	11.81	1.58	Intermediate test				11.92	.61
	Physical Activity Group	8	10.25	2.38	F	.003	df = 2;20	P = 1.00	9.91	.68
	Yoga Group	8	10.31	.88	Post-test				10.54	.65
	Total	24	10.79	1.81	F	2.65	df = 2;20	P = .05*		

P value <0.05 is defined as significant*

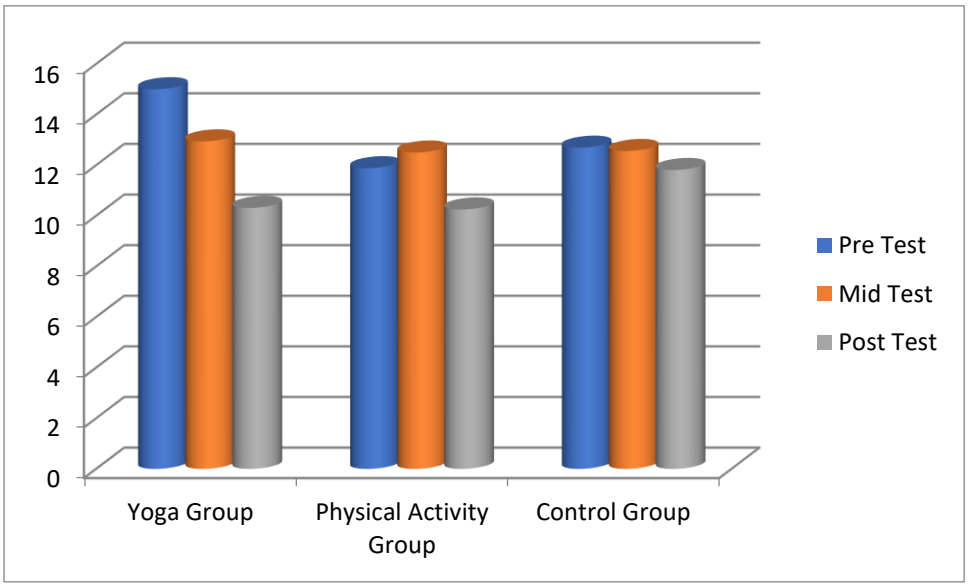


Figure-11: Comparison of means of Odd behavior PB among two experimental groups (Yoga group and PA group) and one control group of participants with ASD

Following a regular non-residential yoga and physical activity training intervention in Odd Behaviour PB, it was found that there was a significant difference in the post-test results **(F=2.65, with df=2,20 and p=0.05*)** after six months, and a statistically no significant

difference for the intermediate test **(F=.003 with df=2,20 and p=1.00),** which was after three months.

Table-25: The pairwise comparison between three different training groups on Odd Behaviors Problem Behaviour

Dependent Variable	Group I	Group J	Mean Difference (I-J	Std. Error	Sig.
Pre-Test	**Control Group**	Physical Activity Group	0.75000	.99216	1.000
		Yoga Group	1.31250	.99216	.600
	Physical Activity Group	Yoga Group	0.56250	.99216	1.000
Intermediate test	**Control Group**	Physical Activity Group	-.05	.89	1.00
		Yoga Group	-.07	.97	1.00
	Physical Activity Group	Yoga Group	-.02	1.04	1.00
Post Test	**Control Group**	Physical Activity Group	1.38	.86	.37
		Yoga Group	2.01	.94	**.05***
	Physical Activity Group	Yoga Group	.63	1.01	1.00

P value <0.05 is defined as significant*

It was discovered statistically that there were no significant differences between any of the groups in the intermediate test phase based on pairwise comparison. There was just one significant difference between the yoga and control groups in the post-test phase **(Mean Difference=2.01*, Std. Error=.94, p=0.05*).**

4.3.7.1. Discussion on findings of Odd behaviour problem behaviours (OBPB) with possible mechanism

The purpose of the current investigation was to ascertain the efficacy of a non-residential, six-month yoga and PA training program in addressing various behavioral behaviors in individuals who had moderate to severe ASD. The majority of research has focused on problem behaviors, which are thought to be one of the main difficulties faced by kids with ASD. In this work another important problem behaviours variable was Odd behaviours problem behaviours (OBPB).

The odd behaviors for ASD are a little strange in nature. They (OBPB) appear as some responses from different external and internal dysfunctions, such as self-laughing, self-talking,

making peculiar sounds, collecting and playing with unwanted objects etc. (Banerjee et al., 2013).

For this study, the yoga and PA program was separate intervention and not integrated with other therapeutic modalities. The conclusive findings of OBPB, as reported by parents, educators, and clinical psychiatrists, showed that frequent, organized yoga and physical activity (PA) instruction significantly reduces the OBPB of children with moderate levels of ASD. After three months of regular yoga and PA training interventions, no significant difference among the subjects' groups (Yoga, PA & Control) were found but after six months of training statistically significant difference among the groups were observed.

For the yoga group, significant improvement in OBPB was observed in post-test only, i.e., after six months of regular structured yoga interventions. The possible reason may be that yoga provides a calm, noiseless and therapeutic environment, which encourages internal calmness in the senses and builds a hassle-free internal stability in the thought process (Rosenblatt et al., 2011). Yoga practices also expand internal sensory connections and improve focuses, which may reduce irritability and frustration in the ASD person (Koeing et al., 2012). Because of that, PHTPB may decrease. Yoga also provides better comfort in different social settings, improves relaxation time (Radhakrishna et al., 2010), reduces sedentary behaviours and significantly helps to manage hyperactivity, develops better control over own body and mind (Litchke et al., 2018). All these developments may bring a reduction in OBPB in ASD children. Another possible reason may be that yoga improves the quality of life, but it takes time to reshape the whole physical, physiological and psychological structure of an individual. And ASD is a complex neurodevelopmental abnormality that started from the very beginning of life, so it may need more long-term intervention (Narasingharao et al., 2017).

For the PA training group, a significant reduction in OBPB was noticed in the post-test on OBPB of ASD children. Very little study has been conducted. Similar results were found by Zachor et al., 2018 & Liang et al., 2022. The possible mechanism for this result may be regular PA training to develop self-control in ASD participants, which may induce control over emotions, reduce destruction, improve attention span and overall cognitive impulses within a specific context (Gabriel et al., 2012). Participating in PA helps children with ASD with their digestion and sleep quality, which might be another explanation.

From these findings it may be assumed that regular yoga training is considered to be more significantly effective in managing OBPB than PA in participants with moderate levels of ASD. And the result indicates long-term intervention may produce more positive effects.

4.3.8 Self-injurious Behavior

The collected data, reported by parents, teachers and psychiatrists on self-injurious behavior problem behavior (SIBPB) in participants with ASD, based on initial test, mid or intermediate test and post-test from yoga group, physical activity group and control group were statistically analyzed using Descriptive statistics (Mean, SD), the Multivariate Analysis of Covariance (MANCOVA) and pairwise comparison with the Bonferroni post-hoc test.

Table-26: Normality and Homogeneity test of pre-test results of Self-injurious Behavior (SIBPB)

Tests of Normality				
	Control, Physical activity and Yoga Group	**Shapiro-Wilk**		
		Statistic	**df**	**p value**
Self-Injurious Behavior Response Pre-Test Result	Control Group	.93	8	.52
	Physical Activity Group	.95	8	.69
	Yoga Group	.90	8	.30

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**'p' value**
Self-Injurious Behavior Response Pre-Test Result	Based on Mean	.19	2	21	.83
	Based on Median	.10	2	21	.91
	Based on Median and with adjusted df	.10	2	20.91	.91
	Based on trimmed mean	.16	2	21	.85

P value <0.05 is defined as significant*

The obtained data on odd behaviors and problem behavior (PB) were analyzed using the **Shapiro-Wilk test** to see if the data were regularly distributed. The "p" values for each of the three groups were more than 0.05, according to the results.

The homogeneity test was conducted using **Levene's test**, and the findings indicated that the sample data was homogeneous since the "p" value was higher than 0.05.

Table-27: Results of One-way MANCOVA with descriptive and adjusted means Self-injurious Behaviour

Group		N	Mean	SD	Box's M			P	df	
Pre-Test	Control Group	8	7.26	2.15	M=2.90, F=.42			.87	6	100991.08
	Physical Activity Group	8	7.00	2.14	Wilks' Lambda =.38			P	df	
	Yoga Group	8	7.69	2.20	F = 5.85			.001	4	38
	Total	24	7.32	2.09	Partial Eta Squared = .38				Adjusted Mean of DV	
Intermediate test	Control Group	8	8.88	1.03	Intermediate Covariance				8.86	.33
	Physical Activity Group	8	7.37	.88	F	6.43	df =1;20	P = .02	7.78	.33
	Yoga Group	8	7.69	1.22	Post-test Covariance				5.37	.27
	Total	24	7.98	1.20	F	.12	df =1;20	P = .73		
Post Test	Control Group	8	6.81	.79	Intermediate test				6.81	.27
	Physical Activity Group	8	5.38	.79	F	5.84	df = 2;20	P = .01*	5.32	.27
	Yoga Group	8	5.31	.65	Post-test				5.37	.27
	Total	24	5.83	1.01	F	9.77	df = 2;20	P = .001*		

P value <0.05 is defined as significant*

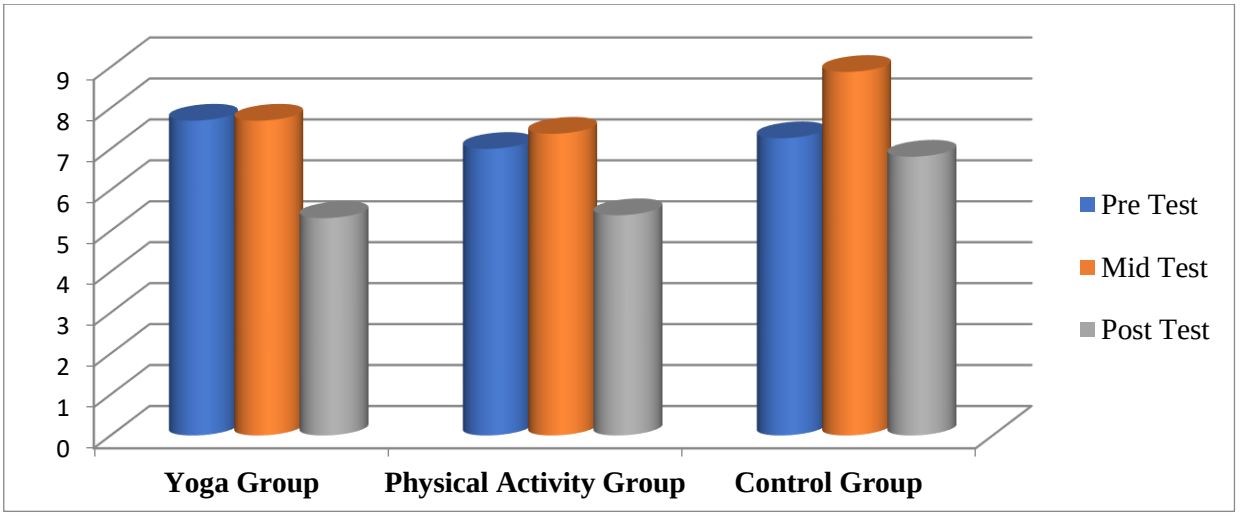


Figure-12: Comparison of means of Self-Injurious behavior PB among two experimental groups (Yoga group and PA group) and one control group of participants with ASD

Six months of consistent, non-residential yoga and physical activity practice was found to be associated with statistically no significant differences in the intermediate test **(F=5.84 with df=2,20 and p=0.01*),** or after three months. Similarly, the post test result **(F=9.77 with df=2,20 and p=0.001*),** or after three months, showed statistically significant differences.

Table-28: The pairwise comparison in the three different phases of training on Self-injuriousBehaviour

Dependent Variable	Group I	Group J	Mean Difference (I-J	Std. Error	Sig.
Pre-Test	**Control Group**	Physical Activity Group	0.75000	.99216	1.000
		Yoga Group	1.31250	.99216	.600
	Physical Activity Group	Yoga Group	0.56250	.99216	1.000
Intermediate test	**Control Group**	Physical Activity Group	1.56	.47	**.01***
		Yoga Group	1.09	.47	**.05***
	Physical Activity Group	Yoga Group	-.48	.47	.98
Post Test	**Control Group**	Physical Activity Group	1.45	.38	**.004***
		Yoga Group	1.49	.38	**.003***
	Physical Activity Group	Yoga Group	.04	.39	1.00

P value <0.05 is defined significant*

The pairwise comparison's findings showed that, at the three-month mark in the intermediate test phase, there was a significant difference between the control group and the groups that engaged in physical activity **(Mean Difference=1.56*, Std. Error=.78, p=0.01*)** and yoga **(Mean Difference=1.09*, Std. Error=.84, p=0.05*).** Halfway through the post-test phase, six months later, significant differences were found between the physical activity group and the control group **(Mean Difference=2.59*, Std. Error=.78, p=0.01*);** similarly, there was a significant difference between the yoga group and the control group **(Mean Difference=3.54*, Std. Error=.84, p=0.001*).**

4.3.8.1. Discussion on findings of Self-injurious behaviors problem behavior (SIBPB) with possible mechanism

The current study was designed to determine how effectively a six-month non-residential yoga and PA training program might address various behavioral behaviors in participants who had moderate levels of ASD. The majority of research has focused on problem behaviors, which are considered to be one of the main difficulties faced by children with ASD. In this work another important problem behavior variable was Self-injurious behavior problem behaviors (SIBPB).

The Self-injurious behaviors for ASD are a little strange in nature. They appear as some responses from different external and internal dysfunctions, such as self-laughing, self-talking, making peculiar sounds, collecting and playing with unwanted objects etc. (Banerjee et al., 2013).

For this study, the yoga and PA program was a separate intervention and not integrated with other therapeutic modalities. Final SIBPB results, as reported by parents, educators, and clinical psychiatrists, show that regular organized yoga and physical activity (PA) instruction significantly reduces SIBPB in children with moderate levels of ASD. After three months of regular yoga and PA training interventions, significant differences among the groups (Yoga, PA & Control) were found but after six months of training the same trend were followed and statistically significant difference among the group were observed.

For the yoga group, statistically significant improvement in SIBPB was observed in intermediate and post-test i.e., after three and six months of regular structured yoga interventions. The possible explanation may be yoga provides a calm, noiseless and therapeutic environment, which encourages internal calmness in the senses and builds a hassle-free internal stability in the thought process (Rosenblatt et al., 2011). Yoga practices also expand internal sensory connections and improve focuses, which may reduce irritability and frustration in the ASD person (Koeing et al., 2012). Because of that, SIBPB may decrease. Yoga also provides better comfort in different social settings, improves relaxation time (Radhakrishna et al., 2010), reduces sedentary behavior and significantly helps to manage hyperactivity, develop better control over own body and mind (Litchke et al., 2018). All these developments may bring a reduction in SIBPB of ASD children. Another possible reason may be that yoga improves the quality of life, but it takes time to reshape the whole physical, physiological and psychological structure of an individual. And ASD is a complex neurodevelopmental abnormality started in the

womb, so it may need more long-term intervention (Narasingharao et al., 2017). However, further investigation is required to completely comprehend how PA affects SIBPB in individuals with ASD.

The result of the PA group has shown statistically significant improvement in SIBPB in intermediate and post-test (after three and six months). Similar results were found by Bahrami et al., 2012. The possible explanation of this outcome may be the PA sessions provided goal oriented, focused, interactive, and dynamic training to participants with ASD (Lee, Vargo & Parretta et al., 2018). Exercise can bring reduction in discomfort, aggression, lethargy, social withdrawal and non-compliance (Marzouki, 2022). The PA also reduces co-morbidities with regard to neuromuscular functions, and helps to manage over-sensitivity to different sensory stimuluses (Bahrami et al., 2012).

From these findings it can be considered that regular yoga and physical activity (PA) training program may have almost the same significant positive effect on lessening of SIBPB in participants with moderate levels of ASD. And the result indicates long-term intervention may produce more positive effects.

4.3.9. Unusual Fear Problem Behavior (UFPB)

The collected data, reported by parents, teachers and psychiatrists on unusual fear problem behavior (UFPB) of participants with moderate level of ASD, based on initial test, mid or intermediate test and post-test from yoga group, physical activity group and control group were statistically analyzed using Descriptive statistics (Mean, SD), the Multivariate Analysis of Covariance (MANCOVA) and pairwise comparison with the Bonferroni post-hoc test.

Table-29: Normality and Homogeneity test of pre-test results of Unusual Fear Problem Behavior

Tests of Normality				
	Control, Physical activity and Yoga Group	**Shapiro-Wilk**		
		Statistic	**df**	**p value**
Unusual Fear Response Pre-Test Result	Control Group	.95	8	.66
	Physical Activity Group	.94	8	.59
	Yoga Group	.93	8	52

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**'p' value**
Unusual Fear Problem Behavior Pre-Test Result	Based on Mean	3.39	2	21	.05
	Based on Median	3.25	2	21	.06
	Based on Median and with adjusted df	3.25	2	19.29	.06
	Based on trimmed mean	3.39	2	21	.05

P value <0.05 is defined as significant*

To ascertain if the data on unusual fear problem behavior (PB) were normal, the **Shapiro-Wilk test** was employed. Indicating that the data was normally distributed, it was found that all three groups had "p" values larger than 0.05.

The homogeneity test was conducted using **Levene's test**, and as the "p" value was larger than 0.05, the results indicated that the sample data was homogeneous.

Table-30: Results of One-way MANCOVA with descriptive and adjusted means Unusual FearProblem Behaviour

Group		**N**	**Mean**	**SD**	**Box's M**			**p**	**df**	
Pre Test	**Control Group**	8	4.19	1.19	**M=6.29, F=.90**			**.49**	**6**	**10991.08**
	Physical Activity Group	8	4.50	1.10	**Wilks' Lambda = .50**			**p**	**df**	
	Yoga Group	8	5.19	1.98	**F =3.94**			**.01**	**4**	**38**
	Total	24	4.63	1.48	**Partial Eta Squared = .29**				**Adjusted Mean of DV**	
Intermediate test	**Control Group**	8	5.81	.80	**Intermediate Covariance**				5.80	.33
	Physical Activity Group	8	4.51	.68	**F**	**.10**	**df =1;20**	**P =.75**	4.77	.34
	Yoga Group	8	4.75	1.16	**Post-test Covariance**				3.13	.24
	Total	24	5.03	1.04	**F**	**.00**	**df =1;20**	**P = .99**		
Post Test	**Control Group**	8	4.31	.65	**Intermediate test**				4.31	.24
	Physical Activity Group	8	3.13	.79	**F**	**4.19**	**df = 2;20**	**P = .03***	3.06	.24
	Yoga Group	8	3.06	.50	**Post-test**				3.13	.24
	Total	24	3.50	.86	**F**	**8.31**	**df = 2;20**	**P = .002***		

P value <0.05 is defined as significant*

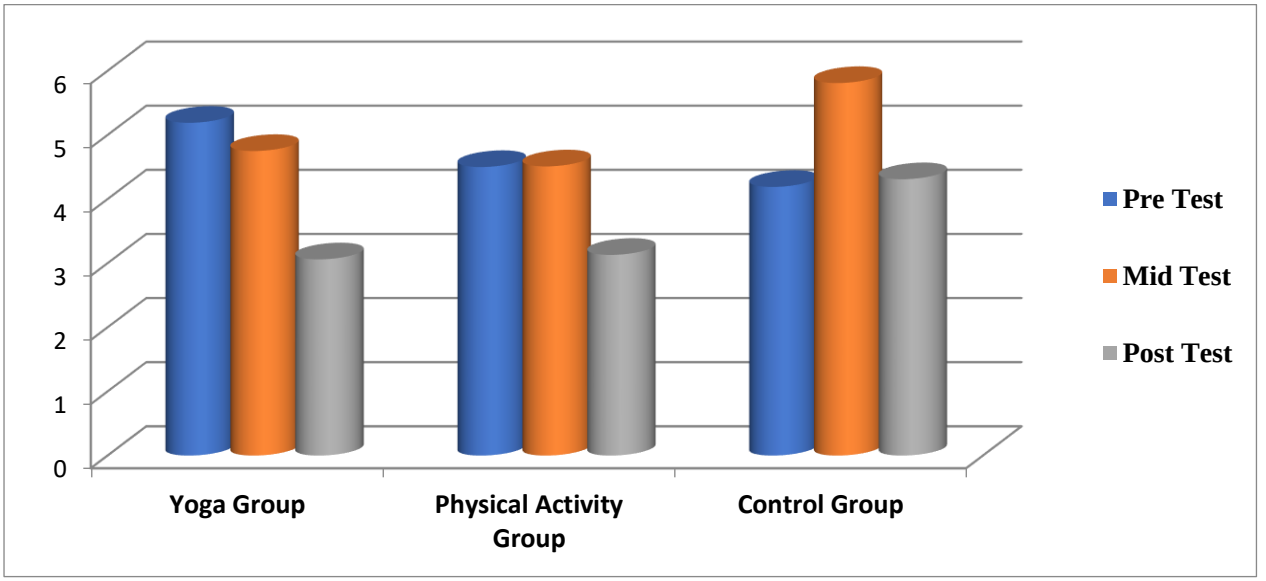


Figure-3: Comparison of means of Unusual fear PB among two experimental groups (Yoga group and PA group) and one control group of participants with ASD

In Unusual Fear Problem Behaviour, after six months of regular non-residential yoga and physical activity practice, it was observed that there was statistically significant difference found among two experimental groups (yoga & PA) and one control group for intermediate test **(F=4.19 with df=2,20 and p=0.03*)** i.e., after three months and same trend was followed, and significant difference among the groups were found in post-test result **(F=8.31 with df=2,20 and p=0.002*)** i.e., after six months.

Table-31: The pairwise comparison between three different training groups on Unusual FearProblem Behaviour

Dependent Variable	Group I	Group J	Mean Difference (I-J	Std. Error	Sig.
Pre -Test	Control Group	Physical Activity Group	0.75000	.99216	1.000
		Yoga Group	1.31250	.99216	.600
	Physical Activity Group	Yoga Group	0.56250	.99216	1.000
Intermediate test	Control Group	Physical Activity Group	1.29	.46	**.03***
		Yoga Group	1.02	.48	.14
	Physical Activity Group	Yoga Group	-.27	.47	1.00
Post -Test	Control Group	Physical Activity Group	1.19	.34	**.01***
		Yoga Group	1.25	.35	**.01***
	Physical Activity Group	Yoga Group	.06	.34	1.00

P value <0.05 is defined as significant*

In the intermediate test phase, or after three months, a significant difference was seen between the control group and the PA group based on pairwise comparison **(Mean Difference=1.29*, Std. Error=.46, p=0.03*).** However, significant differences between the control group and the physical activity group **(Mean Difference=2.59*, Std. Error=.78, p=0.01*)** and between the control group and the yoga group **(Mean Difference=3.54*, Std. Error=.84, p=0.01*)** were found in the post test (after six months).

4.3.9.1. Discussion on findings of Unusual Fear problem behavior (UFPB) with possible mechanism

The current study's objective was to determine how well a six-month non-residential yoga and PA training program could assist participants with moderate ASD for a variety of problematic behaviors. The majority of research has focused on problem behaviors, which are considered to be one of the main difficulties faced by individuals with ASD. In this work another important problem behavior variable was Unusual Fear problem behaviors (UFPB).

The Unusual fears have long been recognized as a feature of ASD; e.g., fear of darkness, candle, water etc. (Lee, 2017). The final findings of UFPB, as reported by parents, educators, and clinical psychiatrists, showed that a consistent, organized yoga and physical activity (PA) training program significantly reduces the UFPB of children with moderate ASD. After three months of regular yoga and PA training interventions, significant difference among the subjects' groups (Yoga, PA & Control) were found and after six months (in post-test) same trend was followed and statistically significant difference among the group were observed.

For yoga group, the results indicated, regular yoga practices are significantly capable to reduce UFPB of children with moderate levels of ASD. There are very few researches are available on unusual fear of people with ASD. The possible explanation for the result of current study may be yoga practices expands internal sensory connection and improve focuses, that may reduce irritability and frustration in ASD person (Koeing et al., 2012). Another noticeable point may be yoga practice works as a very good relaxation tools, which is highly needed to children with ASD. The entire yoga sessions provide a calm and quite environment for the ASD participants, The relaxation (physical and mental) improves digestion and sound sleep to ASD people that may be connected to the reduction of UFPB.

For PA group it was found, regular structured PA training program is highly effective to reduce UFPB of participants with ASD. A possible explanation for the outcome might be that PA provides pleasant sensory stimulation that enhances emotional regulation, enhances attention span, and stimulates cognitive impulses in a particular setting. PA may also lessen stereotyped and repeated behaviors (Bahrami et al., 2012), along with that the UFPB may also decreased. Further study is needed to explore more about use of PA to manage UFPB of person with moderate levels of ASD.

From these findings it may be considered that regular yoga and physical activity (PA) training program may have almost the same significant positive effect on lessening of UFPB in participants with moderate levels of ASD. And the result indicate long-term intervention may produce more positive effects.

4.3.10. Disobedience Problem Behavior

The collected data, reported by parents, teachers and psychiatrists on disobedience problem behavior (DPB) of participants with moderate levels of ASD, based on initial test, mid or intermediate test and post-test from yoga group, physical activity group and control group were statistically analyzed using Descriptive statistics (Mean, SD), the Multivariate Analysis of Covariance (MANCOVA) and pairwise comparison with the Bonferroni post-hoc test.

Table-32: Normality and Homogeneity test of pre-test results of Disobedience Problem Behavior

Tests of Normality				
	Control, Physical activity and Yoga Group	**Shapiro-Wilk**		
		Statistic	**df**	**p value**
Disobedience Behavior Response Pre-Test Result	Control Group	.85	8	.09
	Physical Activity Group	.96	8	.83
	Yoga Group	.87	8	.15

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**'p' value**
Disobedience Behavior Response Pre-Test Result	Based on Mean	3.72	2	21	.04
	Based on Median	3.82	2	21	.04
	Based on Median and with adjusted df	3.82	2	14.78	.05
	Based on trimmed mean	3.76	2	21	.04

P value <0.05 is defined as significant*

To assess the normality of the data gathered on Disobedience Problem Behavior (DPB), the **Shapiro-Wilk test** was employed. The data was found to be regularly distributed in all three groups, with "p" values larger than 0.05.

The homogeneity test was conducted using **Levene's test,** and as the "p" value was larger than 0.05, the results indicated that the sample data was homogeneous.

Table-33: Results of One-way MANCOVA with descriptive and adjusted means DisobedienceProblem Behaviour

Group		**N**	**Mean**	**SD**	**Box's M**			**P**	**df**	
Pre-Test	**Control Group**	8	5.88	.88	**M=2.31, F= .33**			**.92**	**6**	**10991.08**
	Physical Activity Group	8	5.75	1.71	**Wilks' Lambda =.64**			**P**	**df**	
	Yoga Group	8	6.44	.78	**F = 2.35**			**.07**	**4**	**38**
	Total	24	6.02	1.18	**Partial Eta Squared = .20**				**Adjusted Mean of DV**	
Intermediate test	**Control Group**	8	6.44	.86	**Intermediate Covariance**				6.46	.28
	Physical Activity Group	8	5.69	.88	**F**	**1.11**	**df =1;20**	**P =.31**	5.94	.29
	Yoga Group	8	6.00	.60	**Post-test Covariance**				5.33	.31
	Total	24	6.04	.81	**F**	**.08**	**df =1;20**	**P = .78**		
1Post Test	**Control Group**	8	6.19	.80	**Intermediate test**				6.19	.30
	Physical Activity Group	8	5.31	.96	**F**	**1.82**	**df = 2;20**	**P = .19**	5.04	.31
	Yoga Group	8	5.06	.73	**Post-test**				5.33	.31
	Total	24	5.52	.94	**F**	**3.86**	**df = 2;20**	**P = .03***		

P value <0.05 is defined as significant*

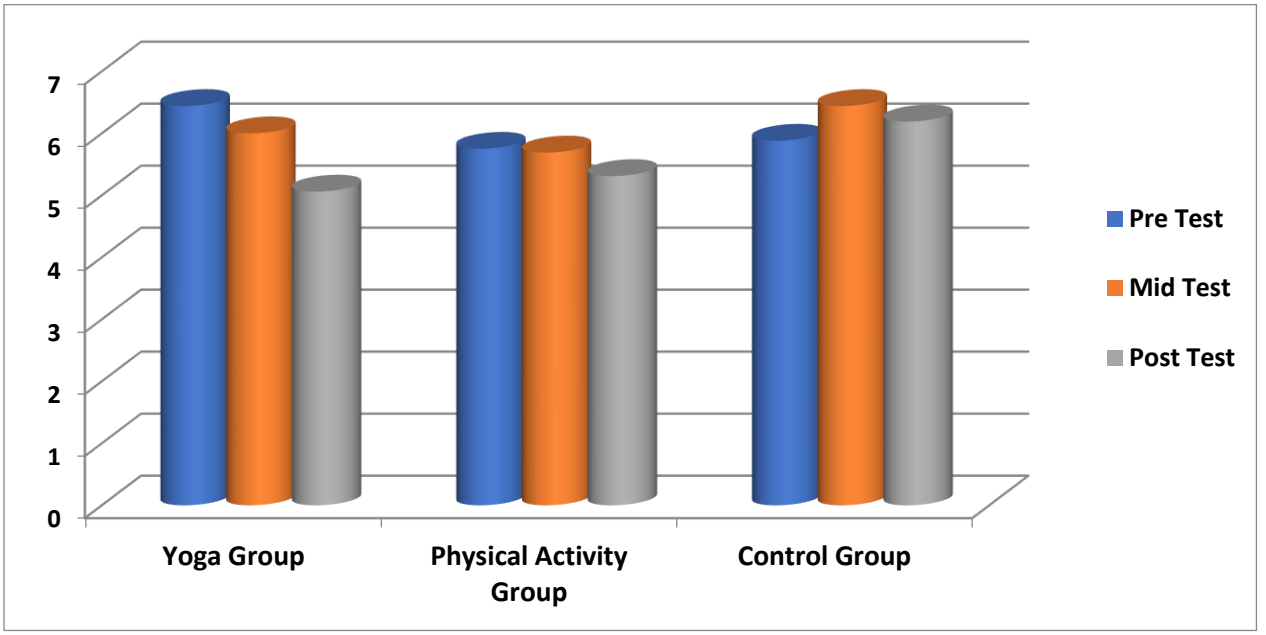


Figure-14: Comparison of means of Disobedience PB among two experimental groups (Yoga group and PA group) and one control group of participants with ASD

After six months of consistent non-residential yoga and physical activity practice, it was found in Disobedience Problem Behavior (DPB) that there was a statistically significant difference between the groups for the intermediate test **(F=1.82 with df=2,20 and p=0.19)**, or after three months, and a significant difference was found in the post test result **(F=3.86 with df=2,20 and p=0.03*),** or after six months.

Table-34: The pairwise comparison between different groups on DisobedienceProblem Behaviour

Dependent Variable	Group I	Group J	Mean Difference (I-J	Std. Error	Sig.
Pre-Test	**Control Group**	Physical Activity Group	0.75000	.99216	1.000
		Yoga Group	1.31250	.99216	.600
	Physical Activity Group	Yoga Group	0.56250	.99216	1.000
Intermediate test	**Control Group**	Physical Activity Group	.73	.40	.24
		Yoga Group	.52	.40	.63
	Physical Activity Group	Yoga Group	-.21	.41	1.00

Dependent Variable	Group I	Group J	Mean Difference (I-J	Std. Error	Sig.
Post-Test	**Control Group**	Physical Activity Group	.87	.43	.17
		Yoga Group	1.15	.44	**.04***
	Physical Activity Group	Yoga Group	.28	.44	1.00

P value <0.05 is defined as significant*

In the intermediate test phase (after three months), paired comparison revealed no significant difference between the groups. However, after six months (during the post-test phase), a significant difference **(Mean Difference=1.15*, Std. Error=.78, p=0.04*)** was seen between the yoga group and the control group.

4.3.10.1. Discussion on findings of Disobedience problem behavior (DPB) with possible mechanism

The current study's objective was to determine how effectively a six-month non-residential yoga and PA training program might treat participants with mild ASD for a variety of behavioral behaviors. The majority of research has focused on problem behaviors, which are thought to be one of the primary challenges faced by children with ASD. In this work another important problem behavior variable was Disobedience problem behaviors (DPB). The common disobedience behavior of ASD children is like refusing to obey commands, intentionally taking time to complete any task etc. (Banerjee et al., 2013).

Final DPB results from parents, educators, and clinical psychiatrists showed that regular organized yoga and physical activity (PA) interventions significantly reduces the DPB of children with moderate ASD. After three months of regular yoga and PA training interventions, no significant, differences among the subjects' groups (Yoga, PA & Control) were found but after six months of training statistically significant difference among the groups were observed.

In the yoga group, there was a notable decrease in DPB after six months of regular structured yoga interventions. The possible reason may be that yoga provides a calm, noiseless and therapeutic environment, which encourages internal calmness in the senses and builds a hassle-free internal stability in the thought process (Rosenblatt et al., 2011). Yoga practices also expand internal sensory connections and improve focuses, which may reduce irritability and frustration in the ASD person (Koeing et al., 2012). Yoga also provides better comfort in

different social settings, improves relaxation time (Radhakrishna et al., 2010), reduces sedentary behavior (Litchke et al., 2018). All these developments may bring a reduction in DPB in ASD children. In the yoga sessions, children developed a habit of following instructions and obeying yoga teachers and others.

The result of the study also indicated that regular structured PA training can significantly reduce DPB in children with moderate levels of ASD. The possible explanation of these results may be that most of the ASD people lead a sedentary lifestyle, and through regular structured PA, children become more active and feel free to take part in different daily activities. The investigator, Stavrou et al., 2018, found the same kind of result; mentioning PA is related to instructions connected to whole body movement of the participants, which make them more proactive to overcome certain resistances.

Based on these results, it's possible to conclude that people with moderate degrees of ASD may benefit significantly from regular yoga and physical activity (PA) training, which will lower their DPB. However, studies show that yoga poses are more successful in lowering the DPB of ASD.

4.3.11. Repetitive Behaviors Problem Behavior

The collected data, reported by parents, teachers and psychiatrists on Repetitive Behaviors problem behavior (RBPB) of participants with ASD, based on initial test, mid or intermediate test and post-test from yoga group, physical activity group and control group were statistically analyzed using Descriptive statistics (Mean, SD), the Multivariate Analysis of Covariance (MANCOVA) and pairwise comparison with the Bonferroni post-hoc test.

Table-35: Normality and Homogeneity test of pre-test results of Repetitive Behaviors

Tests of Normality				
	Control, Physical activity and Yoga Group	**Shapiro-Wilk**		
		Statistic	**df**	**p value**
Repetitive Behavior Response Pre-Test Result	Control Group	.97	8	.88
	Physical Activity Group	.90	8	.29
	Yoga Group	.91	8	.34

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**'p' value**
Repetitive Behaviours Response Pre-Test Result	Based on Mean	1.11	2	21	.35
	Based on Median	1.08	2	21	.36
	Based on Median and with adjusted df	1.08	2	20.04	.36
	Based on trimmed mean	1.07	2	21	.36

P value <0.05 is defined as significant*

The Shapiro-Wilk test was used to determine if the collected data on repetitive behavior problem behavior (PB) was normally distributed. The results showed that all three groups' "p" values were larger than 0.05.

Levene's test was used to perform the homogeneity test, and the results showed that the sample data was homogenous since the "p" value was larger than 0.05.

Table-36: Results of One-way MANCOVA with descriptive and adjusted means Repetitive Behaviour

Group		**N**	**Mean**	**SD**	**Box's M**			**P**	**df**	
Pre-Test	**Control Group**	8	9.81	2.12	**M= 6.40, F=.92**			**.48**	**6**	**10991.08**
	Physical Activity Group	8	11.43	1.32	**Wilks' Lambda =.52**			**P**	**df**	
	Yoga Group	8	11.94	1.66	**F = 3.73**			**.01**	**4**	**38**
	Total	24	11.06	1.89	**Partial Eta Squared = .28**				**Adjusted Mean of DV**	
Intermediate test	**Control Group**	8	11.69	1.19	**Intermediate Covariance**				11.47	.68
	Physical Activity Group	8	10.44	1.15	**F**	**.63**	**df =1;20**	**P =.44**	12.65	.65
	Yoga Group	8	12.50	2.49	**Post-test Covariance**				8.79	.59
	Total	24	11.54	1.86	**F**	**.04**	**df =1;20**	**P = .84**		
Post Test	**Control Group**	8	9.44	1.40	**Intermediate test**				9.49	.64
	Physical Activity Group	8	8.81	1.83	**F**	**2.99**	**df = 2;20**	**P = .07**	7.15	.61
	Yoga Group	8	7.19	1.60	**Post-test**				8.79	.59
	Total	24	8.48	1.83	**F**	**3.45**	**df = 2;20**	**P = .05***		

P value <0.05 is defined as significant*

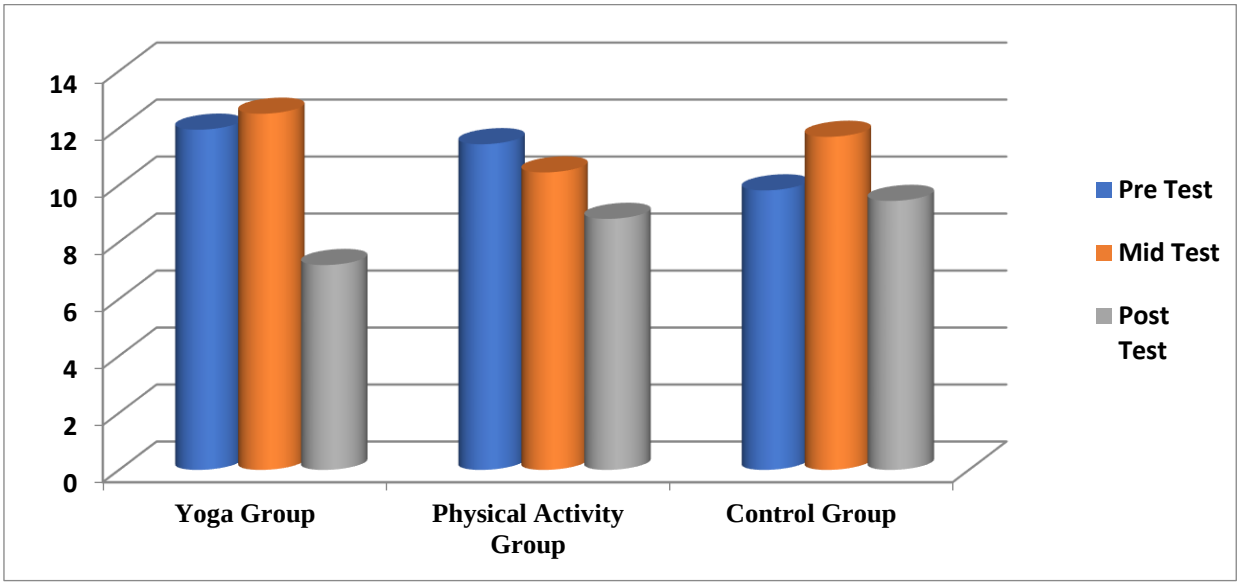


Figure-15: Comparison of means of repetitive behavior PB among two experimental groups (Yoga group and PA group) and one control group of participants with ASD

After six months of regular, non-residential yoga and physical activity practice, it was observed in Repetitive Behaviors that there was a statistically significant difference between the groups in the intermediate test **(F=2.99 with df=2,20 and p=0.07)**, or after three months. In the post test result **(F=3.45 with df=2,20 and p=0.05*),** or after six months, there was a significant difference between the groups.

Table-37: The pairwise comparison between different groups on Repetitive Behaviors

Dependent Variable	Group I	Group J	Mean Difference (I-J	Std. Error	Sig.
Pre-Test	**Control Group**	Physical Activity Group	0.75000	.99216	1.000
		Yoga Group	1.31250	.99216	.600
	Physical Activity Group	Yoga Group	0.56250	.99216	1.000
Intermediate test	**Control Group**	Physical Activity Group	.97	.94	.95
		Yoga Group	-1.18	.99	.74
	Physical Activity Group	Yoga Group	-2.15	.88	**.05***
Post-Test	**Control Group**	Physical Activity Group	.69	.90	1.00
		Yoga Group	2.34	.94	**.05***
	Physical Activity Group	Yoga Group	1.65	.84	.19

P value <0.05 is defined as significant*

A significant difference was seen between the PA group and the yoga group **(p=0.05*, mean difference = -2.15*, standard error =.88).** In the intermediate test phase (after three months) and post test phase (after six months), there were significant differences between the control group and the yoga group **(Mean Difference=2.34*, Std. Error=.94, p=0.05*).**

4.3.11.1. Discussion on findings of Repetitive behavior problem behavior (RBPB) with possible mechanism

The current study set out to investigate the effectiveness of a non-residential, six-month yoga and PA training program in addressing various problem behaviors in participants with moderate-to-high ASD. The majority of research has focused on problem behaviors, which are thought to be one of the biggest difficulties faced by children with ASD. In this work another important problem behavior variable was Repetitive behavior problem behaviors (RBPB).

The RBPB is very common in ASD. According to Turner (1999) and Langen et al. (2011), these behaviors are typified by their frequency and lack of clear function and stated goal as well as their recurrence, inflexibility, invariance, and inappropriateness. It might involve head banging, intricate body motions, rocking, hopping, spinning or whirling, and flapping of the arms or hands or fingers (Banerjee et al., 2013). The causes of RBPB are yet unknown, but the possible causes may be self-enjoyment, such as sensory input (Vestibular system, visual system), distressing environments (especially social environment), to deal with stress & anxiety and to block out uncertainty. (Artchoudane et al., 2019).

For this study, the yoga and PA intervention program were separately implemented by two different experimental groups to find out the effectiveness of RBPB in autistic children. The final result on RBPB, reported by parents, class teachers and clinical psychiatrists, reveals that regular structured yoga and physical activity (PA) training has a significant positive effect on decreasing the RBPB of children with moderate level of ASD. After three months of regular yoga and PA training interventions, no significant differences among the subjects' groups (Yoga, PA & Control) were found but after six months of training statistically significant difference among the group were observed.

For the yoga group, improvement in RBPB was observed in post-test only, i.e., after six months of regular structured yoga interventions. Similar results have been reported by Radhakrishna et al., 2010; Koeing et al., 2012 & Narasingharao et al., 2017. The possible reason may be yoga provides a calm, noiseless and therapeutic environment, which encourages internal

calmness in senses and builds a hassle-free internal stability in the thought process of the ASD participants (Rosenblatt et al., 2011). Yoga provides better comfort in different social settings, improves relaxation time (Radhakrishna et al., 2010). Practicing asanas develops motor proficiencies, improve muscles strengths, joints balance, bilateral coordination, flexibility (especially spine flexibility) and smooth functioning of neuromuscular systems. Breathing exercises develop coordinated breathing movements and subtle awareness of body and mind functions. Yoga practices also expand internal sensory connections and improve focuses, which may reduce irritability and frustration in the ASD person (Koeing et al., 2012). Yoga is also effective in reducing sedentary behavior and significantly helps to manage hyperactivity, develop better control over own body and mind (Litchke et al., 2018), improve digestion and reduce stress (Narasingharao et al., 2017). All these developments may bring a reduction in RBPB in ASD children.

The current study also reveals that PA intervention significantly decreases RBPB in participants with moderate levels of ASD. Similar findings have been mentioned by Levinson & Reid, 1993; Bahrami et al., 2012; Lee, Vargo & Parretta, 2018. The possible explanation of the results may be that children with ASD lead a sedentary lifestyle, which affects their overall health and reduces their social adaptability (Healy et al., 2018). Exercise is beneficial for the human brain and psychology (Mura et al., 2014). In this study, a structured PA training program was implemented by following a one-to-one method, based on the guidelines, recommendations of previous successful research with special needs for children with ASD, which may bring significant development in RBPB were seen. The possible reasons for the outcomes may be that PA improves cognitive function through synaptic plasticity and neuro-genesis of ASD children. Another reason may be that PA gives comfortable sensory stimulation to ASD participants, which reduces tactile over-sensitivity. It is also found PA decreases irritability, aggression, social withdrawal and lethargy of participants with ASD (Gabriel et al., 2012).

From these findings it may be assumed that a regular yoga and physical activity (PA) training program may have a significant positive effect on lessening of RPPB in participants with moderate levels of ASD. And yogic practices may be considered to be more effective for reducing RBPB in ASD participants and the results indicate long-term intervention may produce more positive effects.

4.3.12. Speech Problem Behavior (SPB)

The collected data, reported by parents, teachers and psychiatrists on speech problem behavior (SPB) of participants with moderate level of ASD, based on initial test, mid or the intermediate test and the post-test from yoga group, physical activity group and control group were statistically analyzed using Descriptive statistics (Mean, SD), the Multivariate Analysis of Covariance (MANCOVA) and pairwise comparison with the Bonferroni post-hoc test.

Table-38: Normality and Homogeneity test of pre-test results of Speech Problem Behavior

Tests of Normality				
	Control, Physical activity and Yoga Group	**Shapiro-Wilk**		
		Statistic	**df**	**p value**
Speech problem behaviours Pre-Test Result	Control Group	.97	8	.93
	Physical Activity Group	.91	8	.34
	Yoga Group	.90	8	.30

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**'p' value**
Speech problem behaviours Pre-Test Result	Based on Mean	.70	2	21	.51
	Based on Median	.28	2	21	.76
	Based on Median and withadjusted df	.28	2	14.67	.76
	Based on trimmed mean	.64	2	21	.54

P value <0.05 is defined as significant*

The data on Speech Problem Behavior (PB) was gathered, and its normality was assessed using the **Shapiro-Wilk test.** The data was found to be regularly distributed in all three groups, with "p" values larger than 0.05**.**

The homogeneity test was conducted using **Levene's test,** and as the "p" value was larger than 0.05, the results indicated that the sample data was homogeneous.

Table-39: Results of One-way MANCOVA with descriptive and adjusted means Speech Problem Behaviour

Group		N	Mean	SD	Box's M			P	df	
Pre Test	Control Group	8	4.00	1.36	M=6.12, F= .88			.51	6	10991.08
	Physical Activity Group	8	4.81	1.28	Wilks' Lambda = .59			P	df	
	Yoga Group	8	5.50	2.02	F =2.92			.03	4	38
	Total	24	4.78	1.64	Partial Eta Squared = .24				Adjusted Mean of DV	
Intermediate test	Control Group	8	4.25	1.28	Intermediate Covariance				4.28	.45
	Physical Activity Group	8	3.13	1.43	F	.05	df =1;20	P = .83	4.10	.45
	Yoga Group	8	4.13	.79	Post-test Covariance				2.87	.27
	Total	24	3.83	1.26	F	3.60	df =1;20	P = .07		
Post Test	Control Group	8	3.81	.79	Intermediate test				3.97	.28
	Physical Activity Group	8	2.88	.58	F	2.04	df = 2;20	P = .16	3.04	.28
	Yoga Group	8	3.19	.99	Post-test				2.87	.27
	Total	24	3.29	.87	F	4.31	df = 2;20	P = .03*		

P value <0.05 is defined as significant*

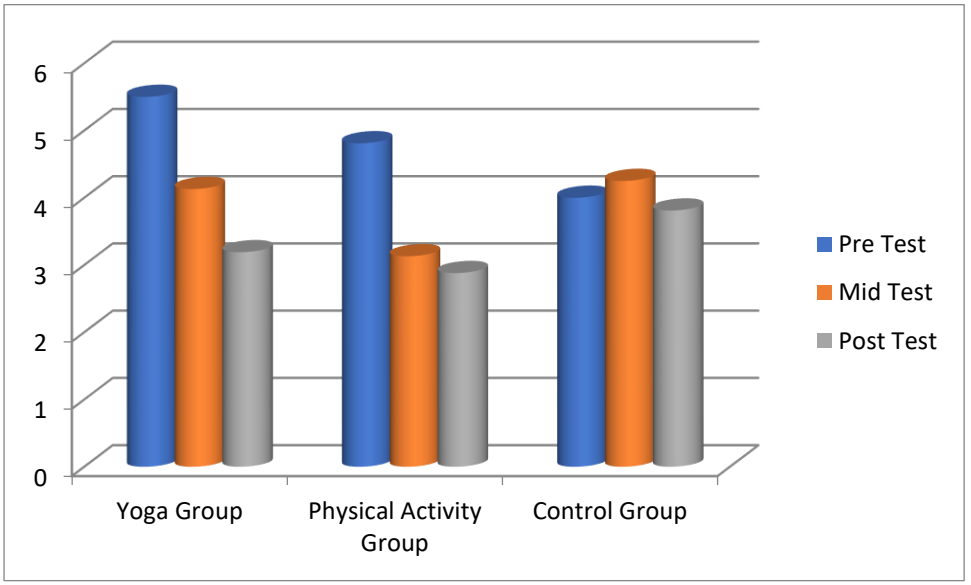


Figure-16: Comparison of means of Speech PB among two experimental groups (Yoga group and PA group) and one control group of participants with ASD

After regular non-residential yoga and physical activity training a statistically significant difference was found in the intermediate test result **(F=2.04 with df=2,20 and p=0.16),** or after three months, in Speech Problem Behaviour (SPB) of ASD children. A significant difference was also found in the post test result **(F=4.31 with df=2,20 and p=0.03*)**, or after six months.

Table-40: The pairwise comparison between different groups on Speech Problem Behaviour

Dependent Variable	Group I	Group J	Mean Difference (I-J	Std. Error	Sig.
Pre-Test	**Control Group**	Physical Activity Group	0.75000	.99216	1.000
		Yoga Group	1.31250	.99216	.600
	Physical Activity Group	Yoga Group	0.56250	.99216	1.000
Intermediate test	**Control Group**	Physical Activity Group	1.16	.63	.24
		Yoga Group	.18	.66	1.00
	Physical Activity Group	Yoga Group	-.98	.63	.40
Post-Test	**Control Group**	Physical Activity Group	1.10	.39	**.03***
		Yoga Group	.92	.41	.11
	Physical Activity Group	Yoga Group	-.18	.39	1.00

P value <0.05 is defined as significant*

In the intermediate test phase (after three months), there was no discernible difference between the groups based on the pairwise comparison. However, significant differences between the control group and the physical activity group showed during the post-test phase **(Mean Difference=1.10*, Std. Error=.39, p=0.03*)** after six months.

4.3.12.1. Discussion on findings of Speech problem behavior (SPB) with possible mechanism

The current study set out to investigate the effectiveness of a non-residential, six-month yoga and PA training program in addressing various problem behaviors in participants with moderate levels of ASD. Problem behaviors are one of the major issues that children with ASD

face, and they have been the focus of the majority of studies. In this work another important problem behavior variable was Speech problem behaviors (SPB).

Problems with speech and language are one of the defining characteristics of ASD. Speech PB is very heterogenous, and it has a number of causes or contributing factors (Gordon, 2007). The common SPB are like repetition of words, repetition of phrases. This behavior immensely interferes with different social interaction and communications of ASD children (Banerjee et al., 2013).

For this study, the yoga and PA program was separate intervention and implemented for six months. The final SPB results, as reported by parents, educators, and clinical psychiatrists, show that regular organized yoga and physical activity (PA) training significantly reduces the SPB of participants with moderate levels of ASD. After three months of regular yoga and PA training interventions, no significant differences among the subjects' groups (Yoga, PA & Control) were found but after six months of training statistically significant difference among the group were observed.

For the yoga group, significant improvement in SPB were observed in the post-test only, i.e., after six months of regular structured yoga interventions. The possible explanation of the result may be that regular yoga practice improves awareness. Visual imitation with guided instructions creates opportunities for verbal and motor imitation, which leads to encouraging the ability to speech. During yoga intervention, teachers' instructions help the students to imitate the lip movement and repetition, facilitating an inclination for speech to ASD participants. Yoga also improves positive confidence for engagement in talk and interaction (Litchke et al., 2018). Regular yoga helps to be more expressive, which leads to more spontaneous initiative to start a conversation and continue the conversation in different social settings (Rosenblatt et al., 2011). Yoga develops an easy and smooth transition ability to shift the task from one to another, and the same transition may be followed in speech too. During chanting, specific sound sequences improve sound awareness and help with vocabulary development for ASD children. All these developments may bring a reduction in SPB for ASD individuals.

The study's findings demonstrated that regularly scheduled organized PA significantly lowers SPB in persons with ASD. Similar results have previously been reported by Yu et al. (2018) and Bass et al. (2009). One plausible reason for the outcome might be because involvement in PA provides chances for social interaction and communication. Another

important reason may be that PA helps to reduce destruction and aggression, which may contribute to beginning a conversation and to continuing the conversation.

It is possible to infer from these results that people with moderate degrees of ASD may benefit greatly from a regular yoga and physical activity (PA) training program, and that PA may be more beneficial in reducing SPB. Additionally, the outcome suggests that long-term intervention could have more advantageous outcomes.

4.3.13. Vestibular Problem Behavior (VPB)

Data on vestibular problem behavior (VBPB) of participants with moderate ASD were gathered, reported by parents, teachers, and psychiatrists. The data was based on initial, mid-, and post-test results from yoga, physical activity, and control groups. Descriptive statistics (Mean, SD), the Multivariate Analysis of Covariance (MANCOVA), and pairwise comparison using the Bonferroni post-hoc test was used in the statistical analysis.

Table-41: Normality and Homogeneity test of pre-test results of Vestibular Problem Behavior

Tests of Normality				
	Control, Physical activity and Yoga Group	**Shapiro-Wilk**		
		Statistic	**df**	**p value**
Vestibular Response Pre-Test Result	Control Group	.86	8	.11
	Physical Activity Group	.96	8	.80
	Yoga Group	.92	8	.39

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**'p' value**
Vestibular Response Pre-Test Result	Based on Mean	2.18	2	21	.14
	Based on Median	1.85	2	21	.18
	Based on Median and with adjusted df	1.85	2	17.84	.19
	Based on trimmed mean	2.17	2	21	.14

P value <0.05 is defined as significant*

The obtained data on vestibular problem behavior (VPB) were examined for normality using the **Shapiro-Wilk test**. The findings demonstrated that the "p" values for each of the three groups were more than 0.05, indicating a regularly distributed set of data.

The homogeneity test was conducted using **Levene's test**, and the findings indicated that the sample data was homogeneous since the "p" value was greater than 0.05.

Table-42: Results of One-way MANCOVA with descriptive and adjusted means VestibularProblem Behaviour

Group		N	Mean	SD	Box's M			P	df	
Pre -Test	Control Group	8	9.25	1.34	M=9.51, F=1.37			.22	6	10991.08
	Physical Activity Group	8	10.31	1.62	Wilks' Lambda = .67			P	df	
	Yoga Group	8	13.88	2.52	F =2.13			.09	4	38
	Total	24	11.15	2.71	Partial Eta Squared = .18				Adjusted Mean of DV	
Intermediate test	Control Group	8	11.50	.89	Intermediate Covariance				11.15	.71
	Physical Activity Group	8	10.56	1.84	F	.89	df =1;20	P = .36	12.94	.81
	Yoga Group	8	12.44	2.13	Post-test Covariance				8.58	.59
	Total	24	11.50	1.81	F	1.80	df =1;20	P = .19		
Post -Test	Control Group	8	8.94	1.47	Intermediate test				9.41	.67
	Physical Activity Group	8	8.38	2.22	F	2.69	df = 2;20	P = .09	7.31	.76
	Yoga Group	8	8.00	1.07	Post-test				8.58	.59
	Total	24	8.44	1.63	F	1.57	df = 2;20	P = .23		

P value <0.05 is defined as significant*

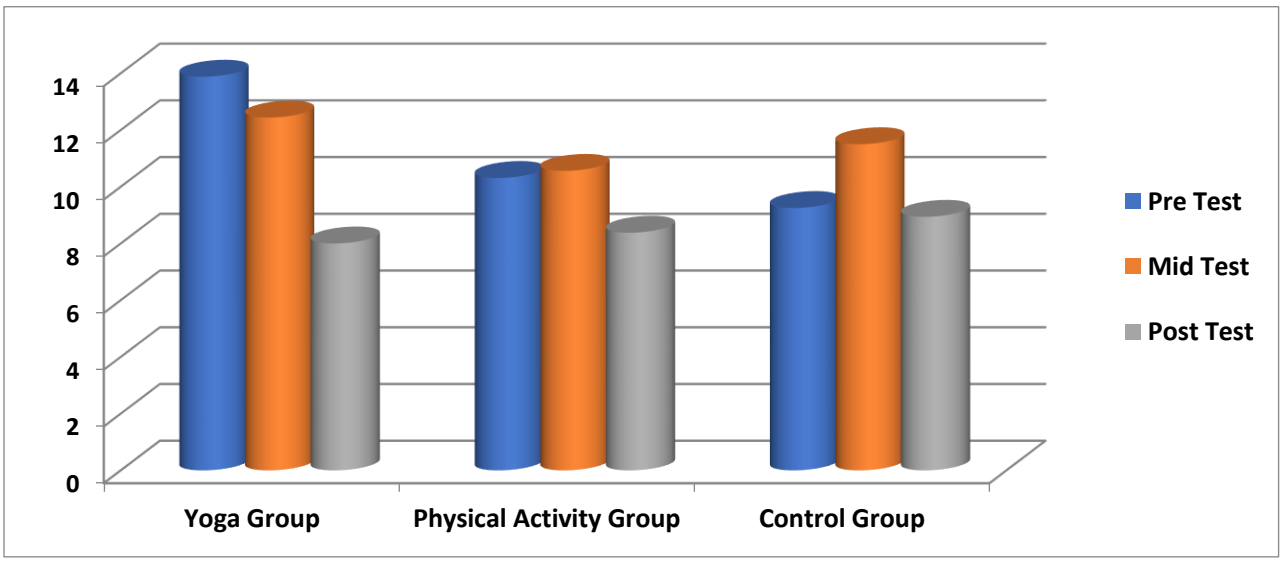


Figure-17: Comparison of means of Vestibular PB among two experimental groups (Yoga group and PA group) and one control group of participants with ASD

One-way MANCOVA results for vestibular problem behavior (VPB) after six months of yoga and physical activity training showed no significant differences between the subjects for the intermediate test **(F=2.69 with df=2;20 and p=0.09),** which was conducted after three months, and in the post-test **(F=1.57 with df=2;20 and p=0.23),** which was conducted six months later.

4.3.13.1. Discussion on findings of Vestibular behavior problem behavior (VPB) with possible mechanism

The current study set out to determine how well a six-month non-residential yoga and PA training program might address various behavioral behaviors in participants who had moderate to severe ASD. Problem behaviors, which are thought to be among the major difficulties faced by children with ASD, have been the focus of the majority of research. In this work another important problem behavior variable was Vestibular problem behaviors (VPB).

Repetitive behaviors, a lack of social skills, and communication challenges are features of autism spectrum disorder (ASD), a complex neurological disease. Most individuals with ASD have auditory and vestibular impairment to some extent in addition to these fundamental symptoms. Gaze impairment, postural instability, and abnormal gait are examples of vestibular dysfunction in ASD. Vestibular dysfunctions frequently result in problematic behavior referred to as vestibular problem behaviors (VPB) (Banerjee et al., 2013).

The final result on VPB, reported by parents, class teachers and clinical psychiatrists, reveals that regular structured yoga and physical activity (PA) training are effective on decreasing the VPB of children with moderate level of ASD. The participants' groups (Yoga, PA, and Control) showed no statistically significant differences after three months of consistent yoga and PA training interventions. This tendency continued, and after six months of training, no statistically significant differences were seen within the group. The results were statistically not significant, but they did show improvement in the mean values of the two experimental groups (yoga and PA group) on the VPB of ASD children, which were detected in both the intermediate test and the post-test.

The possible explanation of these results may be that yogic exercises brings multiple senses working together, and the vestibular system is interconnected and dependent on other different systems of our body. The vestibular stimulation invites abnormal postural responses to autistic children (Smoot Reinert et al., 2015). According to certain research, yoga helps people with ASD establish proper posture. Children with ASD may not have their vestibular problems

acknowledged or reported (Mansour, 2021). Numerous negative effects, including poor posture and vision, delayed fine motor skill development, improper cognitive development and academic performance, and emotional and social behavior, are linked to vestibular dysfunctions (reviewed in Van Hecke et al., 2019). To completely understand how the cerebellum and brainstem are affected in ASD, comprehensive and methodical research on these brain areas is necessary (Mansour, 2021). The positive effects of yoga have been confirmed by several studies, on the vestibular system and its accompanying brain interactions (Narasingharao et al., 2017). In this study, yoga sukshma vyama, asanas help to improve posture and motor skills, breathing exercises, chanting and relaxation improve awareness, develop cognitive and educational performances (Litchke et al., 2018). To completely understand how the cerebellum and brainstem are affected in ASD, comprehensive and methodical research on these brain areas is necessary. However, more systematic and scientific research may be required in order to reach meaningful conclusions.

For the PA group, the outcome showed improvement in VPB was seen, but not significant. There is very little study have been conducted on VPB for children with ASD. The possible explanation of the result may be that PA sessions included exercises (Calisthenics, jumping exercises, balancing and objects management exercises, minor games and relaxation movements) and followed the intervention guidelines of previous research, which are highly effective to activate the vestibular organs & associated systems and responsible brain regions. To know more details further long-term studies may recommend.

From these findings it may be assumed that a regular yoga and physical activity (PA) training program may have almost the same positive effect on reducing VPB in participants with moderate levels of ASD. And the result indicates long-term intervention may produce more positive effects.

4.3.14. Inattentiveness & Restlessness Behavior (IRB)

The collected data, reported by parents, teachers and psychiatrists on Inattentiveness & Restlessness problem behavior (IRPB) of participants with ASD, based on initial test, mid or intermediate test and post-test from yoga group, physical activity group and control group were statistically analyzed using Descriptive statistics (Mean, SD), the Multivariate Analysis of Covariance (MANCOVA) and pairwise comparison with the Bonferroni post-hoc test.

Table-43: Normality and Homogeneity test of pre-test results of Inattentiveness & Restlessness Behavior

Tests of Normality				
	Control, Physical activity and Yoga Group	**Shapiro-Wilk**		
		Statistic	**df**	**p value**
Inattentiveness Response Pre-Test Result	Control Group	.86	8	.13
	Physical Activity Group	.97	8	.89
	Yoga Group	.94	8	.61

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**'p' value**
Inattentiveness behavior Pre-Test Result	Based on Mean	.35	2	21	.71
	Based on Median	.19	2	21	.83
	Based on Median and with adjusted df	.19	2	18.29	.83
	Based on trimmed mean	.34	2	21	.72

P value <0.05 is defined as significant*

The normality of the data on inattentiveness and restlessness problem behavior (PB) was assessed using the **Shapiro-Wilk test.** The data was found to be regularly distributed in all three groups, with "p" values larger than 0.05.

The homogeneity test was conducted using **Levene's test**, and as the "p" value was larger than 0.05, the results indicated that the sample data was homogeneous.

Table-44: Results of One-way MANCOVA with descriptive and adjusted means Inattentiveness & Restlessness Behavior

Group		N	Mean	SD	Box's M			P	df	
Pre-Test	Control Group	8	14.56	2.23	M=8.57, F=1.23			.29	6	10991.08
	Physical Activity Group	8	14.50	2.24	Wilks' Lambda =.23			P	df	
	Yoga Group	8	16.31	1.83	F = 10.49			.00	4	38
	Total	24	15.13	2.19	Partial Eta Squared =.53				Adjusted Mean of DV	
Intermediate test	Control Group	8	9.31	.96	Intermediate Covariance				9.44	.40
	Physical Activity Group	8	12.88	1.19	F	3.59	df =1;20	P = .07	12.49	.41
	Yoga Group	8	12.75	1.34	Post-test Covariance				14.56	.73
	Total	24	11.65	2.02	F	.85	df =1;20	P = .36		
Post Test	Control Group	8	16.38	1.03	Intermediate test				16.48	.73
	Physical Activity Group	8	14.44	2.37	F	23.97	df = 2;20	P = .00*	13.27	.76
	Yoga Group	8	13.50	2.38	Post-test				14.56	.73
	Total	24	14.77	2.29	F	4.59	df = 2;20	P = .02*		

P value <0.05 is defined as significant*

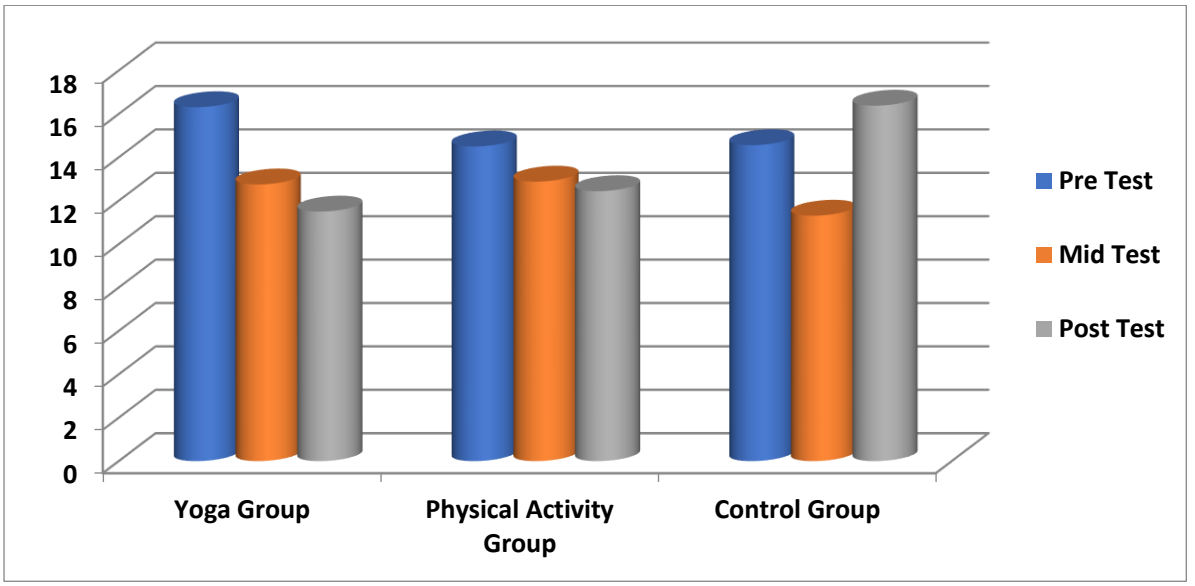


Figure-18: Comparison of means of Inattentiveness & Restlessness PB among two experimental groups (Yoga group and PA group) and one control group of participants with ASD

After completing a regular non-residential yoga and physical activity training program, it was observed that there was a statistically significant difference for the intermediate test **(F=23.97 with df=2,20 and p=0.00*),** or after three months, and also a significant difference for the post test result **(F=4.59 with df=2,20 and p=0.02*),** or after six months, in Inattentiveness & Restlessness Problem Behaviors (IRPB).

Table-45: The pairwise comparison between different groups on Inattentiveness & Restlessness Behavior

Dependent Variable	Group I	Group J	Mean Difference (I-J	Std. Error	Sig.
Pre -Test	**Control Group**	Physical Activity Group	0.75000	.99216	1.000
		Yoga Group	1.31250	.99216	.600
	Physical Activity Group	Yoga Group	0.56250	.99216	1.000
Intermediate test	**Control Group**	Physical Activity Group	-3.58	.55	**.00***
		Yoga Group	-3.06	.59	**.00***
	Physical Activity Group	Yoga Group	.52	.59	1.00
Post -Test	**Control Group**	Physical Activity Group	1.93	1.02	**.01***
		Yoga Group	3.21	1.08	**.02***
	Physical Activity Group	Yoga Group	1.29	1.09	.75

P value <0.05 is defined as significant*

After three months (in the intermediate phase), pairwise comparison revealed a significant difference between the control group and the physical activity group **(Mean Difference=3.58*, Std. Error=.55, p=0.00*)** and between the control group and the yoga group **(Mean Difference=3.06*, Std. Error=1.08, p=0.00*)**. The post-test phase, which took place six months after the interventions, revealed the same patterns. There were significant differences found between the control group and the yoga group **(Mean Difference=3.21*, Std. Error=1.08, p=0.02*)** and between the physical activity group and the control group **(Mean Difference=1.93*, Std. Error=1.02, p=0.01*).**

4.3.14.1. Discussion of findings on Inattentiveness & Restlessness Problem Behavior (IRPB) with possible mechanism

In order to better understand how to manage various problem behaviors in individuals with moderate levels of ASD, this study investigated the efficacy of a six-month non-residential yoga and PA training program. Problem behaviors are one of the primary challenges that children with ASD face, and they have been the focus of a large number of studies. In this work another important problem behavior variable was Inattentiveness & Restlessness Problem Behavior (IRPB).

Inattention and restlessness behavior or hyperactive behavior are very common in ASD and not well understood. It can affect attention spans and communication. Even though not much study has been done in this field, its effect is huge as a problem behavior. The common features of inattention and restlessness behaviors are like problems in paying attention, fails to complete or continue any task, frequently changing activity etc. All these invite a lot of challenges in day-to-day activity of ASD children (Banerjee et al., 2013).

The investigator attempted to examine the efficacy of yoga and PA training for treating IRPB in individuals with ASD in the current investigation. Final results on IRPB were provided by parents, educators, and clinical psychiatrists. They showed that regular organized yoga and physical activity (PA) training significantly reduced the IRPB of children with moderate levels of ASD. After three months of regular yoga and PA training interventions, significant difference among the subjects' groups (Yoga, PA & Control) were found and after six months of training same trend were followed, statistically significant difference among the group were observed.

For the yoga group, reductions in IRPB were observed in intermediate test (i.e., after three months) and in post-test (i.e., after six months) respectively. The possible reason may be regular yoga practices increase parasympathetic activity and decrease sympathetic activity, which has a direct relation with IRPB of children with ASD. It is also found that yoga provides a calm, noiseless and therapeutic environment, which encourages internal calmness in the senses and builds a hassle-free internal stability in the thought process (Rosenblatt et al., 2011). Another cause may be that yoga practices expand internal sensory connections and improve focuses, that may reduce irritability and frustration in people (Koeing et al., 2012). Because of that, the IRPB may decrease. Yoga also provides better comfort in different social settings, improves relaxation time (Radhakrishna et al., 2010), reduces sedentary behavior and significantly helps to manage hyperactivity, develop better control over own body & mind and improves quality of life

(Litchke et al., 2018). All these developments may bring a reduction in IRPB of participants with moderate level of ASD.

The study results also showed that PA intervention is highly effective in managing IRPB in children with moderate levels of ASD. The result of the PA group has shown statistically significant improvement in SIBPB in intermediate and post-test (after three and six months). An almost similar result was found by Bahrami et al., 2012. The possible explanation of this outcome may be that exercise can bring reduction in discomfort, aggression, lethargy, social withdrawal and non-compliance (Marzouki, 2022). The PA sessions provided goal oriented, focused, interactive, and dynamic training to participants with ASD (Lee, Vargo & Parretta et al., 2018). The PA also reduces co-morbidities with regard to neuromuscular functions, and helps to manage over-sensitivity to different sensory stimuluses (Bahrami et al., 2012).

From these findings it may be assumed that a regular yoga and physical activity (PA) training program may have almost the same significant positive effect on lessening of IRPB in participants with moderate levels of ASD. And the result indicates long-term intervention may produce more positive and effective outcomes. Though to draw a firmer conclusion, further studies are recommended.

4.3.15. Odd Sexual Behaviors (OSB)

The data on Odd Sexual Behavior Problem Behavior (OSBPB) of participants with moderate levels of ASD were gathered and reported by parents, teachers, and psychiatrists. The data was based on initial, mid-, and post-test results from yoga, physical activity, and control groups. Descriptive statistics (Mean, SD), the Multivariate Analysis of Covariance (MANCOVA), and pairwise comparison with the Bonferroni post-hoc test was employed in the statistical analysis.

Table-46: Normality and Homogeneity test of pre-test results of Odd Sexual Behaviors

Tests of Normality				
	Control, Physical activity and Yoga Group	**Shapiro-Wilk**		
		Statistic	**df**	**p value**
Odd Sexual Behaviours Response Pre-Test Result	Control Group	.88	8	.18
	Physical Activity Group	.88	8	.20
	Yoga Group	.96	8	.83

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**'p' value**
Odd Sexual Behavior Response Pre-Test Result	Based on Mean	.52	2	21	.60
	Based on Median	.51	2	21	.61
	Based on Median and with adjusted df	.51	2	20.29	.61
	Based on trimmed mean	.54	2	21	.59

P value <0.05 is defined as significant*

The data gathered on unusual sexual practices and problem behavior (PB) was examined for normalcy using **the Shapiro-Wilk test**. It was found that the data was normally distributed for all three groups, with "p" values greater than 0.05.

The homogeneity test was conducted using **Levene's test**, and as the "p" value was greater than 0.05, the results indicated that the sample data was homogeneous.

Table-47: Results of One-way MANCOVA with descriptive and adjusted means Odd Sexual Behaviors

Group		**N**	**Mean**	**SD**	**Box's M**			**p**	**df**	
Pre-Test	**Control Group**	8	3.50	1.56	**M=18.01, F= 2.59**			**.02**	**6**	**10991.08**
	Physical Activity Group	8	3.31	1.33	**Wilks' Lambda =.85**			**P**	**df**	
	Yoga Group	8	5.06	1.78	**F = .82**			**.52**	**4**	**38**
	Total	24	3.96	1.70	**Partial Eta Squared = .08**				**Adjusted Mean of DV**	
Intermediate test	**Control Group**	8	3.31	.53	**Intermediate Covariance**				3.43	.32
	Physical Activity Group	8	3.00	1.10	**F**	**4.17**	**df =1;20**	**P =.05**	2.72	.34
	Yoga Group	8	3.00	1.10	**Post-test Covariance**				2.78	.27
	Total	24	3.10	.92	**F**	**5.64**	**df =1;20**	**P = .03**		
Post Test	**Control Group**	8	2.75	.38	**Intermediate test**				2.86	.27
	Physical Activity Group	8	2.63	1.06	**F**	**1.07**	**df = 2;20**	**P = .36**	2.29	.29
	Yoga Group	8	2.56	.86	**Post-test**				2.78	.27
	Total	24	2.65	.79	**F**	**1.09**	**df = 2;20**	**P = .35**		

P value <0.05 is defined as significant*

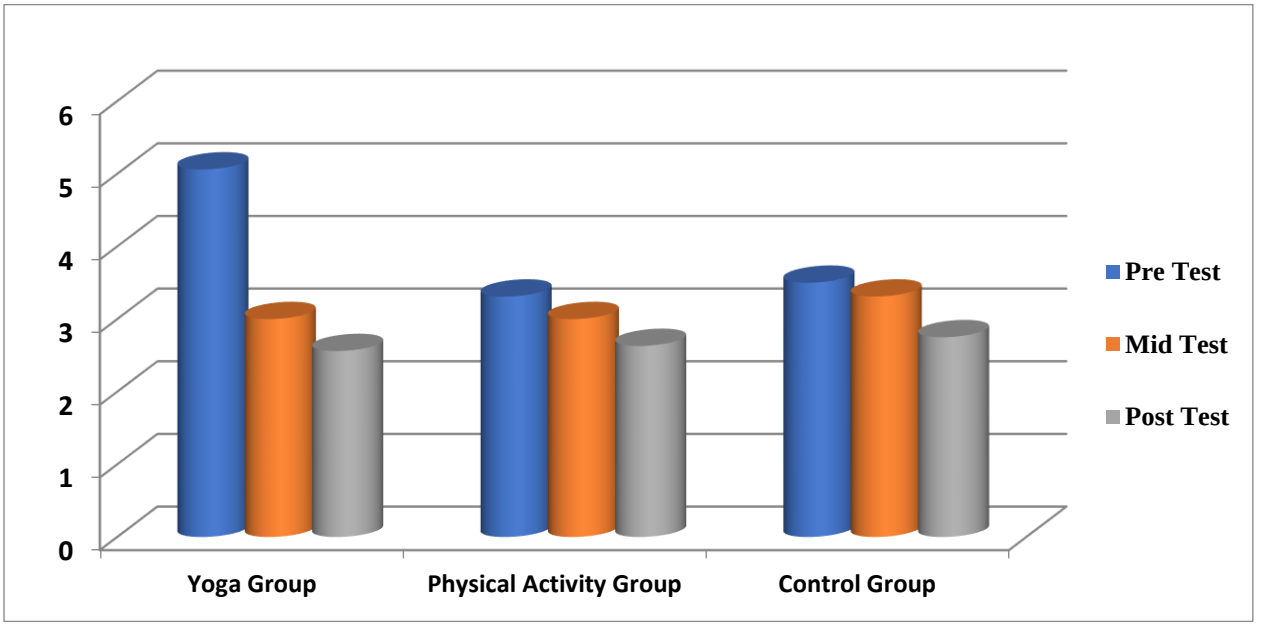


Figure-19: Comparison of means of Odd sexual behaviors PB among two experimental groups (Yoga group and PA group) and one control group of participants with ASD

The results of the one-way MANCOVA in Odd Sexual behavior showed that there was no significant difference between the individuals for the intermediate test (F=.53 with df=2;20 and p=0.60) and post-test (F=1.54 with df=2;20 and p=0.24) following six months of yoga and physical exercise training.

4.3.14.1. Discussion on findings of Odd Sexual behavior problem behavior (OSBPB) with possible mechanism

In order to better understand how to address various problem behaviors in people with mild ASD, the study looked at the effectiveness of a six-month non-residential yoga and PA training program. Problem behaviors are one of the major issues that children with ASD face, and they have been the focus of most studies. In this work another important problem behavior variable was Odd Sexual behavior problem behaviors (OSBPB).

The topic of sexuality and ASD is under studied. Though many study outcomes made it clear from parents and caregiver reports that individual with ASD individual are aware and interested in sexuality issues. According to Beddows and Brooks (2016), children and adolescents diagnosed with ASD may exhibit improper sexual conduct due to a lack of understanding of their physical and mental development, despite feeling the urge for sexual

activity. Public masturbation, improper love gestures, inappropriate arousal, and exhibitionism are examples of these behaviors (Banerjee et al., 2013).

For this study, the structured yoga and PA program was a separate intervention and implemented as CAM therapy to reduce different problem behaviors of participants with ASD. Final OSBPB results from parents, educators, and clinical psychiatrists show that frequent organized yoga and physical activity (PA) instruction helps reduce OSBPB in children with moderate levels of ASD. After three months of regular yoga and PA training interventions, no significant difference among the subjects' groups (Yoga, PA & Control) were found, and same trend were followed after six months of training statistically no significant difference among the group were observed.

The study's findings showed that although there was no statistically significant difference between the groups, the mean value of OSBPB improved in the intermediate and post-tests. It is believed that the severity of the ASD, inadequate sex education, ignorance of typical puberty, and other related issues are the causes of OSBPB. ASD children born with social disability. Social skills development is also important for autistic children to be aware of odd sexuality (Beddows & Brooks, 2016). Yoga & PA provides better comfort in different social settings and improves the social quality of life (Narasingharao et al., 2017; Li et al., 2023). The possible explanation may be that yoga provides a calm, noiseless and therapeutic environment, which encourages internal calmness in the senses and builds a hassle-free internal stability in the thought process (Rosenblatt et al., 2011), which leads to improvement in deeper social understandings (Koeing et al., 2012). The ASD children live a sedentary life, which ignite different unproductive behaviors. Yoga and PA help to reduce sedentary behaviors and increase participation in social activities (Litchke et al., 2018). All these developments may reduce OSBPB in ASD children, though further studies are needed to develop more comprehensive understandings.

From these findings it may be assumed that a regular yoga and physical activity (PA) training program may have almost the same significant positive effect on lessening of OSBPB in participants with moderate levels of ASD. And the result indicates long-term interventions may produce more positive and effective outcomes.

4.3.16. Total Problem Behavior score

Total problem behavior Score (TPB) data collected from parents, teachers, and psychiatrists were analyzed statistically using descriptive statistics (Mean, SD), the Multivariate Analysis of Covariance (MANCOVA), and pairwise comparison with the Bonferroni post-hoc test. The data was based on initial, mid-, or intermediate, and post-tests from yoga, physical activity, and control groups.

Table 48: Normality and Homogeneity test of pre-test results of Total Problem Behavior score

Tests of Normality				
	Control, Physical activity and Yoga Group	**Shapiro-Wilk**		
		Statistic	**df**	**p value**
Total Problem Behaviours Response Pre-Test Result	Control Group	.94	8	.64
	Physical Activity Group	.95	8	.70
	Yoga Group	.97	8	.87

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**'p' value**
Total Problem Behavior Response	Based on Mean	2.04	2	21	.16
	Based on Median	2.03	2	21	.16
	Based on Median and with adjusted df	2.03	2	16.64	.16
	Based on trimmed mean	2.04	2	21	.16

P value <0.05 is defined as significant*

The normality of the data gathered on the Total Problem Behavior (TPB) score was assessed using the **Shapiro-Wilk test.** The "p" values for each of the three groups were found to be more than 0.05, suggesting that the data was normally distributed.

The homogeneity test was conducted using **Levene's test**, and the findings indicated that the sample data was homogeneous since the "p" value was greater than 0.05.

Table-49: Results of One-way MANCOVA with descriptive and adjusted means of Total Problem Behavior Score

Group		N	Mean	SD	Box's M			P	df	
Pre Test	Control Group	8	123.13	10.96	M=59.42, F=8.54			.00	6	10991.08
	Physical Activity Group	8	127.56	8.69	Wilks' Lambda =.26			P	df	
	Yoga Group	8	154.75	17.62	F = 9.13			.00	4	38
	Total	24	135.15	18.92	Partial Eta Squared = .49				Adjusted Mean of DV	
Intermediate test	Control Group	8	137.44	5.65	Intermediate Covariance				138.93	4.05
	Physical Activity Group	8	125.13	9.93	F	.55	df =1;20	P =.46	131.69	4.79
	Yoga Group	8	134.13	12.55	Post-test Covariance				108.45	3.39
	Total	24	132.23	10.77	F	.37	df =1;20	P = .55		
Post Test	Control Group	8	137.50	5.55	Intermediate test				138.60	3.68
	Physical Activity Group	8	107.75	10.98	F	3.31	df = 2;20	P =.05*	102.52	4.36
	Yoga Group	8	104.31	9.26	Post-test				108.45	3.39
	Total	24	116.52	17.43	F	25.80	df = 2,20	P =.00*		

P value <0.05 is defined as significant

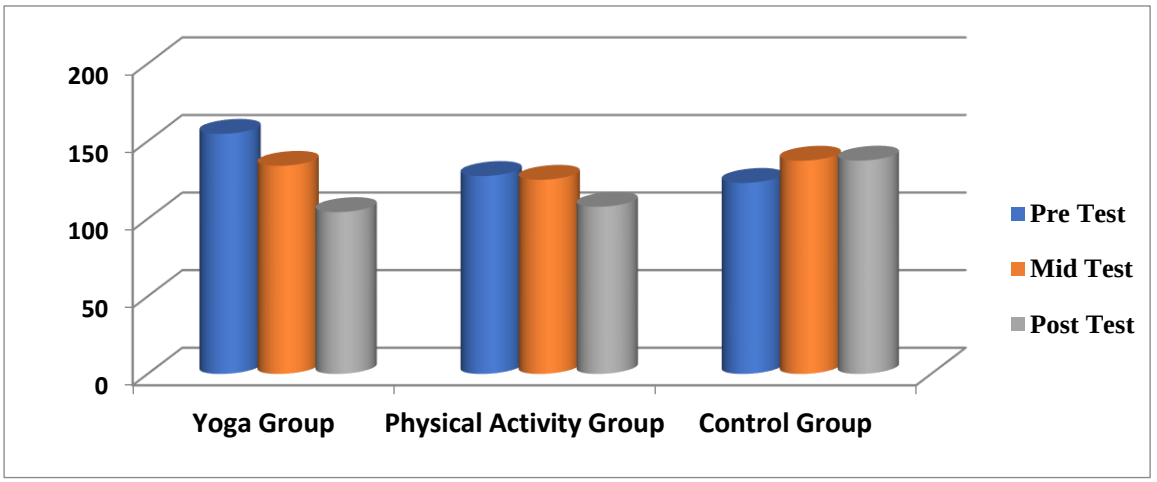


Figure 20: Comparison of means of Total PB among two experimental groups (Yoga group and PA group) and one control group of participants with ASD

The results of the Total Problem Behavior (TPB) study showed that, following six months of consistent non-residential yoga and physical activity practice, there was a statistically significant difference for the intermediate test (F=3.31 with df=2,20 and p=0.05*), which measured the progress after three months, and a significant difference for the post test (F=25.80 with df=2,20 and p=0.00*), which measured the progress after six months.

Table-50: The pairwise comparison between different groups on Total Problem Behavior score

Dependent Variable	Group- I	Group- J	Mean Difference (I-J)	Std. Error	Sig.
Pre -Test	**Control Group**	Physical Activity Group	**0.75000**	**.99216**	**1.000**
		Yoga Group	**1.31250**	**.99216**	**.600**
	Physical Activity Group	Yoga Group	**0.56250**	**.99216**	**1.000**
Intermediate test	**Control Group**	Physical Activity Group	**12.86**	**5.01**	**.05***
		Yoga Group	**7.23**	**7.23**	**.99**
	Physical Activity Group	Yoga Group	**-5.63**	**6.71**	**1.00**
Post -Test	**Control Group**	Physical Activity Group	**30.16**	**4.57**	**.00***
		Yoga Group	**36.09**	**6.59**	**.00***
	Physical Activity Group	Yoga Group	**5.93**	**6.12**	**1.00**

P value <0.05 is defined as significant*

The pairwise comparison revealed significant differences between the control group and the physical activity group in the intermediate test phase (after three months) **(Mean Difference=12.86*, Std. Error=5.01, p=0.05*).** After six months of training (during the post-test phase), significant differences were found between the control group and the physical activity group (Mean Difference=30.16*, Std. Error=4.57, p=0.00*) and between the control group and the yoga group **(Mean Difference=36.09*, Std. Error=6.59, p=0.00*).**

4.3.16.1. Discussion on findings of Total problem behavior (TPB) with possible mechanism

The aim of the current study was to study the efficacy of six months non-residential structured yoga and PA training program in treating different problem behaviors (PB) of participants with moderate level of ASD. The majority of research has focused on problem behaviors, which are thought to be one of the main difficulties faced by kids with ASD. For this study variable no. 16 was Total Problem Behavior (TPB) score. It is nothing but cumulative scores of all 15 problem behavior variables selected for this study. These 15 problem behavior items were: 1. Auditory PB, 2. Tactile PB, 3. Gustatory-Olfactory PB, 4. Social PB, 5. Temper tantrums PB, 6. Physical harm towards others PB, 7. Odd Behavior PB, 8. Self-injurious

behaviors PB, 9. Unusual fears PB, 10. Disobedience PB, 11. Repetitive behavior PB, 12 Speech PB, 13. Vestibular PB, 14. Inattentiveness and restlessness PB and 15. Odd sexual behavior PB. (Banerjee et al., 2013).

The final result on PB, reported by parents, class teachers and clinical psychiatrists, reveals that regular structured yoga and physical activity (PA) training is significantly effective in decreasing PB of participants with moderate level of ASD. After three months (in intermediate test) of regular yoga and PA training interventions, significant differences among the subjects' groups (Yoga, PA & Control) were found. And after six months (in post-test) of training interventions, the same trend was followed and statistically significant differences between the groups were noticed.

The challenging or problem behaviors pose significant problems for individuals with ASD. participants with moderate levels of ASD were chosen as the study's targeted sample group, and the results indicated that yoga is a useful complementary and alternative medicine (CAM) treatment for reducing and managing problem behaviors in special education settings. Earlier, Narasingharao et al., 2017 studied ASD individual and found almost similar results. From the reports of parents, class teachers of school and clinical psychiatrists, it was seen that yoga has significantly decreased PB in home, school and other environments. The possible explanation may be yogic practices (prayer, sukhsma vyama, asanas, pranayamas, chanting and relaxation meditation) provide a calm, noiseless and therapeutic environment, which encourages internal calmness in the senses and builds a hassle-free internal stability in the thought process (Rosenblatt et al., 2011). Various studies have shown yoga induced relaxation response, sound sleep, coordinated motor proficiency, awareness (gross & subtle), calmness, behavioral confidence, better group tolerance, better emotional expressivity and better response to instructions (Radhakrishna et al., 2010; Koeing et al., 2012). Yoga also provides better comfort in different social settings, improves relaxation time (Radhakrishna et al., 2010, Kaur & Bhatt, 2019), reduces sedentary behavior and significantly helps to manage hyperactivity, develops better control over own body and mind (Litchke et al., 2018). All these developments may bring significant reduction in PB of ASD children. These positive developments in participants contribute a lot to improving brain functions, addressing frontal lobe deficits for optimal state of calmness, cooperations and voluntary response in children with ASD (Ramanathan et al., 2019).

Another possible reason may be that yoga improves the quality of life, but it takes time to reshape the whole physical, physiological and psychological structure of an individual. It is also a proved and established fact that yoga may increase in parasympathetic activity reflected by the vagal nerve (Artchoudane et al., 2019). And ASD is a complex neurodevelopmental abnormality started in the womb, so it may need more long-term interventions (Narasingharao et al., 2017).

This study's findings also suggested that a physical exercise regimen is a beneficial complementary and alternative medicine (CAM) intervention for reducing and managing problematic behaviors in special education environments. Similar study findings have been found by Gabriels et al., 2012; Bahrami et al., 2012. The possible explanation for these effective results may be that PA develops cognitive, perceptive and motor processing, through activating muscles and other organs of the body (Lee et al., 2018). It is also reported that different types of muscular contractions (isometric, isotonic) can improve brain speed and central processing ability of individual with ASD (Tse et al., 2018). Exercises also improve reaction time, a fundamental contributor to information processing through various central and peripheral neural pathways (Gabriels et al., 2012). Another explanation may be that PA improves focus, concentration and relaxation in ASD (Pan, 2010). It may be happening that participants with ASD use different physical activities as alternative options for language and verbal communications (Bahrami et al., 2012). Exercises have so many possibilities, such as it gives comfortable sensory stimulations, reduces destruction & aggression, improves imitation skills & attention span, improves bilateral coordination, develops good peer relationships, decreases inappropriate vocalization and self-injurious behavior of participants with ASD.

From these findings it may be assumed that a regular yoga and physical activity (PA) training program may have almost the same significant positive effect on reducing different PB of participants with moderate levels of ASD. And the result indicates long-term intervention may produce better outcomes.

4.4. Testing of hypothesis

Considering the significant differences in problem behaviors observed between the aforementioned groups, the hypothesis from the introductory chapter that there would be significant differences between the mid-test and post-test results from a six-month non-residential yogic practice intervention on problem behavioral patterns in children with autism spectrum disorders is ACCEPTED.

Another hypothesis was that there would be notable differences in problem behaviors between the aforementioned groups at the mid-test and post-test resulting from a six-month non-residential physical activity intervention on the behavioral patterns of children with autism spectrum disorders. This hypothesis was ACCEPTED.

The hypothesis that there would be no significant differences between the effects of a six-month yoga and physical activity intervention on problem behavioral patterns in children with autism spectrum disorders was also ACCEPTED, as there were no discernible differences between the two interventions' effects on problem behaviors in the aforementioned groups.

Chapter V

Summery, Conclusions and Recommendation

5.1. Summary

5.2. Conclusions

5.3. Application of the study

5.4. Strength of the study

5.5. Limitation of the study

5.6. Suggestions for future study

Chapter V

Summery, Conclusions and Recommendation

5.1. Summary

Yoga and physical activities are getting huge popularity as a complementary and alternative medicine. The outcomes of an organized yoga and exercise program on problem behaviors (Auditory problem behavior, Tactile PB, Gustatory-Olfactory PB, Social PB, Temper tantrum PB, Physical harm towards other PB, Odd behavior PB, Self-Injurious behavior PB, Unusual fear PB, Disobedience PB, Repetitive behavior PB, Speech PB, Vestibular PB, Inattentiveness PB, Odd sexual behavior PB, Total problem behavior) of participants with ASD was studied in two experimental groups (Yoga group and Physical activity group) and one Control group. It was a randomized control study, conducted in a special school setup in Kolkata, West Bengal, India. Twenty-four (n=24) subjects with moderate ASD whose parents agreed to participate in the study were assigned in two experimental groups (the yoga group and the physical activity group). These groups received yoga and physical activity interventions for six months, while the control group did not receive any of these interventions. The admission record of the school indicates that the subjects had moderate levels of ASD. The yoga intervention consisted of a six (6) month regular non-residential yoga program comprising prayer, loosening exercises, asanas, pranayamas/breathing exercises and chanting. And the physical activity intervention for six (6) months comprises warming up & stretching exercises, calisthenics, jumping, balancing, object controlling exercises, minor game and cooling down movement practices. The control group received special school curriculum activities and training.

The results of the study showed six months of regular structured yoga and physical activity training program in a special school environment significantly decreased problem behaviors of participants with moderate level of ASD. There was significant decrease in problem behavior characteristics in the yoga group (Self-injurious PB, Repetitive PB and Inattentiveness PB) in the mid-test (after three months) followed further by a significant reduction in most of the PB parameters (Auditory PB, Tactile PB, Social PB, Self-injurious PB, Unusual fear PB, Disobedience PB, Repetitive PB, Inattentiveness PB and Total problem behaviors) by the end of yoga intervention in the post-test (after six months). For physical activity group, also saw a substantial decrease in PB parameters (Self-injurious PB, Unusual fear PB, Inattentiveness PB and

Total problem behavior) in mid-session (after three months) followed further by a significant reduction in most of the PB parameters (Auditory PB, Social PB, Self-injurious PB, Unusual fear PB, Disobedience PB, Repetitive PB, Inattentiveness PB and total problem behaviors) of participant with moderate level of ASD, at the end of physical activity intervention in post-test (after six months). In the control group no appreciable improvement in any of the PB was observed. in the control group. Yoga and physical activity intervention are both effective tools for the holistic management of problem behaviors, overall health and well-being of children with moderate levels of ASD. There were no significant changes in any of the problem behaviors parameters in the control group.

5.2. Conclusions

Based on the experimental situation in this investigation, the following findings were made, taking limitation and delimitation into account.

- The current study showed that after three months of a regular non-residential structured yoga program in special school contributed to a significant reduction in problem behaviors, such as Self-injurious PB, Repetitive PB and Inattentiveness PB in children with moderate levels of ASD.
- The study also found that after six months of regular non-residential structured yoga program in special school contributed to a significant reduction in problem behaviors; such as Auditory PB, Tactile PB, Social PB, Self-injurious PB, Unusual fear PB, Disobedience PB, Repetitive PB, Inattentiveness PB and Total problem behaviors of children with moderate level of ASD.
- After three months of a regular non-residential structured physical activity (PA) program in special school contributed to a significant reduction in problem behaviors, such as Self-injurious PB, Unusual fear PB, Inattentiveness PB and Total problem behavior of children with moderate level of ASD.
- Other findings of the study were that after six months of regular non-residential structured physical activity program in special school contributed to a significant reduction in problem behaviors; such as Auditory PB, Social PB, Self-injurious PB, Unusual fear PB, Disobedience PB, Repetitive PB, Inattentiveness PB and total problem behaviors of children with moderate level of ASD.

- The current study also revealed that regular yoga and physical exercises are both equally highly effective for reducing and the management of different problem behaviors of children with moderate levels of ASD.

5.3. Application of the study

The study showed the path that the short modules of yoga and physical activity program applied in this study can be easily incorporated into the busy time schedule of a special school. The yoga and PA modules were very compact for a special school and comprised of a mix of repetitive and new innovative practices that supported the needs and preferences of the individual with a moderate level of ASD. The training modules used in the study were very fit for a small space of a special school and with a minimum requirement of equipment. The yoga and PA practices include simple practices that children at various levels of functioning can perform. Consistent and regular implementation of these yoga and PA modules can decrease parental support for different activity of children with levels of ASD. In order to help students with ASD improve their general health and well-being, special schools can incorporate regular yoga and PA activities. The study findings would be helpful to special education teachers, physical education & yoga practitioners and caregivers of children with ASD. A regular participation in yoga and PA training can regulate problem behaviors, permitting children to be better involved in classroom activities.

5.4. Strength of the study

The current study was a unique one, as the participating target group for this study was the moderate level of children with ASD (diagnosed with ISAA) and showed their high level of participation and performance response in yoga and PA training program. Furthermore, to the best of the investigator's knowledge, there was little or no yoga and PA research work on moderate level children with ASD being conducted. This was possibly the first one in West Bengal and in the Eastern region of India. The study applied intervention for six months with a control group. Another strength of the study was that a short and compact, incorporated daily yoga and PA module was developed for a special school. From the literature context, very little study on yoga and PA on problem behaviors and the moderate level of ASD children were conducted, so the study will contribute to empowering limited existing literature. The study also collected data on problem behavior response from ASD participants by parents, school teachers' and clinical psychologists, which was also a unique and innovative approach used in this study to collect exact

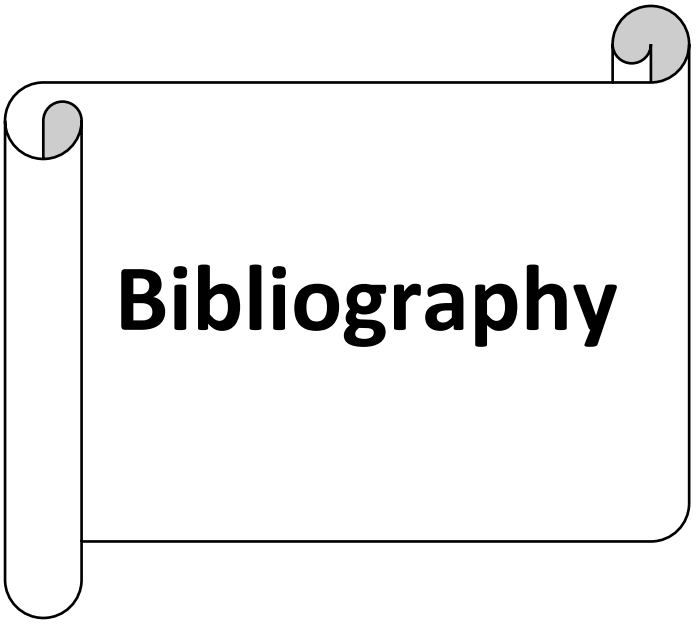
responses. The mid-point data was also taken. The yoga and PA modules used in this study may provide comprehensive knowledge for the formation of yoga and PA teachers' training curriculum to teach yoga and PA to children with different levels of ASD.

5.5. Limitation of the study

The study's findings demonstrated the substantial benefits of yoga and the PA program in reducing problem behaviors in children with moderate levels of ASD. Despite the positive results, there are certain issues to consider. The small sample size was a limitation for this study. Participants' individual differences or uniqueness (such as IQ, adaptation ability), variation in yoga and PA sessions attended, and the duration of interventions was short. The knowledge, understanding and perception ability of assessors (parents, school teachers and clinical psychologists) was different about ASD and problem behaviors. The pre-mid-post-test assessments were done by different teachers and psychologists. If it was the same, then the result would have been more accurate and understandable. There was no information acquired on how the therapies affected their academic and functional assessments in special schools. Assessment procedure of problem behaviors were by subjective, objective assessments may produce more accurate and reliable outcomes. A wide range of responses to yoga and PA interventions were observed.

5.6. Suggestions for future study

- The area of research in ASD is extremely promising and needs consistent efforts. The same yoga and PA interventional programme should be implemented for larger samples with control groups.
- A combination of quantitative and qualitative assessments of developmental aspects should be indulged in future study to better understand the effectiveness of yoga and PA on problem behaviors.
- The research with objective assessment should be integrated into future study.
- Future studies may be conducted with longer experimentation, to investigate the relationship between yoga and PA intervention participation for autism severity.
- Research on the effects of yoga and PA over extended intervention periods on the motor skills of children with ASD can be conducted in the future.
- To evaluate the sustainability of convenience through yoga and PA intervention.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Appendices

Appendix-1 Successfully completed PhD course work

Appendix-2 Anti plagiarism certificate

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Appendix-15 Workshop participation

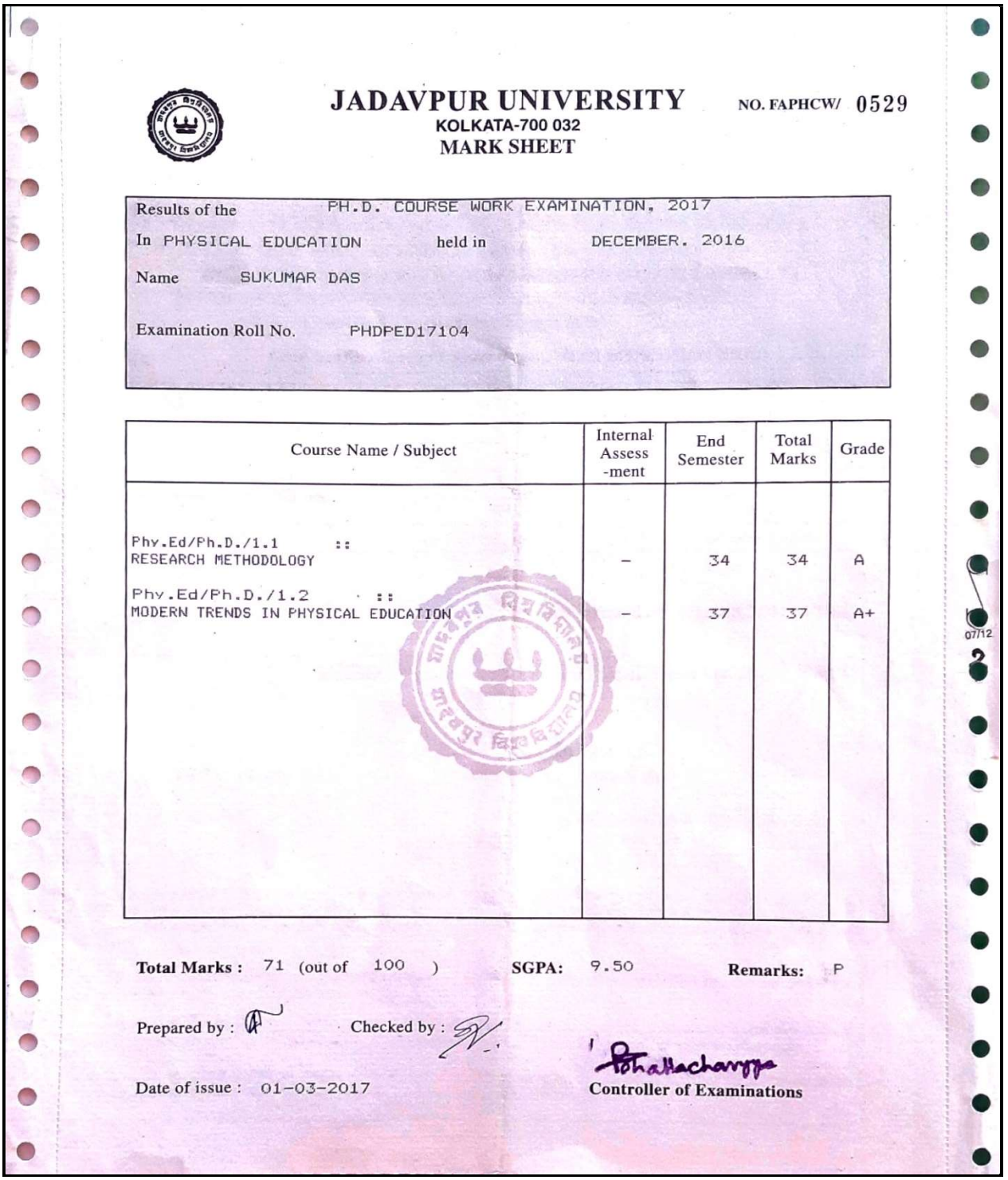
Appendix-16 Yoga certificate course from Kaivalyadham, Lonavla

Appendix-17 Successfully qualified QCI in yoga from AYUSH Govt. of India

Appendix-18 M.A in Yoga from J.V.B.U Rajasthan

Appendix-1

Successfully completed PhD course work



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MARK SHEET

Results of the PH.D. COURSE WORK EXAMINATION, 2017

In PHYSICAL EDUCATION held in DECEMBER, 2016

Name SUKUMAR DAS

Examination Roll No. PHDPED17104

Course Name / Subject	Internal Assess -ment	End Semester	Total Marks	Grade
Phy.Ed/Ph.D./1.1 :: RESEARCH METHODOLOGY	–	34	34	A
Phy.Ed/Ph.D./1.2 :: MODERN TRENDS IN PHYSICAL EDUCATION	–	37	37	A+

Total Marks : 71 (out of 100) **SGPA:** 9.50 **Remarks:** P

Prepared by : Checked by :

Date of issue : 01-03-2017

Controller of Examinations

Appendix-2

Anti-plagiarism certificate

EFFECTS OF YOGIC PRACTICES AND PHYSICAL ACTIVITIES ON CHILDREN WITH AUTISM SPECTRUM DISORDERS

ORIGINALITY REPORT

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Appendix-3

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IJDR

International Journal of Development Research
Vol. 13, Issue, 11, pp. 64254-64257, November, 2023
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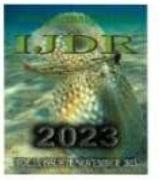

RESEARCH ARTICLE OPEN ACCESS

THE EFFECTS OF PHYSICAL ACTIVITIES ON SELECTED PROBLEM BEHAVIORS OF CHILDREN WITH AUTISM SPECTRUM DISORDERS

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ABSTRACT

The purpose of this present study was to investigate the effects of physical activities on selected problem behaviors of children with autism spectrum disorders. The study assigned twenty school aged children with Autism Spectrum Disorder from a special school andwere randomly divided into physical activity group (n=10) and control groups (n=10). A total sixteen participants were completed the study with regularity. For the experimental group structured physical activity interventions were implemented for 12 weeks with the regular scheduled program, while participants of control group received their regular special school activities and interventions only without any physical exercises. The assessments on selected problem behaviors of Autism Spectrum Disorder participants were done at baseline and post-intervention (after 12 weeks). Results of the study revealed that regular physical activity participation for 12 weeks decreasedselected problem behaviors of children with Autism Spectrum Disorder but that were not significant.

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INTRODUCTION

Autism Spectrum Disorder (ASD) is generally defined as a common and complex neurodevelopmental disorder. The last few decades have witnessed a dramatic global increase in prevalence and awareness of ASD. An estimated 1 in 68 school-aged children have been identified as having ASD (Christensen *et al*., 2016) and recently it was 1 in 54 children diagnosed with ASD (Centre for Disease Control and Prevention (CDC), 2023). In India, the prevalence rate of ASD is increasing and it was reported higher percentage in urban population (0.11) than the percentage of the rural population (0.09) with an estimated number of around 1.7-2 million children (Chauhan *et al*., 2019; Mahapatra *et al*., 2019). However, India still lacks an accurate estimation of the prevalence of autism due to the lack of standardized tests for ASD encompassing its intrinsic cultural diversity and multilinguistic population (Rudra *et al*., 2017). Despite such challenges, the current scenario in India has been witnessing an increased prevalence of ASD as the most common developmental disorder in children (Juneja & Sairam, 2018). Autism Spectrum Disorder (ASD) is a group of complex neurodevelopmental disorders or impairments, it ranging from moderate to severe varying degrees of impairments. These impairments are social communication and interaction, expressive and receptive communication, restricted and repetitive behavior, self-injurious behavior and different problem behaviors (APA, 2022). The symptoms of ASD vary a lot from individual to individual but it usually manifests in children as early as eighteen months, where the characteristic features differ from typical development and various other developmental conditions (Zeidan *et al*., 2022). Children with ASD commonly experience various emotional and behavioral problems, generally indicated as 'problem behaviors'. Such problem behaviors include internalizing and externalizing behaviors such as physical aggression, self-injury, inattention, hyperactivity, anxiety, depression, withdrawal, unusual response of different external stimulus and self-stimulatory behaviors such as hand flapping, rocking, and spinning (Lindor *et al*., 2019; Williams *et al*., 2018). Exhibition of temper tantrums, impulsiveness, and non -compliance is also seen frequently in children with ASD with either motoric or vocal expressions of frustration, anger, and extreme distress. Such problem behaviors interfere with children's optimal development, functioning, social interactions, and relationships (McGuire, 2016). The exact causes of ASD are unknown. However, various genetic and non-genetic factors, by themselves or in combination, are considered risk factors for the development of ASD. The etiology of ASD can be multifactorial, with genetic and non-genetic factors. Children with ASD exhibits different unique needs, strengths and challenges. Due to challenges, comorbidities, heterogeneity and for fulfilling specific demands and needs of ASD children, several interventions are coming up to provide the unequal needs of this autism population (Hyman *et al*., 2020). The interventions for children with ASD fall into many categories: Behavioral, Developmental, Social relational, Psychological, Educational, Pharmacological, and Complementary and Alternative (CAM), each encompassing multiple outcomes that

can overlap across domains (Hyman *et al*., 2020). These CAM therapies are art, music, yoga, physical exercise, dance and acupuncture etc. are emerging as promising interventions for children with ASD (Brondino *et al*., 2015). Physical activity plays a vital role in people's life from many aspects, especially important for children because it not only improve their physical condition, but also their self-esteem, social skill, and behaviorand establish a positive health and lifestyle for their future lifespan. Physical exercise is defined as a subset of physical activity that is planned, structured, and repetitive; has a final or an intermediate objective; and involves the improvement or maintenance of physical fitness and overall health. The beneficial effects of physical activity intervention on children with ASD have garnered a lot of interest over the last decade. At present it is found that little evidencesare available on the utilization of structured physical activity program for problem behavior of children with ASD; a few studies had conducted in India and there is very less studies or possibly hardly any study available in West Bengal. Therefore, this study was planned to investigate the effects of structured physical activity on selected problem behaviors of children with ASD.

MATERIALS AND METHODS

Participants

As per understandability of the children/adolescents, the motivation, interest and availability of the parents, 20 children already diagnosed from Pradip Center for Autism Management, Kolkata, West Bengal, India, were selected as samples for this studyand randomly divided into experimental (n=10) and control groups (n=10). The diagnosis of autism spectrum disorders (ASD) was confirmed by using the Indian Scale for Assessment of Autism (ISAA). The children with moderate level of ASD were selected as sample for this study. So, the purposive sampling method was used and as it is a study on behavior so, both male and female children were included in the sample. The chronological age of the subjects was 8 to 14 years, and the mental age of the samples were not considered for this study. The children who had a minimum of one year of special school education were selected as a sample only. A total of sixteen participants (n=16) completed the study. The demographic variables between the experimental group and control group were listed in Table 1.

Research design and procedures

A randomized controlled pre-post experimental design was employed for this study. The aim of the study was to explore the effect of physical activity intervention program on problem behaviors of children with ASD. The experimental group and control group were attending their regular classes in special school's curriculum. Simultaneously, Physical activity group attended the physical activity intervention program for 3 months; 36 exercise sessions; 3 alternative days in a week; each session was 45-60 minutes; approx. 3 hours per week. All sessions were conducted in an empty hall room of Pradip Center for Autism Management, Kolkata, West Bengal, India. The control group followed their regular institutional classes and other school activities only.

Physical activity intervention program

For implementation of PA intervention program, a one-on-one method was applied. The structured physical exercise modules were designed to address the special needs of the children with ASD, keeping in mind their strengths, limitations, and contraindications. Each physical activity session included four phases; A. Preparatory phase, B. Specific activity phase, C. Minor game phase and D. Cooling down phase. Details of PA intervention program have mentioned in table 2.

Data collection and analysis

The problem behavior of the ASD participants was assessed by Problem Behavior Checklist, which is a standardized questionnaire consisted with 15 items and a total 52 questions with 5 points rating scale. The assessments for this study were done by parents of the ASD children, class teachers of the special school (Pradip: Center for Autism Management) and two Clinical psychologists. The final scoreswere done by making an average from these three scores, obtained by these three assessors. The average scores were considered as final data for analysis for this study.To make the data more accurate, authentic and reliable, the average scores were taken.For comparative analysis of the data on behavior variable the independent two tailed t-test were applied and the significance level significance level was set at 0.05 ($P<0.05$).

Table 1.The demographic details of participants having moderate level of ASD

Variables	Experimental group (n=10)	Control group (n=10)
Age (Mean, SD)	9.5(.92)	10.1(2.2)
Gender (male/female)	5/3	5/3
Level of autism	Moderate level of ASD	Moderate level of ASD

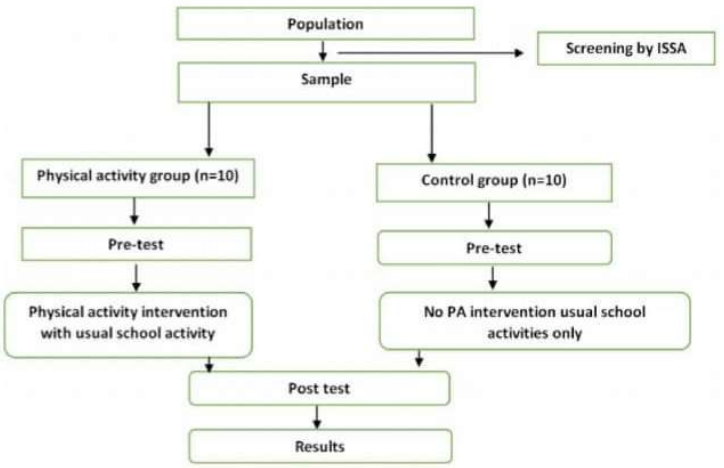

Figure 1. Experimental design

Table 2. Physical activity intervention program

Preparatory Phase		Specific Activity Phase				Minor Game Phase	Cooling Down Phase
Warm-up activity	Stretching activity	Calisthenics/apparatus drills	Jumping exercise	Balancing exercise	Objects/Ball holding exercise	Single /Group games	Relaxation movements
5-15 Minutes		20-30 Minutes				5-10 Mins	3-5 Mins
a.Walking b.Jogging c.Running	a.Bending b.Twisting c.Rotating e.Pulling f.Pushing exercises	2-count, 4-count, 8-count exercise. (Free hand and with apparatus)	a.Hopping (single & both leg) b. Jumping while body in motion.	a.Hurdle step over b.Bear crawls c.Knee bend standing	Carrying ball and other object (by single &both hands)	a. Single games with balls. b.Peer group games c.Games with music	a. Light Walking movements. b. Light Sitting movements c. Light Lying movements (Supination/Pronation)

Table 3. Comparison between Physical activity group and Control group on selected problem behavior variables

Variable	Groups	N	Pre -test Mean & Std.	Post -test Mean & Std.	Cal. t value
Auditory Problem Behaviors	Physical activity group	8	8.68 ± 1.41	7.94 ± 1.15	0.264
	Control group	8	7.94 ± 2.43	8.94 ± 1.40	0.334
Tactile Problem Behaviors	Physical activity group	8	16.13 ± 2.22	15.88 ± 1.13	0.781
	Control group	8	16.31 ± 2.56	16.5 ± 0.93	0.850
Gustatory-olfactory Problem Behaviors	Physical activity group	8	12.5 ± 2.46	11.63 ± 1.92	0.441
	Control group	8	12.19± 1.31	13.56 ± 0.68	0.023

Level of significance 0.05, t.05 (14) = 2.145

RESULTS

The t-test showed results on selected problem behavior variables (Auditory Problem Behaviors, Tactile Problem Behaviors and Gustatory-olfactory Problem Behaviors) was not significant but the experimental group revealed certain improvement. The results have been given below in Table 3.

DISCUSSION ON FINDINGS

The results of this study showed that following 12 weeks structured PA intervention has not significantly decreased Auditory problem behavior, Tactile problem behavior and Gustatory-Olfactory problem behavior of children/adolescents with ASD. The documented evidences from different research report it was found PA intervention has a positive relationship with motor skills (Gabriels *et al*., 2012; Marzouki *et al*., (2022)), communication skills (Radhakrishna *et al*., 2010), social behaviors and skills (Zhao *et al*. 2018, Yu *et al*., 2018), social dysfunction (Movahedi *et al*. 2013), repetitive and stereotype behaviors (Bahrami *et al*., 2012, Tse, Pang, & Lee, (2018)) of people with ASD. But evidences are very less, for drawing firm conclusions on PA and ASD severity researcher must needs to go deeper. In this present study an attempt was made to find out some connection between PA and Auditory, Tactile and Gustatory-Olfactory problem behavior of ASD, and the results found not significant. Although, the PA program was designed based on the guidelines, recommendations on physical activity, some previous successful researches, the development characteristics, and the special needs for children with ASD. There are a few studies on PA and Problem behavior of ASD and some studies reported that appropriate duration of intervention may effects on Problem behaviors and other autism related outcomes.

CONCLUSIONS

In conclusion, this study was the first step towards gaining a better understanding of Physical activity intervention on auditory, tactile and gustatory-olfactory problem behavior of children with ASD. It is also provided that in future research development of more comprehensive and inclusive PA programs for children with ASD are needed to fulfill the gaps of PA intervention and autism spectrum disorders.

Acknowledgements: The authors are grateful to all the participants who were involved in this study.

Ethical approval: The 'Institution Ethics Committee' for Human Research, Jadavpur University has duly justified and provisionally approved this study.

Authors contribution: Both the authors have contributed equally. The critical revision of the work. was done by GCS.

Funding for the study: The authors have no relevant financial or non-financial interests to disclose.

Competing interest: The authors declare no competing interests.

Conflict interest: Both the authors certify that they have no conflict of interest in this study to disclose.

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Appendix-4

Presentation in international seminar

No. 784

International Congress
on
Global Innovation and Research in Education,
Sports Sciences and Yoga

Organised by

Department of Physical Education
Mahisadal Girls' College
Purba Medinipur :: West Bengal :: India
10th & 11th December, 2017

GIRESSY-2017

Certificate of Appreciation

This is to certify that Mr./Ms./Mrs./Dr./Prof. Sukumar Das, Research Scholar,
of Dept. of Physical Education, Jadavpur University has contributed in the
International Congress on "Global Innovation and Research in Education, Sports Sciences and Yoga on 10th & 11th December,
2017 at Mahisadal Girls' College, organised by Department of Physical Education, Mahisadal, Purba Medinipur, West
Bengal, India as Resource Person/Invited Lecture/Chair Person/Co-chair Person/Paper Presenter/Poster Presenter/ Participant.
Topic entitled as Fostering Yoga Education in Modern
Education: Some Suggestions.

Dr. Utpal Kumar Utthasani
Principal & Chairman of the Congress
Mahisadal Girls' College

Mr. Harka Bdr. Vishwa
Retd. Education Officer
Samtse Bhutan

Dr. Malay Mukhopadhaya
OSD, Dept. of Higher Education
Govt. of West Bengal

Dr. Deba Prasad Sahu
Organising Secretary
Mahisadal Girls' College

Appendix-5

Presentation in national seminar


The Physical Education Unit
Palli Siksha Bhavana (Institute of Agriculture)
VISVA-BHARATI
Sriniketan, Birbhum, West Bengal-731236

National Seminar on
"NUTRITION and WELLNESS"
(7-8 November, 2016)

Certificate

This is to certify that Mr. Sukumar Das has participated as ~~Resource Person~~/Registered Delegate in the National Seminar on "Nutrition and Wellness", held at Visva-Bharati, Sriniketan, West Bengal during 7th & 8th November, 2016. He/~~she~~ has ~~participated~~/presented a paper entitled "The Life of Indian Paralympic Athletes and their Indomitable Spirit: A Great Source of Inspiration"

Organising Secretary
(Ashoke Mukherjee)

Patron
(Sarthak Chowdhury)

Appendix-6

Institutional Ethics Committee approval

যাদবপুর বিশ্ববিদ্যালয়
কলকাতা-৭০০০৩২, ভারত

*JADAVPUR UNIVERSITY
KOLKATA-700 032, INDIA

Prof.Gopal Chandra Saha
Dept. of Physical Education
Jadavpur University

Ref No: IEC/21/C/23
Date: 13.02.2023

Dear Sir/ Madam,

Institutional Ethics Committee (IEC) Approval

Title of the Study: Effect of Integrated Yogic practices and physical activities on children with autism spectrum disorders.

The above application of **Sukumar Das** has been considered on behalf of the Jadavpur University Institutional Ethics Committee in accordance with the procedures laid down by the University for ethical approval of all research involving human participants.

I am pleased to inform you that, on the basis of the information provided to the Jadavpur University Institutional Ethics Committee, the proposed research has been judged as per meeting appropriate ethical standards, and accordingly approval has been granted in the meeting dated **28.09.2022** and duly approved by the Chairperson on **06.02.2023**.

Should there be any subsequent changes to the project, which raise ethical issues not covered in the original application, P.I. should submit details to the Jadavpur University Institutional Ethics Committee for consideration.

Hope this will serve your purpose.

Thanking You,

Professor
Department of Psychology,
University of Calcutta
92, A.P.C. Road, Kolkata-700009

(Prof. Pritha Mukhopadhyay)
CHAIRPERSON

(Shri Indrajit Banerjee)
CONVENER

Appendix-7

Signed informed consent form

PARENT/GUARDIAN CONSENT LETTER

Dear Parent;

With due regards, I would like to inform you that I am Mr. Sukumar Das, Ph.D. Scholar, Department of Physical Education, Jadavpur University under the supervision of Professor Gopal Chandra Saha (Professor, Department of Physical Education, Jadavpur University) has planned to conduct research work with the intention of finding out the impact of regular Yoga and Physical exercise on behavior patterns of children with Autism Spectrum Disorders. For this purpose, on the basis of existing literature, expert opinions and the best of our knowledge, we have prepared a Yoga and Physical exercise training programme which may alter the behavior pattern of children with autism. It is globally proved and accepted that different yogic exercises and physical activities have a significant positive effect on the structure and functions of the human brain. To execute and justify the potentiality of this training programme, we need your kind valuable co-operation. Your active co-operation and participation of your child will help to determine the effectiveness and utility of these programmes (yoga and Physical activity).

Please take a few moments to read the enclosed information statement. We hope it will help you to understand what we will be doing and how. We are expecting your kind co-operation and assistance ahead.
Thanking you.

(Mr. Sukumar Das)

(Ph.D Scholar, Department of Physical Education, Jadavpur University)

(Prof. Gopal Ch. Saha)

(Supervisor, Department of Physical Education, Jadavpur University)

অভিভাবক এবং পিতামাতার সম্মতিপত্র

প্রিয় শ্রদ্ধেয় অভিভাবক,

আপনার নিকট আমার বিনীত নিবেদন এই যে আমি শ্রী সুকুমার দাস (Ph.D Scholar, Department of Physical Education, Jadavpur University) এবং আমার গবেষণা উপেদেষ্টা অধ্যাপক ড. গোপাল চন্দ্র সাহা-র (Supervisor, Department of Physical Education, Jadavpur University) তত্ত্বাবধানে একটি গবেষণা করার পরিকল্পনা করা হয়েছে। যে গবেষনাতে বিভিন্ন যোগ ব্যায়াম ও শারিরীক ক্রিয়াকলাপ অনুশীলনের ফলে অটিজম শিশুদের ব্যাবহার বা আচরণের উপর প্রভাব আলোচনা করা হইবে। এই উদ্দেশ্য সাধনের জন্য পূর্বে সম্পাদিত গবেষণার তথ্য, বিশেষজ্ঞদের অভিমত এবং আমাদের সর্বোত্তম জ্ঞান ও অভিজ্ঞতার ভিত্তিতে বিভিন্ন যোগ ব্যায়াম ও শারিরীক ক্রিয়াকলাপ অনুশীলন প্রশিক্ষনের একটি প্রোগ্রাম বা কার্যক্রম প্রস্তুত করা হয়েছে এবং অনুমান করা হচ্ছে যে এই যোগ ব্যায়াম ও শারিরীক ক্রিয়াকলাপ অনুশীলনের ফলে অটিজম শিশুদের ব্যাবহার বা আচরণের পরিবর্তন হতে পারে। এটি বিশ্বব্যাপী প্রমাণিত এবং স্বীকৃত যে বিভিন্ন যোগ ব্যায়াম ও শারিরীক ক্রিয়াকলাপ মানব মস্তিষ্কের গঠন ও কার্যকারিতার উপর ইতিবাচক প্রভাব ফেলে। অত এব এই প্রশিক্ষন কর্মসূচীর সম্ভাব্যতা বাস্তবায়ন এবং ন্যায্যতা মুল্যায়নের জন্য আপনাদের এবং আপনার শিশুদের স্বতঃস্ফুর্ত অংশগ্রহন এবং সার্বিক সহযোগিতা একান্তভাবে কামনা করিতেছি।

ধন্যবাদান্তে

শ্রী সুকুমার দাস
((Ph.D Scholar, Department of Physical Education, Jadavpur University)

ড. গোপাল চন্দ্র সাহা
(Supervisor, Department of Physical Education, Jadavpur University)

PARENT INFORMATION STATEMENT

RESEARCHER'S STATEMENT TO PARENTS

We are asking permission for your child to take part in an evaluation study at his/her school. Please read the information carefully. For any queries about the study, call the number mentioned below.

WHAT IS THE PURPOSE OF THE STUDY?

The purpose of the study is to observe your child's reactions and responses by following regular 'Yoga and Physical activity training programme' in respect of autistic behavior patterns.

HOW WILL YOU PROTECT MY CHILD'S PRIVACY?

The study is entirely voluntary and confidential. The data or information to be collected from your child during entire experiment will be used for research purpose only.

WHAT IS THE VENUE AND DURATION OF INTERVENTION?

For this study, the researcher has chosen your child's school as the venue and framed a 'Yoga and Physical activity training programme' that should be followed by six (6) months for three (3) alternative days in a week. Duration of each session will be 45 min to 60 minutes (1 hour) as per the interest and motivation of your child.

WHO WILL BEAR THE EXPENDITURE OF STUDY?

The total expenditure for this study both during the training period (yoga mat and other equipment) and collection of data will be bear by researchers only.

OTHER INFORMATION

Your child's data will only be identifiable by a unique **ID number.** All information your child gives as part of this study will be kept strictly confidential.

INFORMED CONSENT STATEMENT

I, ……, give permission for my child, ……...to participate in the research project entitled, "Effects of yogic practices and physical activity on children with autism spectrum disorder." The study has been explained to me and my questions answered to my satisfaction. I understand that my child's responses and identity will be kept confidential. I give this consent voluntarily.

Parent/Guardian signature :……

RESEARCHER'S NAME AND CONTACT:

MR. Sukumar Das, 9088262518/9134370416, sukumardas159@gmail.com

গবেষণার সংক্ষিপ্ত তথ্য বিবৃতি

অভিভাবকদের নিকট গবেষকের বিবৃতি:

আমরা আপনার সন্তান কে তার স্কুলে একটি মূল্যায়ন নির্ধারক গবেষণাতে অংশ গ্রহনের জন্য আবেদন জানাচ্ছি। সাবধানে তথ্য পড়ুন এবং গবেষণা সংক্রান্ত কোনো প্রশ্নের জন্য নীচে উল্লেখিত নম্বরে যোগাযোগ করুন।

গবেষণাটির উদ্দেশ্য:

গবেষণাটির উদ্দেশ্য হল নিয়মিত যোগ এবং শারীরিক কার্যকলাপ কর্মসূচী অনুশীলনের ফলে শিশুর ক্রিয়া- প্রতিক্রয়া গুলিকে অটিজম আচরণ ধারার নিরিখে পর্যালোচনা করা।

শিশুর বিভিন্ন তথ্যের গোপনীয়তা রক্ষা:

সমগ্র গবেষণাটি চলাকালীন শিশুর নিকট হইতে যে সকল তথ্য সংগ্রহ করা হইবে তাহা কেবলমাত্র গবেষণার কাজে ব্যবহৃত হইবে এবং সম্পুর্ন ভাবে গোপন রাখা হবে।

গবেষণাটি সম্পাদনের স্থান ও সময়কাল:

গবেষণাটি সম্পাদনের জন্য আপনার সন্তানের স্কুলকে স্থান হিসাবে নির্বাচন করা হয়েছে এবং একটি যোগা ও শারীরিক কার্যকলাপ অনুশীলন কর্মসূচী প্রস্তুত করা হয়েছে, যাহা সপ্তাহে তিন দিন করে ছয় মাসের জন্য, প্রতিদিন 45 মিনিট থেকে 60 মিনিট করে নিয়মিত অনুশীলন করানো হইবে।

গবেষণাটির খরচ:

সমগ্র গবেষণাটি চলাকালীন গবেষণার যাবতীয় খরচ শুধুমাত্র গবেষক বহন করিবেন।

অন্যান্য তথ্য:

আপনার সন্তানের সকল তথ্য বা ডেটা শুধুমাত্র একটি ID দ্বারা সংগ্রহ করা হইবে এবং সকল তথ্য কঠোর ভাবে গোপন রাখা হইবে।

সম্মতি প্রদান

আমি, ... আমার সন্তান ..... এর জন্য এই যোগ ও শারীরিক কার্যকলাপ অনুশীলন প্রশিক্ষন গবেষণা প্রকল্পে অংশ গ্রহনে স্বতঃস্ফুর্ত ভাবে সম্মতি প্রদান করিতেছি।

অভিভাবক/পিতামাতার স্বাক্ষর

Appendix-8

Permission letter for data collection

To

The principal

Pradip: Centre for Autism Management

Kolkata, West Bengal 700015

Date- 22.01.2023

Sub: Application for data collection for Ph.D. research work

Madam

With due respect, I would like to inform you that I am Mr. Sukumar Das, Ph.D. scholar, Department of Physical Education, Jadavpur University, Registration No- AOPED0200516, under the supervision of Professor Dr. Gopal Chandra Saha, Department of Physical education, Jadavpur University. My registered research topic is **"Effects of yogic practices and physical activities on children with autism spectrum disorders".** The topic has been duly justified and approved by Jadavpur University Ethics Committee. The purpose of this study is to find out the impact of regular yoga and physical exercises on behavior patterns of children with autism spectrum disorders.

To conduct this research work on the basis of understanding and interest, 18 children (both male and female), aged ranging from 8 to 14 years, with moderate levels of autism, were diagnosed by a rehab-psychologist/ psychiatrist/ clinical psychologist from institution for autism management. Parents of the autistic children and caregivers/teachers will act as volunteers for this study. To accomplish the goal of the study, 18 selected samples (children with autism) will randomly be divided into 3 equal groups. As-

A. Yoga Group (6)
B. Physical activity Group (6) and
C. Control Group (6).

The two experimental groups will follow yoga and physical exercise interventions for six (6) months, three alternative days in a week. The duration of each session is 45 minutes to 60 minutes (1 hour) as per interest and motivation of the children.

The assessment of behavior pattern will be done by the problem behavior checklist,

- **Before beginning of the interventions (Pre-Test),**
- **After three (3) months of interventions (Post-Test-I),**
- **After six (6) months (Post-Test-II) and then**
- **After nine (9) months (Post-Test-III).**
- The last 3 months (from 6^{th} to 9^{th} month) there will be no interventions. It is an observation period only.
- As it is self-funded research work, all expenses of this study will bear by the researcher himself only.

Therefore, to successfully complete this study in due time, your kind cooperation and assistance is needed. I hope that you are kind enough in this regard.

Thanking you.

Yours sincerely

(Mr. Sukumar Das)

Ph.D Scholar, Department of Physical Education, Jadavpur University.

(Prof. Gopal Ch. Saha)

(Supervisor, Department of Physical Education, Jadavpur University)

Appendix-9

Data collection certificate

TO WHOM IT MAY CONCERN

This is certified that Mr. Sukumar Das, Son of Mr. Babu Das, Research Scholar, Department of Physical Education, Jadavpur University, has successfully completed the six-month (01/04/2023 to 01/10/2023) Yoga and Physical activity training intervention programme on his research work and the research title was "Effect of yogic practices and physical activities on children with autism spectrum disorders". He completed that particular research experiment on moderate levels of children with autism spectrum disorders from this institution.

During this period of the research programme we found him and his assistants (Yoga and Physical activity teachers) were very sincere, curious, analytical and hard-working. I wish him all success in his future.

Appendix-10

Prayer (3-4 Mins)	Opening prayer with Namaskar mudra
Loosening exercise (7-10 Min)	**Standing/Sitting** **Neck exercise** Forward, Backward and sideward bending, Turning sideways, Half rotation (front/back) **Upper body exercise** Shoulder rotation, Wrist rotation, Hands up & down, Finger squeeze **Lower body exercise** Waist rotation, Forward, Backward and sideway bending, Squat, Ankle stretch, Toe squeeze
	Dynamic Exercises Walking (Slow/fast & backward) Jogging (Slow/fast & backward) Running (Slow/fast & backward running) Spot jump Side bending Jumping zag
Asanas/Postures (15-20 Min)	**Standing** Vrikshasana, Tadasana, Utkatasana, Trikonasana, Padahastasana, Ardhachakrasana, Ardhakatichakrasana, Veerabhadrasana, Parsochandrasana **Sitting** Paschimottasana, Sinha Mudra, Dandasana, Vajrasana, ParivrittaVajrasana, Sasankasana, Padmasana, Janusirasana, Bhadrasana, Ushtrasana, Gomukhasana **Supine** Pavanmuktasana, Setubandhasana, Paddothanasana, Utthanpadasana, ShavaUdarkarasana **Prone** Makarasana, Bhujangasana, Salvasana, Dhanurasana
Pranayama/Breathing exercise (8-10 Min)	Hand stretch breathing, Abdominal breathing, Bhramari pranayama
Relaxation poses (5-7 Min)	Sukhasana (Cross legged pose) Shavasana (Corpse pose) Makarasana (Crocodile posture)
Chanting (4-5 Min)	AAA UUU MMM OM Chanting
Prayer (3-4 Min)	Closing prayer with Namaskar Mudra

Appendix-11

Preparatory Phase		**Specific Activity Phase**				**Minor Game Phase**	**Cooling Down Phase**
Warm-up activity	**Stretching activity**	**Calisthenics/apparatus drills**	**Jumping exercise**	**Balancing exercise**	**Objects/Ball holding exercise**	**Single /Group games**	**Relaxation movements**
5-15 Minutes		20-30 Minutes				5-10 Mins	3-5 Mins
a.Walking (Slow/Brisk) b.Jogging (Slow/Fast) c.Running (Slow/Fast)	a.Bending b.Twisting c.Rotating e.Pulling f.Pushing exercises	2-count, 4-count, 8-count exercise. (Free hand and with apparatus)	a.Hopping (single & both leg) b.JumpingStanding & Dynamic.	a.Hurdle step over b.Bear crawls c.Knee bend standing	Carrying ball and other objects (by single &both hands)	a. Single games with balls. b.Peer group games c.Games with music	a. Light Walking movements. b. Light Sitting movements c. Light Lying movements (Supination/Pronation)

Appendix-12

Problem Behavior Questionnaire for ASD

NAME:	
AGE:	SEX:
HEIGHT:	WEIGHT
FAMILY MEMBERS-	BIRTH ORDER-
PARENTS EDUCATIONAL STATUS:	

DETAILS OF RESPONSE- 1=Not at all Relevant; 2=Somewhat Relevant; 3=Moderately Relevant;
4=Very much Relevant; 5=Most Relevant.

Statements/ বিবৃতি			**Response/ প্রতিক্রিয়া**				
			1	2	3	4	5
Auditory/ শ্রবণ	1.	অপ্রত্যাশিত উচ্চ শব্দে নেতিবাচক সাড়া দেয়। Responds negatively to unexpected loud noises.					
	2.	আশেপাশে প্রচুর শব্দ হলে বিভ্রান্ত হয় বা কোনো কাজ করতে সমস্যা হয়। Is distracted or has trouble functioning if there is a lot of sound around.					
	3.	অদ্ভুত আওয়াজ উপভোগ করছে বলে মনে হচ্ছে। Seems to enjoy strange noises.					
Tactile/ স্পর্শকাতর	4.	পেইন্ট, পেস্ট বা ভেজা বালির মতো "অগোছালো" উপকরণে হাত দেওয়া এড়িয়ে চলে। Avoid getting hands in “messy” materials like paint, paste or wet sand etc.					
	5.	নির্দিষ্ট অঙ্গবিন্যাস দ্বারা বিরক্ত হয়. Is irritated by certain textures.					
	6.	মসৃণ বা শক্ত পৃষ্ঠতল বা উপরিতল স্পর্শ করতে পছন্দ করে। Prefers to touch smooth or hard surfaces.					
	7.	আশেপাশে কেউ থাকলে বিরক্ত হয়। Is irritated when someone is nearby.					
	8.	অপ্রত্যাশিতভাবে স্পর্শ করা অপছন্দ করে. Dislikes being touched unexpectedly.					
	9.	হাত দিয়ে পুঙ্খানুপুঙ্খভাবে স্পর্শ করে বস্তুগুলি পরীক্ষা করার প্রবণতা আছে। Tends to examine objects by touching them thoroughly with hands.					

	10	বস্তুগুলিকে মুখের মধ্যে রেখে পরীক্ষা করতে থাকে। Tends to examine objects by putting them in mouth.					
Gustatory Olfactory- Examination/ স্বাদ ও ঘ্রাণ বিষয়ক - পরীক্ষা	11	ইচ্ছাকৃতভাবে বস্তুর গন্ধ শোঁকে। Deliberately smell objects.					
	12	কিছু খাবারের জন্য অস্বাভাবিক তৃষ্ণা বা তীব্র আকাঙ্খা আছে। Has unusual craving for certain food.					
	13	অখাদ্য বা খাবার অযোগ্য জিনিস খায়। Eats inedible things.					
	14	3 বছর বয়সের পরেও বিছানা ভেজানো। Bed wetting even after 3 years of age.					
	15	প্রস্রাব নিয়ন্ত্রণে সমস্যা হয় Faces trouble in controlling urination.					
Social/ সামাজিক	16	বই, কাগজপত্র, এবং ম্যাগাজিন ছিড়ে ফেলে। Tears books, papers, and magazines.					
	17	বস্তু/গ্লাস/খেলনা ভেঙে ফেলে। Breaks objects/glass/toys.					
	18	খেলনা নিক্ষেপ করে। Throws toy.					
Temper tantrums/ বদমেজাজের	19	পা ছোঁড়াছুড়ি করে বা পা দিয়ে আঘাত করে। Stamps feet.					
	20	বস্তু বা জিনিসপত্রের ওপর প্রহার বা আঘাত করে। Bangs objects.					
	21	মেঝে উপর গড়াগড়ি দেয়। Rolls on the floor.					
Physical harm toward others/ অন্যের প্রতি শারীরিক ক্ষতি	22	অন্যকে ঠেলে দেয়। Pushes other.					
Odd Behavior/ অদ্ভুত আচরণ	23	স্ব-হাসি বা নিজে নিজে হাসতে থাকে। Self- laughing.					
	24	স্ব-কথন বা নিজের সাথে কথা বলতে থাকে। Self- talking					
	25	অদ্ভুত শব্দ করে। Makes peculiar sound.					
	26	সূতা, লাঠি বা দড়ি ইত্যাদির মতো অবাঞ্ছিত বস্তু মজুত করে। Hoards unwanted objects like					

		thread/stick/string etc.					
	27	অবাঞ্ছিত বস্তু যেমন ময়লা, দড়ি ইত্যাদি নিয়ে খেলা করে। Plays with unwanted objects like dirt/ string etc.					
Self-injurious behavior/ স্ব-ক্ষতিকর আচরণ	28	নিজের মাথাতে আঘাত করে। Bangs head.					
	29	নিজের শরীরে নখ দিয়ে আঁচড় কাটে। Scratches self.					
	30	চামড়া বা ক্ষত স্থানের খোসা ছাড়িয়ে দেয়। Peels skin or wound.					
Unusual fears/ অস্বাভাবিক ভয়	31	মোমবাতি, জল ইত্যাদি বস্তুর অস্বাভাবিক ভয় পায়। Unusual fear of objects like candle, water etc.					
	32	অন্ধকারের অস্বাভাবিক ভয়। Unusual fear of darkness.					
Disobedience/ অবাধ্যতা	33	আদেশ মান্য করতে অস্বীকার করে। Refuse to obey commands.					
	34	যে কোন কাজ সম্পূর্ণ করতে ইচ্ছাকৃতভাবে সময় লাগে। Takes time intentionally to complete any task.					
Repetitive Behavior/ পুনরাবৃত্তিমূলক আচরণ	35	শরীর বা শরীরের কোনো অংশের দোলন, কম্পন বা নড়ন। Rocks body.					
	36	মাথা নাড়ানো বা ঝাঁকানো। Nods head.					
	37	পেন্সিল/কলমের শেষ কামড়ে দেয়। Bites end of pencil/pen.					
	38	শরীরের কোনো অংশ বারবার নাড়া দেয়। Shakes part of the body repeatedly.					
Speech/ কথাবার্তা	39	শব্দের পুনরাবৃত্তি করে। Repeats words.					
	40	বাক্যাংশ পুনরাবৃত্তি করে। Repeats phrases.					
Vestibular / ভারসাম্যবোধ	41	অনেক লাফায় বা লাফাতে থাকে। Jumps a lot.					
	42	কোনো ব্যতিক্রমী ভাল ভারসাম্য আছে. Has exceptionally good balance.					
	43	প্রাপ্তবয়স্কদের মতো দ্রুত গতিবিধি বা চলাফেরা পছন্দ করে।					

		Likes fast movements as when being whirled by an adult.					
	44	সিঁড়ি বেয়ে উঠতে বা নামতে সমস্যা হয় বা দ্বিধা হয়। Has trouble or hesitates in climbing or descending stairs.					
	45	আনন্দিত-গো-রাউন্ড পছন্দ করে। Likes merry-go-round.					
Inattentiveness and restlessness/ অমনোযোগীতা এবং অস্থিরতা	46	যা বলা হয়েছে তাতে মনোযোগ দিতে সমস্যা হয়। Has problem in paying attention to what is told.					
	47	একটি প্রয়োজনীয় সময়ের জন্য প্রদত্ত কাজ চালিয়ে যেতে ব্যর্থ হয়। Fails to continue the given task for a required time.					
	48	কোন কাজ সম্পূর্ণ করতে ব্যর্থ হয়. Fails to complete any task.					
	49	প্রয়োজনীয় সময়ের জন্য এক জায়গায় বসতে সমস্যা তৈরি করে। Creates problem in sitting at one place for a required time.					
	50	ঘন ঘন কার্যকলাপ পরিবর্তন করে। Frequently changes activity.					
Odd-sexual behavior/ অদ্ভুত-যৌন আচরণ।	51	সামাজিকভাবে অনুপযুক্ত জায়গায় অনুপযুক্ত Masturbation করে। Inappropriate masturbation in socially inappropriate place.					
	52	সামাজিকভাবে বিব্রতকর উপায়ে নিজের যৌনাঙ্গে স্পর্শ করার প্রবণতা। Tendency of touching one's own genital area in a socially embarrassing way.					

Signature of Parents:

Signature of Teachers/ Care givers:

Signature of Rehab-Psychologist/ Psychiatrist/ Clinical Psychologist.

Appendix-13

Qualified UGC National Eligibility Test

Electronic Certificate No.: 141019223

University Grants Commission
NATIONAL EDUCATIONAL TESTING BUREAU

ज्ञान-विज्ञानं विमुक्तये

NATIONAL ELIGIBILITY TEST FOR ASSISTANT PROFESSOR

UGC Ref. No.: 19223/(NET-JUNE 2014) Roll No.: 11470081

Certified that **SUKUMAR DAS**

Son Daughter of **LATE BABU DAS**

and **PUTUL DAS** has qualified

the UGC-NET for eligibility for Assistant Professor held on **29-06-2014**

in the Subject **PHYSICAL EDUCATION**

The date of qualifying NET is **10th November 2014** , which is also the date of declaration of the result.

This is an electronic certificate only and its authenticity should be verified from the UGC by the employer through **www.ugcnetonline.in**. This electronic certificate can also be verified by scanning QR Bar Code printed on the electronic certificate.

Validity of the electronic certificate is forever.

Surender Singh
Head
NET Bureau

Date of Issue: **24-03-2015**

Note: a) UGC has issued the electronic certificate on the basis of information provided by the candidate in his/her Application Form. The appointing authority should verify the original records/certificates of the candidate while considering him/her for appointment, as the Commission is not responsible for the same. The candidate must fulfil the minimum eligibility conditions for NET within two years from the date of declaration of UGC-NET result.

b) Wherever PWD is shown in the UGC Ref. No., the recruitment body should check the relevant documents of disabilty.

Appendix-14

Qualified SET (State Eligibility Test)

Certificate No. WBCSC20172649

THE WEST BENGAL COLLEGE SERVICE COMMISSION

TWENTIETH STATE ELIGIBILITY TEST FOR THE POST OF
ASSISTANT PROFESSOR OF COLLEGES & UNIVERSITIES
(Accredited by the UNIVERSITY GRANTS COMMISSION, New Delhi)
(Valid in the State of West Bengal only)

Certified that SUKUMAR DAS

Son/Daughter of LATE BABU DAS

and PUTUL DAS

Roll No. 0514521 *Category* SC *PWD* NO

has qualified at the Twentieth West Bengal SET -2017 *held on* 03.12.2017 *in*

the Subject PHYSICAL EDUCATION

The date of qualifying for SET is 06.06.2018

This Certificate is valid forever.

Prof. (Dr.) Subha Sankar Sarkar
Chairman
Steering Committee, W.B.SET

Dr. Dipak Kumar Kar
Chairperson
The West Bengal College Service Commission &
Member Secretary, W.B. SET

Date of Issue : *21.06.2018*

Note : a) The West Bengal College Service Commission is issuing the Certificate on the strength of the information provided by the candidate. The appointing authority should verify the original record/certificate(s) of the candidate while considering him/her for appointment, as the SET agency cannot take the responsibility of authenticating the genuineness of his/her claims.

b) If the candidate is a PG student, he/she must complete the same with the requisite marks within two years of the date of declaration of result of the SET examination.

c) If the candidate belongs to SC/ST/OBC/PWD category, the appointing authority should check the document(s) while considering him/her for appointment, as per the stipulations laid down by the concerned Dept. (s) of the State Govt.

d) This is an electronic certificate and its authenticity should be verified by the employer from the WBCSC. The electronic Certificate can also be verified by **scanning QR Bar Code printed on the certificate.**

Appendix-15

Workshop participation

Ministry of Youth Affairs & Sports
Government of India

Lakshmibai National Institute of Physical Education
North East Regional Centre, Guwahati, Assam

Diamond Jubilee Celebration
"60 Years of Excellence"

Certificate of Participation

Awarded to

Mr. SUKUMAR DAS From JADAVPUR UNIVERSITY

In recognition and appreciation for attending the National Workshop on Research Methodology and Statistical Analysis from 22nd to 28th March, 2018

Mr. Thepfukolie Punyu
Joint Organizing Secretary

Dr. Sanjeev Kumar
Organizing Secretary

Prof. Biswajit Basumatary
Workshop Chairman &
Dean, LNIPE,NERC, Guwahati

Appendix-16

Yoga Certificate Course from Kaivalyadham, Lonavala

KAIVALYADHAM S.M.Y.M. SAMITI'S
GORDHANDAS SEKSARIA COLLEGE OF YOGA AND CULTURAL SYNTHESIS
LONAVALA, PUNE

We, the Chairman and the Secretary of the Governing Body, on the recommendation of the Examination Committee of the College certify that

Sukumar Das

having been examined for the

CERTIFICATE COURSE IN YOGA (C.C.Y)
(May 2 - June 12, 2017)

and having passed in the Grade I in Theory, Grade I in Practicals and Grade I in Practice teaching with overall Grade I.

May 29, 2017

(SECRETARY)

(CHAIRMAN)

Serial No.: 12

Appendix-17

Successfully qualified QCI in yoga, from AYUSH Govt. of India

सत्यमेव जयते

QCI

Certification of Yoga Professionals

Certificate

indian yoga association

yoganushasanam

Number : QCI/IYA/ 1 000969

This is to certify that

Sukumar Das

has been evaluated and certified as

Level 1 - Yoga Instructor

(Language of Examination - **English**)

Under the Scheme for Voluntary Certification of Yoga Professionals
Supported by Ministry of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH) Government of India

and

managed by Quality Council of India

Valid From

04-06-2017 until **03-06-2020**

(The validity of the certificate solely depends on the certified professional's continued compliance to prescribed competence standard and rules of the Scheme)

Evaluated and certified by
Indian Yoga Association

Indian Yoga Association CEO PrCB New Delhi

Authorised Signatory and Seal

Appendix-18

M.A in Yoga from J.V.B.U Rajasthan

Sr. No. : **40645**

JAIN VISHVA BHARATI INSTITUTE, LADNUN

(Declared as Deemed-to-be University Under Section 3 of the UGC Act, 1956)

EXAMINATION – 2020

(DISTANCE MODE)

MASTER OF ARTS IN YOGA AND SCIENCE OF LIVING

(FINAL YEAR)

MARKS SHEET

ENROLMENT NUMBER : **D-49237/18** ROLL NO. : **12066**

STUDENT NAME : **SUKUMAR DAS**

FATHER'S NAME : **BABU DAS**

MOTHER'S NAME : **PUTUL DAS**

PAPER NO.	PAPER TITLE	MAX. MARKS		MARKS OBTAINED			REMARKS
		AS	TH / PRAC	AS	TH / PRAC	TOTAL	
PAPER-VI	SPIRITUALITY AND SCIENCE	30	70	22	53	75	
PAPER-VII	SCIENCE OF LIVING IN SELF MANAGEMENT	30	70	22	67	89	
PAPER-VIII	SCIENCE OF LIVING AND HEALTH	30	70	22	60	82	
PAPER-IX	APPLIED SCIENCE OF LIVING AND RESEARCH METHODOLOGY	30	70	22	63	85	
PAPER-X	PRACTICAL	-	100	-	76	76	
				TOTAL MARKS OBTAINED (OUT OF 500)		407	

RESULT	YEAR-WISE TOTAL MARKS OBTAINED		GRAND TOTAL	PERCENTAGE	DIVISION	REMARKS
	PREVIOUS YEAR	FINAL YEAR				
PASS	361/500	407/500	768/1000	76.80	FIRST	

Marks in Figure : SEVEN SIX EIGHT

Note : Minimum Pass Marks in each theory paper (Assignment + Theory) are 36%; in Practical, Dissertation & Viva-voce are 50% and in aggregate is 40%.; Division Ist 60% & above, IInd Division 50% and above.

*** NO = Number * AS = Assignment * TH = Theory * PRAC = Practical * TOT = Total * AB = Absent * G = Grace * F = Fail * R = Reappear in paper in next year exam.**

Place : Ladnun-341306 (Rajasthan)

Date of Declaration of Result : **NOVEMBER 18, 2020**

J.V.B. INSTITUTE

Prepared by **Checked by** **Controller of Examinations**