Palacky University Olomouc

Faculty of Physical Culture

Motor proficiency of preschool children aged 5 to 7 related to age, gender, cognitive level and participation in organized physical activity

Doctoral Dissertation

Mgr. Ivana Djordjević

Mentor: prof. PhDr. Hana Válková, CSc.

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Declaration

I hereby declare that I have completed this dissertation independently under the supervision of prof. PhDr. Hana Válková, CSc. I have provided all literal sources and met all principles of scientific ethics.

Mgr. Ivana Djordjević
In Olomouc, date 2021

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Author's first name and surname: Mgr. Ivana Djordjević

Title of the doctoral thesis: Motor proficiency of preschool children aged 5 to 7 related to age, gender, cognitive level and participation in organized physical activity

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This study aims to determine the level of motor proficiency and differences in motor skills of preschool children aged 5 to 7 from Serbia according to age, gender, cognitive level, and participation in organized physical activities. One hundred and seventy-five children (male n=84 and female n= 91) aged in months 60 to 94 were assessed with MABC-2 test and Raven CPM. Descriptive statistics crosstabs, Pearson's $\chi 2$ test for continency tables and proportions were used for each group's level of motor proficiency. MANOVA and discriminant analysis were employed to find differences in motor proficiency between groups. The prevalence of DCD in Serbian preschoolers was 1.2%, and the prevalence for being 'at risk' of movement difficulty is 7.4%. Significant differences have been observed in all independent variables from small to large effect sizes. Higher-order cognitive skills were reflected in gross motor skills. Since aiming & catching, and balance were the most discriminative variables in all groups, our findings can contribute to understanding how important it is to promote object control skills games for girls and older preschoolers generally. These two variables usually influenced total test scores. To improve balance and fine and gross motor coordination during early childhood is challenging, and to make progress, children at that young age can only do it through the tasks and vigorous play that OPA can provide. The implications are addressed for parents, physical education teachers, early childhood educators and physical activity policymakers.

Keywords: MABC-2, preschool children, physical activity, motor competence, intelligence

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Název disertační práce: Motorické dovednosti předškolních dětí ve věku 5 až 7 let ve vztahu k věku, pohlaví, kognitivní úrovni a účasti na organizovaných pohybových aktivitách

Pracoviště: Katedra aplikovaných pohybových aktivit

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Cílem této studie bylo zjistit úroveň motoriky a rozdíly v motorických dovednostech předškolních dětí ve věku 5 až 7 let ze Srbska ve vztahu k věku, pohlaví, kognitivní úrovni a účasti na organizovaných pohybových aktivitách. Prostřednictvím testu MABC-2 a Raven CPM bylo hodnoceno 175 dětí (84 chlapců a 91 dívek) ve věku 60 až 94 měsíců. Výsledky testů motorických dovedností u každé skupiny dle výše uvedených hledisek byly zpracovány deskriptivní statistikou, dále byl použit Pearsonův χ2 test pro hodnocení dle kontingenčních tabulek a jejich proporcí. K nalezení rozdílů v motorické zdatnosti mezi skupinami byla použita MANOVA a diskriminační analýza. Prevalence DCD u srbských předškoláků byla 1,2 %, prevalence "ohrožení" deficitem v pohybové úrovni byla 7,4 %. Významné rozdíly byly pozorovány u všech nezávislých proměnných dle principu „effect size“ (malé či větší četnosti jedinců ve skupině). Kognitivní dovednosti vyššího řádu se odrazily v motorických dovednostech založených na hrubé motorice. Házení předmětu s cílením i chytání, dále rovnováha, byly nejvíce rozlišujícími proměnnými ve všech skupinách. Tyto dvě proměnné obvykle ovlivnily celkové skóre testu. Vzhledem k tomu mohou prezentovaná zjištění přispět k pochopení, že především pro dívky, ale i starší předškoláky obecně je důležité podporovat hry zaměřené na manipulaci s předměty. Zlepšit rovnováhu a koordinaci, jemnou a hrubou motoriku v raném dětství je náročné a dosáhnout pokroku mohou děti v tomto věku pouze prostřednictvím náročnějších pohybových úkolů a her, které mohou poskytnout především sportovní školy. Nalezené výsledky jsou určeny pro využití v raném dětství, a to všemi aktéry, což jsou rodiče, učitelé TV, vychovatelé dětských skupin, a především odpovědní tvůrci politiky v oblasti pohybových aktivit.

Klíčová slova: MABC-2, předškolní děti, pohybové aktivity, motorické kompetence, inteligence

Poděkování: studie byla součástí projektu "Hodnocení motorického vývoje dětí ve věku 5 -7 let zapojených do organizovaných pohybových aktivit." (Code No. IGA_FTK_2014018).

Contents

LIST OF ABBREVIATIONS AND ACRONYMS

AB – Age Band
AC - Aiming & Catching

ADHA – Attention Deficit Hyperactive Disorder

BAL - Balance

CPM- Raven's progressive colour matrices

DCD – Developmental Coordination Disorder

GMS- Gross Motor Skills

IQ- Intelligence quotient

LOC- Locomotor skills

MABC-2 - Movement Assessment Battery for Children 2nd. edition

MD- Manual dexterity

MVPA- Moderate to Vigorous Physical Activity

OC- Object Control skills

OPA- Organized Physical Activity

PA- Physical Activity

TTS - Total Test Score

INTRODUCTION

Children's development results from a complex interaction between heredity, growth, maturation, environmental domains and has a biological and behavioural context (Rodić, 2004). Behavioural development relates to the evolution of intellectual, psychological, and sociological attributes. Motor learning, like a development, implies that it is a permanent change in motor behaviour. This process often leads to a change in behaviour and, in most cases, leads to an increased capacity to perform the particular skill or set of skills (Gallahue & Ozmun,1995). Learning occurs as a result of practice and experience, and it is not a result of growth and maturation, two fundamental characteristics of the dynamical process involved in the development (Sugden &Wade, 2013). Such changes are continuous and provided by the interaction among constraints over the body, the environment and the task (Newell, 1986). By about seven years of age, a child should learn the fundamental motor skills (FMS) adequately before starting the movement specialization process (Hardy, King, Farrell, Macniven, & Howlett, 2010). Many children participate in organized sports to build physical and social skills (Patel, Soares, & Wells, 2017; Washington et al., 2001). Playing sports depends on the child's physical growth and neurodevelopmental readiness (Patel et al., 2017). Therefore, working with children tends awareness of the child's level at different stages of development and needs specific strategies to optimize his abilities in each age group (Patel et al., 2017).

The need for children's company increases at preschool age, and mutual relationships are established among children based on games. Different types of PA can be very stimulating in the preschool-age by organizing various forms of play and socializing with other children, promoting learning, memory and motor patterns. Gallahue, Ozmun & Goodway (2011) thinks that physical activity positively affects fundamental movement patterns and encourages learning the sports technique of performing some elements. Joining institutions in early childhood such as kindergarten (Sabo, 2003, 2004; Lemos, Avigo, & Barela, 2012), recreational and sports clubs (Logan et al., 2019; Šalaj, Krmpotić, & Stamenković, 2016; Temple, Crane, Brown, Williams, & Bell, 2016; Zahner et al., 2009) and family indoor and outdoor activities (Barnett, Hinkley, Okely, & Salmon, 2013) have a positive impact on child motor learning, development, and maturity. When choosing recreational and sports activities for preschool children, there are particular preferences between the sexes. For girls, the most popular are dance, ballet, and (rhythmic) gymnastics,and boys prefer to participate in contact sports such as martial arts and team ball games such as football (Gutierrez & Garcia- Lopez 2012; Temple et al., 2016; Zahner et al., 2009).

Unfortunately, not all children can perform at the same level. Children at risk of movement difficulties have demonstrated developmental delays in motor skills (Connor-Kuntz & Dummer, 1996; Hamilton, Goodway & Haubenstricker, 1999; Goodway & Branta, 2003). Poor motor performance may cause adverse influence in preschool children on everyday life tasks, educational settings, and participation in sport-related PA (Henderson, Sugden, & Barnett, 2007). Longitudinal studies have shown that children with low motor competence tend to be less physically active than children with higher motor competence, and that trend continues through adolescence and adulthood (Barnett, Morgan, van Beurden, & Beard, 2008; Hands, 2008). The relationship between PA and lower motor skill performance could lead to a sedentary lifestyle that can cause children's health problems (Haga, 2008b; Hands, 2008; Tsiotra, Nevill, Lane, & Koutedakis, 2009). Consequently, assessment at preschool age is important because children with low motor competence can be detected early and approached through intervention and appropriate pedagogical programs (Henderson, Sugden, & Barnett, 2007). Interventions with sports content and a tasks-centred approach will help children increase the capacity of motor skills at a maximum level during preschool and school periods (Revie & Larkin, 1995; Ruiz-Pérez & Palomo-Nieto, 2018).

Regarding the psychomotor development and maturation of children, motor learning, successful participation in the classroom and physical education, this study aims to determine differences in the level of motor proficiency in 5 to 7 years children at the end of the preschool period according to age and gender differences, cognitive level, and participation in organized sport-recreative activities. Since this is the first study in Serbia using the MABC-2 test as an instrument, an additional goal is to investigate DCD prevalence among preschoolers.

2 LITERATURE REVIEW

2.1 Biological influence of developmental change

The development of a child's movement is described as an adaptive change that occurs as the child progresses to maturity. Children's resources are a crucial part of this interaction. This chapter examines some of the primary biological influences, describing selected changes in structures and functions as a child progresses to maturity, and summarises how these natural changes may affect movement development. Growth and maturation are biological processes, while development comprises some behavioural domains (Malina, 2012).

2.1.1 Growth and development of body

Human growth and development are essential in anthropological study, considering overall status, biological, physiological, psychological, and motor development. Developmental psychology, along with ontogenetic development, studies the human organism's physical development as a two-way connection between physical and mental development (Brković 2011).

Growth and development are particularly intense after a child's birth when the increase in body length is 23-24 cm, and the annual weight gain is about 7 kg. By the third year, the child's weight increases by about 3 kg per year, growing to approximately 11-12 cm, which is, assumed to be 50% of the final height for an adult (Riegerová & Ulbrichová, 1998). Children continue to grow rapidly on average 5-6 cm per year, gaining 5-6 kg in weight between the third and fifth year. The first phase of dynamic growth and development here ends after the development of the skeletal and neuromuscular system in the conditions of accelerated morphological changes, characteristic of the stage of dynamic growth and development is replaced with a phase of slower development.

In a period of six to seven years, they enter a phase of harmonization of the functions of the organism as a whole. According to some research, children annually grow 5-8 cm (Popović, 2008), while weight gain is 2-3 kg until puberty. The onset of puberty begins the second phase of dynamic growth, starting secondary changes in the body and rapid growth in height. Height and weight determine physical maturity, which depends on success in complaining tasks at a certain age. Changes in body proportions during puberty distinguish male and female physiques, including changes in secondary sex characteristics.

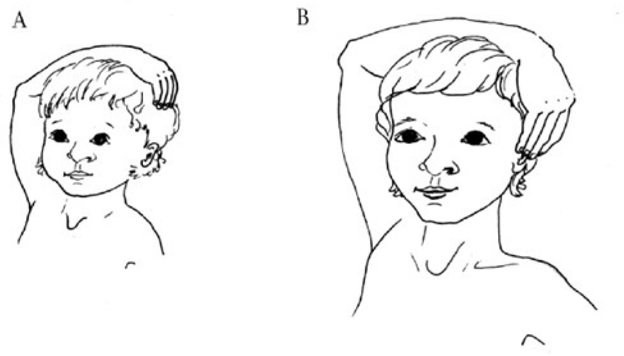
Brkovic (2011) explained *individual differences* in the pace of growth. In some children, the total physical and mental development can be faster or slower, which is normal tempo, i.e., the self-rhythm of development determined by the biological development plan, regulated by internal factors. These differences in tempo of development and other very significant individual differences manifest among children and students the same age, including gender differences, may require an individualized approach when working with children. Influence of diversity and individuality of the growth and development in children at the same age might be conditioned by (Rodić, 2004):

- *internal factors* (inheritance, the work of internal glands, race, ethnicity, gender) and
- *external factors (*geographic and climatic conditions, hygiene, socioeconomic conditions, diseases and injuries, nutrition, and personal engagement in physical activities).

Due to these factors, the growth progression is not the same for all children, nor have the same growth and development of the whole organism. The general course of development is most often described based on changes in body height and body weight during life. Detailed insight into morphological changes can be obtained by analyzing longitudinal body characteristics, transverse body characteristics, and volume and amount of adipose tissue (fat). Some bodies are growing faster than others, and the proportions of certain parts of the body change after development, which is particularly noticeable in the proportions of the head and body length (Medved et al., 1987; Riegerova & Ulbrichova, 1998).

According to Riegerova & Ulbrichova (1998), by aligning the length of the upper extremity - arm with the size of the head, the "Philippine measures" method, it is possible to evaluate school children's maturity. For example, the hands of a child aged 6-7 growing faster than the head, and the child easily reaches the ear on the opposite side (middle childhood). after changing body proportions (Picture 1-B). However, before the body proportion changes, the child cannot handle the opposite ear when putting his hand over his head, which is still early childhood (Picture 1-A).

Picture 1 The Philippine test measures A-early childhood; B-Middle childhood (Flugel, 1986, after Brković, 2011)



When determining the optimal time for school is taken into account, especially the main physiological systems to achieve a level that the child can successfully fulfil the tasks set by the school. To begin schooling is determined by the seventh year. The following indicators could influence the motor performance and development of fundamental movement skills: body height, body weight, development of the skeletal and muscle systém, development and functional maturity of the cardiovascular systém and respiratory system, primarily through the functional maturity of the brain.

2.1.2 Development of a locomotor system at preschool age

During skeletal development, changes are seen as two components, an increase in size and an increase in maturity (Acheson, 1954). The skeleton remains the same proportions in all age periods and is in phases of ossification: 15 to 20% of body weight. At the age of seven, the skeletal system is still plastic and can be easily deformed by the influence of harmful external factors (for example, inadequate sitting in school desks there carry the bag on the shoulder). A spinal column has gained its natural physiological curvature of the arches and feet elevated in periods six to seven. Plasticity articulated connexion allows joint mobility, which tends to decrease with age (Dejanovic & Fratric, 2007). The process of ossification is closely linked with the organism's overall maturation, and during puberty, it is one to two years faster in girls than in boys. Based on the x-ray on hand, it is possible to determine bone maturity in children (Acheson, 1954). In boys, a wrist x-ray shot at the end of puberty, the bond maturity in children's eight bones, is the most reliable test of sexual maturity (Riegerova & Ulbrichova, 1998).

The evaluation of biological maturity is assessed by comparing the appropriate indicators of the examined individual characteristic for that age. The primary criteria for determining biological age and maturity by observing the locomotor system are :

• Body weight, body weight, chest circumference, head circumference;
• Body proportions;
• Skeletal maturity at which establishes the order and time ossification of skeletal;
• Dental maturity (number of permanent teeth);
• Posture and foot shape;
• Development of muscle and fat.

Muscle links with bones still are not strong enough in children aged 6 to 7. The structure of muscle fibres is predominantly aerobic. Slow-twitch muscle fibres are almost wholly defined. At this age, musculature allows children to participate in physical exercises of high-intensity short duration and an exercise of a moderate-intensity long period of total duration but frequent breaks. Generally, boys of this age (given the tendency to be engaged in active play) have more developed muscle mass and muscle strange than girls (Bala, Jaksic & Popovic, 2009; Popovic, 2008; Starc et al., 2019). Strenght of the legs muscle increases more than in arms, prevails strength of extensor than flexors. Bala & Katić (2009) were on a large sample of 1170 children, 565 boys and 605 girls, ages 4 to 7.5 years from preschools analyzed conditions and age differences between boys and girls. Anthropometric characteristics related to bone growth in length were significant in favour of boys and those related to voluminousness and subcutaneous fat in favour of girls (Bala & Katić, 2009).

2.1.3 Development of a cardiorespiratory system at preschool age

The main functional physiological peculiarities of children's respiratory organs are the following: breathing is frequent (compensates the lungs small volume) and superficial. The younger a child is, the more frequent breathing is (physiological shortness of breath). Respiratory functions and respiratory capacity are directly related to an underdeveloped chest and low strength of respiratory muscles.

The frequency of respiratory movements at rest is significantly higher than in adults and is in 3-years-old children 30 - 25 times per minute, 7-years-old children - 20-25 times per minute. The greater need for oxygen, which occurs during physical exercise, is satisfied by children with a significant increase in respiratory movements. Vital capacity is around 1250-1300cm2, which is approximately a quarter of the value achieved by adults. However, tissue respiration and oxidation processes are very intense due to the significant lungs vascularisation, blood circulation speed, and high diffusion capacity. Low tolerance to carbon dioxide in the blood is also characteristic (occurs in anaerobic mode, during more prolonged continuous endurance exercise).

The cardiovascular system of children of different ages has many peculiarities which influence its functioning. In six to seven years, the heart's dimensions are five to six times larger than in a newborn. It weighs about 80-90g. The heart rate, i.e., the number of beats per minute at rest, is around 85-100, measured by pulse values. The pulse values are slightly lower in healthy children with developed muscles than those with less developed muscles. The heartbeat rhythm in children is often uneven and under influences such as temperature changes, intense emotions, breathing rhythm, tension, and breath-holding.

Thermoregulation is better in children than in adults, and thanks to that, they recover faster from physical work. Better thermo-regulation explains the larger surface of the child's skin, breathing frequency, and the widespread capillary network.

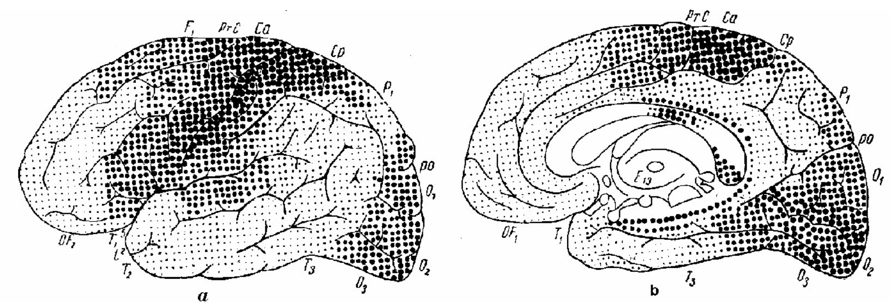
2.1.4 Development of the nervous system up to school age

The crucial period of brain development begins around the age of 2 and ends around 7. During this period, the number of connections (synapses) between brain cells (neurons) in two-year-olds is twice as high as in adults. Because learning takes place on these connections between brain cells, twice as many synapses allow learning faster in this period than any time across the life span. This lifetime provides an excellent opportunity to lay the foundations of holistic education for children and learn the second language as a mother thong. The experiences that children gain at this stage leave lasting effects on their development.

There are certain principles of growth that are important to know when working with children. The intensity of individual organs' growth is not always the same, the trend is not linear, and organs during growth increase their mass and change their structure (Medved et al., 1987), for example, the brain. Nervous systém changes through quantitative, qualitative, and functional changes.

Quantitative changes and the brain’s development speed can be traced by comparing the weight of the children’s and adults’ brains Table 1 (Brković, 2011). Tanner (1989) explained brain size or weight as a measured brain maturity because different brain parts grow and develop at different rates and reach maximum velocity at different times. For example, by birth, brain weight is only 25% compared to the adult brain, 50% at six months, 75% at two years and a half and 90% at six. Thus, at seven, children achieved almost all of the adult brain. Quality and functional changes as the myelination and functional training of associative fibres have been illustrated (Picture 1) by Luria (in Brković, 2011, 148).

Picture 1. Myelination of various areas of the cortex: a) outer surface, b) inner surface; (Luria, 1976; after Brković, 2011, 148)



Most nervous system cells generally start in a different place to where they eventually end up in the mature organ. Parts of the cortex that are maturing the earliest are marked with large dots, and parts marked with small dots are maturing later—the midpoints concern zone where myelination is developing in the meantime. In a peripheral nervous system, the motor nerve’s conduction time increases by about 1m/s per week between 20 to weeks’ gestation from 20 to 30 m/s with above 60 m/s being custom in adulthood; much of this is due to myelinization (Brown, Omar & O’Reagan, 1997). Furthermore, neurological connections that develop from 3 to 6 years enable increased cognitive ability and better hand-eye coordination and motor control. Changes in the brain's internal structure are crucial to intellectual and motor development.

2.2 Motor development

Motor development is an integral part of overall development and is an active consequence of developmental changes. Sugden and Wade (2013) defined motor development as “an adaptive change towards competence.” In these changes, the development of the nervous system provides the basis for the development of the motoric system. The nervous system extends to all body parts and participates in all body functions by gathering, organizing, and transporting information. The development of the neuromuscular system is manifested through movement and physical activities, and physical activities express the possibilities and needs of the organism within the framework of the achieved development (Kukolj, 2011). The specifics of the development of the neuromuscular and total motor system are directly projected on the quantitative and qualitative characteristics of the movement.

It has historically been assumed that motor control and cognition develop separately. However, it is now well documented in the literature that motor and cognitive skills mature in a similar trajectory (Abdelkarim et al., 2017). Piaget pointed out that children’s cognitive and motor development are closely linked, and he was the first to explore how intelligence develops from contact with the outside world (Piaget, 1952). While infants communicate with the external environment, the brain responds to new experiences (Piaget, 1952). For example, when the child develops new motor skills, planning and predicting the outcome of movement stimulate cognitive development.

Defining motor abilities is conditioned by the speed of maturation, primarily of the central nervous system (CNS). Cortical function becomes fine-tuned with development. The regions of the brain associated with basic functions such as sensory and motor processes mature first, and then the association areas are involved in top-down behaviour control (Casey, Tottenham, Liston, & Durston, 2005). Areas of the brain that are in charge of gross and fine motor skills include the cerebral cortex, cerebellum and basal ganglia. The cerebral cortex controls muscle movements, and the basal ganglia control the position and voluntary movement. The cerebellum monitors the muscles during movement. Finally, different parts of the motor cortex control the movement of different parts of the body (Alexander, DeLong, & Strick, 1986, Brown et al., 1997). As the CNS matures, the child can master movements and coordinate them, which is reflected in movements such as catching, lowering, throwing and other manipulative skills (Nićin, 2000). Movement is essential for the development of perceptual skills, and both of these skills are essential for cognitive development (Casey et al., 2005). Therefore, delay or deficits in gross motor skills may affect cognitive development, and opposite (Diamond, 2000; Piek, Hands, & Licari, 2012). Thus, mobility is crucial for cognitive functioning, helping to form neural connections and cortico-differentiation.

Contemporary research has increased awareness of the relationship between motor and cognitive development in early childhood. Studies involving neuro-imaging have found that increased physical activity stimulates the materialization of grey matter in the brain (see Casey et al. 2005 for a review). A recent study showed that long-term physical activity has beneficial effects on neurophysiological functioning, while short-term physical activity may drive changes in neurophysiological functioning (Meijer et al., 2020). Furthermore, in the following study, Meijer et al. (2021) indicate a relationship between cardiovascular fitness and gross motor skills to neurocognitive functioning and white matter microstructure in children.

Gill, Goldowitz, & Zwicker (2018) tried to explain why children with DCD and DCD/+ADHD struggle with learning motor tasks and why cognitive strategies are effective to learn motor skills. Initial findings indicate that children with DCD have reduced grey matter volume in sensorimotor-associated cerebellar regions and in regions considered significant for visual guidance of movement compared to typically developing children. In addition, children with DCD had increased grey matter volume in cerebellar regions engaged during cognitive tasks (Gill, Goldowitz, & Zwicker, 2018). Another study using finger sequencing tasks by (Licari et al., 2015) showed that children with DCD have reduced activation in the left superior frontal gyrus when performing fine motor skills. This area plays an important role in executive and spatially oriented processing. Decreased activation was also seen in the left inferior frontal gyrus, an area that is typically active during observation and imitation of hand movements (Licari et al., 2015). In addition, increased activation in the right postcentral gyrus has been observed, which may reflect the increased reliance on somatosensory information during the performance of complex fine motor tasks (Licari et al., 2015).

2.2.1 Motor development and related terminology

Motor learning implies that it is a permanent change in motor behaviour and, in most cases, leads to increased capacity to perform "a particular skill or set of skills" (Gallahue & Ozmun, 1995). Furthermore, learning occurs due to practice and experience and is not the result of growth and maturation, two primary characteristics of the dynamic process involved in the development (Sugden &Wade, 2013).

Motor performance is usually described as involving motor behaviour at a particular moment in time. Malina (2012) defines *motor competence/motor proficiency* as "the acquisition and refinement of skilful performance in various movement activities." Competence is considerable for being effective in our environment instead of focusing on achieving specific skills. Teaching skills can directly address the problems the child experiences in daily life with self-care or recreational activities (Sugden & Henderson, 2007).

Motor abilities appear to underpin numerous skills that are possibly genetically determined, are not easily influenced by practice, and are thought to be more fundamental than the concept of skill. For example, Shmidt and Lee (2011) described "abilities represent the 'equipment' that a person has at his or her disposal, determining whether or not a given motor task can be performed either poorly or well" (p.285).

We all think and speak of abilities when we use agility, coordination, dexterity, rhythm, speed, and balance. Likewise, we often describe people in terms of ability, such as having good eye-hand coordination or poor dynamic balance. However, the ability is an interference derived from observing performance consistencies across similar kinds of movement tasks. This means that an individual consistently performing at the same level on several movement tasks indicates that an essential trait or quality is responsible for the consistent level. Ability can be quite broad, as when stating that an individual is athletic, or can be more limited when saying that an individual has poor arm speed. An ability or a combination of abilities should predict levels of performance across a number of movement tasks (Sugden & Wade, 2013, p.175).

Fine motor skills are defined as "small precise hand movements while maintaining good coordination between the fingers and thumb " (Brotherson, 2009). Also, fine motor skills involve limited activities of the body extremities and are more precise movements of the small muscles in the lips, tongue, eyes, hands, fingers and feet (Mayer Burger & Mayer, 1984). Examples of fine motor skills are grasping, handwriting, releasing, pinching and blinking. Fine motor skills develop with age. Initially clumsy, the child attempts to use a spoon independently. The hand movements of the arms eventually become more precise until the child can take a pencil and verify that it manages to write the letters between the two lines. The most often used method to assess the neuromuscular development of fine motor skills in psychology is a paper-and-pencil test of hand-eye coordination and attention span. Due to this fact, children write their names and numbers, copy geometric figures, complete a drawing, recognize shapes and discriminate among prepositions. The games that encourage the development of fine motor skills should be part of a daily game for preschool children. They contribute to strengthening the hand muscles, its agility, and coordination of the development of eye-hand, the development of perception and concentration, which is a prerequisite for mastering the art of writing (Rodić, 2004).

Gross motor skills are "the ability to perform a movement of the arms, feet or body with a particular control using large muscles of the body" (Brotherson, 2009). Gross motor skills encourage the development of coordination and balance and help the child develop a good perception of their body in space. The development of gross motor skills development in an integrated preschool child is one of preschool age's main physical education objectives. Motor proficiency develops during preschools through various forms of physical activity such as running, jumping, catching, and throwing. According to the authors, Gallahue and Ozmun (2006) and MacNamara et al. (2011), these motoric skills used in everyday recreational activities can be the basis for creating more complex movements. In addition, executing different motor acts, including balance coordination, constitutes motor skills (Henderson, Sugden, & Barnett, 2007). Therefore, children's movements and experiences at preschool age provide a crucial platform for the development of motor skills, namely: locomotor skills (jumping and running, walking, galloping, hopping), object-control skills (throwing, aiming and catching, kicking) and stabilizing skills (static balance as one leg stork and dynamic balance while moving, walking on tip-toes), and all together are *'building blocks'* of motor competence (Stodden et al., 2008). Typically developing children will acquire an entire range of fundamental movement skills that naturally occurs throughout development till the end of preschool (Hardy et al., 2010).

2.2.2 Characteristics of motor development and motor learning in children age three to seven

A child's development in the preschool period, which lasts from about 3 to 6 or 7 years, is dynamic. In addition to biological growth and development, this period of life brings many significant physical and mental changes that the child has to deal with. At the end of this phase, the child must face starting school, gradually separating from the family, and overcoming his egocentric thinking to successfully join a group of peers (Vágnerová, 2000). Typically developing children will acquire an entire range of fundamental movement skills that naturally occurs throughout development.

As the child grows between ages 3 and 6, the number of neurological connections that develop in the brain increases cognitive ability. As a result, the children can complete a larger number of physical activities. As for motor development, motor coordination is improving in all directions. The development of motor skills is reflected in self-service activities, such as undressing, dressing, tying shoelaces, and using cutlery (Bednářová & Šmardová, 2008). Examples, such as handling scissors, manifest the perfection of fine motor skills or improving writing motor skills (holding a pencil, the ability to imitate lines, shapes). Preschool children get dressed, although help is still needed with things like buttons and tied laces (Bednářová & Šmardová, 2008). Running, jumping, and overcoming obstacles have been improved.

The child has a better balance, which allows them to move, jump, and skip. Children between third and fourth year can jump in high 30cm, and long jump 20 – 70 cm (Kragujevic & Rakic, 2004). At the age of 4, it is hooping on one foot, riding a tricycle or a tiny bike with training wheels, throwing the ball over his head, going up and down the stairs—a child with four rides a tricycle, a six-year cycle (Patel, Soares, & Wells, 2017). Motor functions are essential for the perception of a child, especially for space and time orientations. Agility develops when walking and running with a direction change, using exercises with objects, such as a ball. Children aged 3-4 years learn better methods of passive movement, and 5-7 years of age learn better by imitation movement.

Up to 7 years of age, motor abilities improve further. With six-seven years motor skills receive new quality, reflected in the strength, speed, accuracy, and consistency of their appearance. Large muscles are well developed on the limbs and trunks, but small muscles are less developed, especially the muscles of the hands, which may affect the quality of the writing and speed of fatigue (Malina & Bouchard, 1991). In addition, the cause of still poor coordination in that period is incomplete ossification of the phalanx and wrist and incomplete efferent innervation (Brković, 2011), development of these processes runs till the age of 12 (Riegerová & Ulbrichová, 1998). However, from age 7 to the end of puberty, there is a significant improvement to maximum performance in manual skills involving movement time and reaction, typing, or manipulation

Furthermore, they become more proficient in perception-action, allowing them to intercept or avoid moving objects and persons depending on the situation. At this age, they will build the basic skills required in daily life in response to increasingly complex environmental demands. Their abilities will influence future participation and performance in the classroom, physical education, and afterschool activities. The children began to master the fine movements, thanks to the development of the musculature of the hand. At the seven years, there is visible quantitative and qualitative progress in locomotors and manipulative movements (Hardy, 2010). Kragujevic & Rakic (2004) described movement competence at the first grade of elementary school:

About 93 % to 94 % of children are out walking and running smartly and rhythmically straight forward with associated movements opposing legs and hands: step length and speed increase. Gallop-step can move about 84% of children. They successfully master the throwing and catching and control such action's direction, speed, and accuracy. Children in the 1st grade have a strong command of skill in place hopping, jumping, standing long jump (about 97 cm), jumping in the air (about 52 cm), and can learn to skip rope. Because of poor depth perception, jumping in depth is performed with less difficulty (p.7).

During this time, the process and *lateralization* (establishes the domination of one side) but continues to stabilize. Thanks to the dominance of the preferred hand, there is a feeling of high security in the performance of complex motor through concrete tasks and competition (Mareš, Průcha, & Walterová, 2009). The result depends on the efficiency of the coordination of hands/feet. Exercise the non-dominant hand functions can significantly enhance, but never with the aim of translation but because to this page is every respect equally developed. According to Kragujevic and Rakic (2004), a primary 81% of the children belong right-handed. Specifically, diverse and rich experience in children creates a specific awareness of the body and its capabilities. Awareness of his own "self" in no small correlative related experience gained to his body muscle activity. This physical being is seen through a child's motion: lightness and weight and his performance, satisfaction, perception of beauty, feel the power and impression on others.

The *perception* is improving in children of this age. Preschool perception is primarily egocentric and global, related to emotional experience (Malina & Bouchard, 1991; Kragujevic & Rakic, 2004). The child mostly notices what attracts him in some way. Touch, smell, hearing, taste, and sight are getting better and better. The child should be helped to exercise his senses with various fun games (for example, with his eyes closed, then listening to search for a hidden sound toy). A typical example of perception and orientation in space occurs, for example, in the practice of preschool performances. Although the children practised well, changing the space or going on stage changes the perception, affecting the performance because most children get confused in the new environment. If possible, it is best to show the children where they will play or perform, rehearse and point out some landmarks.

Furthermore, individual physical differences play a significant role in preschool. In a children's team, the child can become more robust and more prominent, quickly becoming a leader in the group. Less physically fit children are shy and find it difficult to fit into the team. However, it is not always a question of physical condition. Physical appearance and beauty also play a role. Children should be taught to understand that children with disabilities are different and build a positive attitude toward that (Ričan, 2004).

Unfortunately, not all children can perform at the same level. Children at risk of developmental delay have been found to demonstrate developmental delays in fundamental motor skills development (Connor-Kuntz & Dummer, 1996; Hamilton, Goodway & Haubenstricker, 1999; Goodway & Branta, 2003). Signs of fine motor dysfunction in children include difficulty mastering basic self-help skills such as dressing or putting on shoes, difficulty drawing, drawing objects with a pencil, manipulating scissors, and frequent frustrations when learning new activities (Bednářová & Šmardová, 2008). Some signs of gross motor dysfunction in children are difficulty perceiving body location in a static position, tracking movement while engaging in motor activity, difficulty following instructions, problems translating verbal inputs into appropriate responses, and poor gross motor coordination (Henderson et al., 2007). There are several reasons for inappropriate motor development (disease, disorder or injury). However, the MABC-2 performance test used in this study is a diagnostic tool for developmental delay and can identify a possible reason that influences poor motor performance. Poor motor performance may cause adverse influence in preschool children on everyday life tasks, educational settings, and participation in sport-related PA.

2.2.3 Assessment and tests of motor proficiency in preschool age

Several internationally recognized and standardized assessments of movement skills exist and are widely used in literature and practice to assess the motor performance of children and adolescents. The Movement Assessment Battery for Children - 2nd edition (MABC-2; Henderson, Sugden & Barnett, 2007), Bruininks-Oseretsky Test of Motor Proficiency- 2nd edition (BOT-2; Bruininks & Bruininks, 2005) or Test of Gross Motor Development- 3rd edition (TGMD3; Ulrich, 2013) are the most frequently mentioned in contemporary research in preschool children (e.g., Brown & Lalor, 2009; Piek et al., 2012; Slater, Hillier and Civetta, 2010). These tests have a broad application in physical therapy, psychology and adaptive physical education and are used as research tools. All tests monitor motor efficiency by assessing motor competence and helping decision-making adapt various programs for children. However, they differ, and it is good to know their proprieties before selecting the tool for evaluation or targeted intervention programs.

The BOT-2 test (Bruininks & Bruininks, 2005) is the newest version of BOT (Bruininks, 1978) that has been designed to assess the fine and gross motor skills of children 4 through 21 years of age. Unlike other tests, this test has long and short forms. Long-form measure in 4 areas with eight subtests and 53 tasks in fine manual control, manual coordination, body coordination, and strength and agility. The long-form is the most reliable and comprehensive measure of motor proficiency, taking 40 to 60 minutes for administration. The Bref Form of the test consists of 8 subtests and 13 tasks, which assess fine motor precision and integration, manual dexterity, bilateral coordination, balance, speed and agility, upper-limb coordination, and strength (Bruininks & Bruininks, 2005). The short version is easier to use in screening, program evaluation, and research (administrations take 15 to 20 minutes).

In comparison, the extended version is more suitable for need if suspected of motor problems. The correlations between the two forms range from .82 to 87

(Bruininks & Bruininks, 2005). The scoring system is organized from descriptive categories: total point scores converted to standard scores, and percentile rank regarding age, gender. Combined norms are referenced in the manual too.

The TGMD-3 (Ulrich, 2013), the revised version of TGMD and TGMD- 2 (Ulrich, 1985, 2000), is a standardized, criterion and normative-referenced, valid, and reliable gross motor assessment for children aged 3–10 years and 11 months. The TGMD-2 measures 12 motor skills across two subscales: locomotor (run, gallop, hop, leap, jump, and slide) and object control (throw, catch, kick, strike, roll, and dribble) skills. As could be noticed, the age range here is limited compared to the two other tests and do not assess fine motor skills, i.e. manual dexterity. The scoring system is similar. Each skill ranges from 6 to 10 points, depending on the task. Each skill within a subscale is then summed for a raw skill subscale score. Each subscale can be combined for an overall gross motor raw skill score. Raw scores for locomotor and object control and overall gross motor can be converted into standard scores and percentile ranks based on age and sex (Ulrih, 2000, 2013).

The Movement Assessment Battery for Children-2 (Henderson et al., 2007) is the latest version reversed from older versions Test of Motor Impairment (TOMI; Stot, Moyer, Henderson, 1984) and MABC (Henderson & Sugden, 1992). Unlike the other two tests, the MABC-2 kit has two components for gathering information checklist and a performance test, supplemented with guidelines ecological intervention program. A checklist is a form of a questionnaire about everyday tasks, and it is intended for, i.e. parents and teachers, to rate the child's non-motor and motor competence in predictable and unpredictable environments. A psychologist most often applies it in educational settings.

The MABC-2 performance test assesses the three motor domains: Manual Dexterity, Aiming & Catching, and Balance within eight test items. Unlike the other two tests, tasks differ from age bands: 3–6 years old, 7–10 years old, and 11-16 years. Furthermore, there is no sex separated norms. The raw score can be converted to a standard score (SS) provided for each age group for every item. Component scores (CS) for domains and Total test scores are uniform, and they can be used to compare throughout the different age range. Blank, Smits-Engelsman, Polatajko, & Wilson (2012) said that SS tests and scaling that differ between age groups can cause difficulties with longitudinal analysis of individuals for research purposes or ongoing evaluation. The TTS can be converted to a percentile score according to the MANUAL norms (Henderson et al., 2007) and a traffic light system that describes the level of a child's motor competence. A score at or below the 5th percentile is classified as the *red zone* indicating a significant movement of difficulty. A score between the 5th and 16th percentile is classified as the *amber zone*, indicating a possible risk of movement difficulty. From the 25th percentile to the 99.9 percentile, this score is classified as the *green zone*, the zone of a typically developed child. The mean norm score is SS 10 with a standard deviation of 3.

Slater et al. (2010) ranked MABC-2 and TGMD-2 tests the highest, equally first in identifying children with motor difficulty, in evaluating seven different tests. However, they cautioned that further psychometric properties are required. BOT-2 was ranked as third Slater et al. (2010), where opinions cross concerning reliability in younger children aged 3 to 5. Some found BOT-2 complete version too long and too hard in 4 years old typically developed and 5 years old children with movement difficulties (Blank et al., 2012; Deitz, Kartin, & Kopp, 2007).

2.3 Determinants of motor skill development and level of physical activity

The characteristics of preschool children in terms of integrity mean that the motor, physical, cognitive and conative aspects of child development are closely related. Development in one domain of physical abilities affects development in another domain. Motor development is understood as changes in motor behaviour along the life span and increased capacity to perform specific skills (Sugden &Wade, 2013). Such changes are continuous and provided by the interaction among constraints over the body, the environment and the task (Newell, 1986). Motor skills development during the growth process is influenced by various internal and external factors such as gender, age, physical activity (Barnett et al., 2013; Giagazoglou et al., 2011). Socioeconomic status, mother's educational level or older siblings (Morley, Till, Ogilvie, & Turner, 2015; Venetsanou & Kambas, 2010), ethnicity, and cognitive correlates (Oberer, Gashaj, & Roebers, 2017) were also determinants of motor skill development. A study from Finland by Sääkslahti & Niemistö (2021) pointed out that children living in the small cities and the countryside had better motor proficiency and spent more time playing outdoors than children living in urban areas. The Finnish outdoor environment, such as forest, water, snow and ice, are attractive and can motivate children to challenge their motor skills (Sääkslahti & Niemistö, 2021). Barnett et al. (2013) investigated child, family and environmental correlates. They found that correlates of motor skills differ according to the category of skills. Locomotor skills were associated with age, home equipment and swimming lessons, but only age was significant. Object control was positively associated with age and sex, home equipment, unstructured activity participation, MVPA, parent confidence, but only age, MVPA, and no dance were significantv (Barnett et al., 2013).

Motor competence can be viewed as a determinant of participation and levels of physical activity (Stodden et al., 2008; Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006). Consequently, poor motor performance may cause adverse influence in preschool children on everyday life tasks, educational settings, and participation in sport-related PA (Henderson, Sugden, & Barnett, 2007). Longitudinal studies have shown that children with low motor competence tend to be less physically active than children with higher motor competence, and that trend continues through adolescence and adulthood (Barnett, Morgan, van Beurden, & Beard, 2008; Hands, 2008). In addition, children with suspected motor problems and a low tendency for active play lean towards having an even higher risk of physical inactivity in adolescence (Kantomaa et al., 2011). Furthermore, motor competence has been related to physical fitness (Ivashchenko, Nosko, Bartik, & Makanin, 2020; Haga, 2008a; Hands, 2008) and self-perception (Barnett et al., 2008; Vedul-Kjelsås, Sigmundsson, Stensdotter, & Haga, 2012). On the contrary, reduced physical activity in children with low motor competence may be associated with lower performance levels on several components of physical fitness, such as cardiovascular endurance, muscular strength and endurance, and speed (Haga, 2008b; Hands, 2008; Tsiotra, Nevill, Lane, & Koutedakis, 2009; Zahner et al., 2009). Thus, identifying children who do not prefer active play and have motor problems may allow targeted interventions to support their motor learning and participation in active play and promote physical activity and fitness later in life.

Recent studies show a significant relationship between actual motor competence and perceived competence (LeGear et al., 2012; Robinson, 2010). Young children usually have positive perceptions of their physical competence, although their actual competence might be different and usually low. LeGear et al. (2012) said that these positive perceptions at preschool age provide*" a window of opportunity"* for fostering skillfulness.

A Barnett, Salmon & Hesketh (2016) longitudinal study investigated physical activity in early childhood as a predictor of motor skills competence at 19 months, 3.5 years, and five years. They conclude that more time in the MVPA in early preschool contributes to locomotor skills and ability perception. Still, the MVPA was not a predictor of actual or perceived object control skills (Barnett et al., 2016). This was confirmed by the following study in children aged 4 to 8 years (Barnett, Ridgers, Salmon, 2015), where the only association between facility control skills and PA was found in older preschool children. Thus, the perceived abilities of the ball skill seem to be related to actual competence.

In contrast, two other studies with preschool children found that object control skills were associated with the level of physical activity in boys (Cliff, Okely, Smith, & McKeen, 2009; Temple et al., 2016). Similar to these findings, Xin et al. (2020) reported a strong level of evidence to support low to moderate associations between MVPA and components of FMS, specifically, the total and object control skill. However, this study has not associated stability and locomotor skills with moderate to vigorous PA (Xin et al., 2020).

Furthermore, attending institutions in early childhood such as kindergarten (Sabo, 2003, 2004; Livonen & Sääkslahti, 2014; Venetsanou & Kambas, 2010), recreational and sports clubs (Radošević, Gavrilović, Veselinović, & Parčina, 2018; Temple, Crane, Brown, Williams, & Bell, 2016), and family indoor and outdoor activities (Barnett, Hinkley, Okely, & Salmon, 2013) have a positive impact on child motor learning and development. Temple et al. (2016) have found that the more active categories of physical activities, active recreation and organized sports predict at least one subtype of motor skill in preschool children. However, since the girls were associated only with stork balance, the same study indicates that light needs to be shed on optimally portraying young girls' motor skill proficiency and the relationships between their participation and motor skills (Temple et al., 2016). Also, Olesen, Kristensen, Ried-Larsen, Grøntved, & Froberg (2014) emphasize the large variation of PA among preschool ages, indicating that girls, in particular, are susceptible to the environment offered for PA during the preschool period. A little is known about preschooler organized sports participation (Harlow, Wolman, & Fraser-Thomas, 2018) and is needed to focus on those environmental properties (sport context) that promote motor learning opportunities (Flôres, Rodrigues, Copetti, Lopes, & Cordovil, 2019).

2.3.1 Motor proficiency in relation to organized physical activities

Many children participate in organized sports every year as a way to build physical and social skills. As is well known, playing sports depends on the child's physical growth and neurodevelopmental readiness (Patel et al., 2017). When working with children, it is very important to be aware of the child's level at different stages of development and engage in specific strategies to optimize his abilities in each age group. However, when the demands and expectations exceed the maturation and readiness of the child, the positive influence of participation in organized sports can be negated. In addition, the nature of parental or adult involvement can also influence how participation in organized sports is a positive experience for preschoolers and preadolescents (Washington et al., 2001).

Social interaction becomes complex with the preschool child engaging in various simple games. When choosing sports activities for preschool children, there are particular preferences between the sexes. For girls, the most popular are dance, ballet, and rhythmic gymnastics. In both sexes, swimming and riding a bicycle, boys prefer to participate in contact sports such as martial arts and team sports games such as football (Gutierrez & Garcia- Lopez 2012; Temple et al., 2016; Zahner et al., 2009). Martial arts (judo and aikido) positively affects preschool children's behaviour and motor skill development (Bojanić, Bojanić, Gadžic, & Milosavljević, 2018; Demiral, 2011; Sterkowicz-Przybycień, Kłys, & Almansba, 2014). A recent pedagogical experiment by Galan et al. (2021) has shown the effectiveness of 9 months football classes in 6- years-old children on overall morphological and motor status. Sabo (2004) concluded that activities in the field of physical education in preschool have more significant effects on the development of coordination, flexibility, and balance when children are involved in activities from the nursery, compared to activities carried out from the oldest preschool age to enrollment in primary school.

There are also cultural preferences regarding the popularity of the sport in some countries. For example, Gu et al. (2021) analyzed the influence of table tennis as a physical activity intervention program in a Chinese kindergarten. Children from the experimental group show significant improvement in locomotor skills (gallop, hop, leap, slide) and object control (catch, overarm throw, strike a stationary ball, stationary dribble, and underhand roll). Furthermore, they outperform children from the control group on most gross motor skills. After an intervention, the female experimental group showed significant improvement in the run, horizontal jump, slide scores, and catch. Thus, table tennis as organized physical activity can promote GMS development in preschool age, especially object control skills (Gu et al., 2021).

Temple et al. (2016) emphasize that the more active categories of physical activities, active recreation and organized sports provided for at least one subtype of motor skill in preschool children. However, less active recreational activities were not associated with motor skill levels. In addition, boys scores were significantly higher in object control skills than girls, and girls scores were higher in stork stand than boys. Furthermore, the same study (Temple et al., 2016) found significant differences between participation and motor skills in boys. Although active recreation predicted balance (stork stand times) and object control skills, participation in PA predicted both locomotor and object control skills. The organized sport was related to object control skills only. Temple et al. (2016) also indicate that since no evidence is found in girls, more light needs to be shed on optimally portraying young girls' motor skill proficiency and the relationships between their participation and motor skills. Knowledge of the sources of PA in preschool children is scarce. However, a potentially important finding is the large variation of PA among preschool ages, indicating that girls, in particular, are very sensitive to the environment offered for PA during preschool attendance (Olesen et al., 2014).

Gallotta, Baldari, and Guidetti (2018) investigated the impact of different four-month physical and pre-sport activity programmes on preschool girls motor proficiency. Twenty-five girls, aged between 4 to 6 years, ten practising physical activity, six performing classical dance, nine involved in swimming. Girls' motor competency was assessed with the BOT-2. The differential effects of the interventions appeared in fine manual control and coordination and the running speed and agility. A playful and varied physical activity intervention led by a specialized teacher effectively developed preschool girls' motor skills (Gallotta et al., 2018).

Organized sport has a beneficial effect on typically developed children and children with special needs. Westendorp, Houwen, Hartman, and Visscher (2011) compared the specific gross motor skills related to sport participation of 156 children with mild and borderline intellectual disabilities and 255 typically developing children aged 7-12 years. The most-mentioned sports children with mild ID reported were soccer (65.4%), gymnastics or swimming. The children with borderline ID participated mostly in soccer

(40%), gymnastics (17%), and basketball or judo/karate (10%) and the typically developing children in soccer (41%), gymnastics (16.5%), and volleyball (10%). Children were divided into groups who participated in sports and those who did not in each group. Locomotor skills were not significantly different between sports participants and nonparticipants. However, the object-control subtest scores of the children who participated in sports were significantly higher than those who did not, with a moderate-to-large effect size in the mild ID group on the bounce, the catch and the roll. Furthermore, a significant but small effect was found on strike with borderline ID group and the kick and the overhand throw in typically developed children (Westendorp et al., 2011).

More studies are related to organized physical activities in young school children from age 7. For example, Nazario and Vieira (2014), Ribeiro-Silva, Marinho, Brito, Costa, and Benda (2018), and Vallence et al. (2019) found that children who participated in organized physical activity had better overall scores related to the requirements of each sport discipline than nonparticipants. In addition, Vandorpe et al. (2012) stated that children who consistently engage in sports from 6 - 7 years of age during the following years showed better levels of coordination than children who only partly participated or did not participate in the sports-recreational environment. Nazario & Vieira (2014) investigated the motor performance of Brazilian children 8 to 10 years old in PE classes, rhythmic gymnastics, handball and indoor football. In their study, according to the manual of the TGMD-2 test, below the level expected for age, as “very poor”, were classified children who only attend physical education classes. Furthermore, children who attended rhythmic gymnastics and handball were classified as “below average”, and those enrolled in indoor soccer were classified as “average” (Nazario & Vieira, 2014).

2.3.2 Age and gender differences of motor proficiency

The most commonly investigated determinants were biological and demographic such as sex, age and BMI (see review Barnett et al., 2016). Increasing age was the most coherent determinant of all aspects of motor competence (Barnett et al., 2016; Giagazoglou et al., 2011; Ojari, Arabameri, Ghasemi, & Kashi, 2019; Venetsanou, & Kambas, 2011) and can be interpreted by the rapid progress caused by the biological processes of development during the period between four and eight years of age and master at 9 to 10 (Butterfield, Angell, & Mason, 2012; Halmová & Šimonek, 2020, Ojari et al., 2019). However, in the earliest years, motor development is more influenced by biological maturation, and later, it is more influenced by practice and opportunities (Barnett et al., 2016). Therefore, the relationship between age and gross motor competence may change through the developmental periods of early childhood, preschool age, middle childhood, and adolescence.

Gender was also linked to motor skills development. Some studies stated that boys and girls generally do not differ in total test scores in preschool (Hardy et al., 2010, LeGear et al., 2012; Van Waelvelde, Peersman, Lenoir, Smits Engelsman, Henderson, 2008) rather in individual motor skills. Regarding manual dexterity, more often girls are linked to being better fine motor skills (Flatters, Hill, Williams, Barber, & Mon-Williams, 2014; Morley et al., 2015) or no differences have been found between gender (Kokštejn, Musálek, Šťastný, & Golas, 2017). However, the aforementioned study by Flaters et al. (2014) said that this situation changes with age favouring boys. There is strong evidence that boys have been better in manipulative and object control skills (Foulkes et al., 2015; Goodway, Robinson, & Crowe, 2010; Hardy et al., 2010; Rodríguez-Negro, Huertas-Delgado, & Yanci, 2021; Spessato, Gabbard, Valentini, & Rudisill, 2013). While some studies showed no differences in object control skills between gender (LeGear et al., 2012; Van Waelvelde et al., 2008). On the other hand, girls have better scores in locomotor skills (Foulkes et al., 2015; Hardy et al., 2010) and static and dynamic balance (Kokštejn, Musálek, & Tufano, 2017; Psotta, Hendl, Kokštejn, Jahodová, & Elfmark 2015; Rodríguez-Negro et al., 2021). For example, Psotta et al. (2015) found out that Czech girls established the mature static balance at 7, while the Czech boys by two years later. In studies by Singh et al. (2015) and Van Waelvelde et al. (2008), balance skills have been shown to be similar between gender in early preschool age. Insufficient evidence for gender differences in locomotor skills is observed as well (Barnett et al., 2016; LeGear et al., 2012; Van Waelvelde et al., 2008), while some identify better LOC skills in boys (Piek et al., 2012; Spessato et al., 2013).

Giagazoglou et al. (2011) have found a significant interaction between the tasks performed and the age of participants in the three age groups 4 to 6 in manual dexterity, ball skills, total score, all in favour with increasing age. Boys were better than girls in ball skills. Sports participants were significantly better in all three domains and TTS of the MABC-2 test (Giagazoglou et al., 2011). Kokštejn et al. (2017) found differences between gender in favour of girls in younger age, but these differences did not appear at the end of preschool. In the second study by Kokštejn, Musálek, Šťastný and Golas (2017) that focused as our study on the assessment of motor proficiency of preschool children before the entrance to elementary school, boys outperformed girls in aiming and catching skills—no significant gender differences in manual dexterity and balance are found. Overall, the findings of a low level of FMS in most children and gender differences in aiming and catching skills where girls score in the 25^{th} percentile indicated low aiming and catching skills (Kokštejn, Musálek, Šťastný, et al., 2017).

Spessato et al. (2013) compared the FMS of 3–10 years old boys and girls from Brazil. The finding for locomotor skills differs from most studies that report similar performance values between boys and girls. Boys demonstrated superior scores for object control and locomotor component skill values. However, regarding the norms, the vast majority of both sexes performed below average (Spessato et al., 2013). Foulkes et al., 2015 also found that boys had significantly better object control skills than girls, with greater competence observed for punches and throws over the arm. On the other hand, girls were more competent in running, jumping and galloping.

A study by Morley et al. (2015) determined the motor proficiency of 369 children (176 females, 193 males aged 4–7 years considering gender and socioeconomic status. Significant multivariate effects have been found for gender and socioeconomic status. The mean, standard score classified the participants towards the lower end of the average score using the BOT-2 test. Girls outperformed boys for fine motor skills, and males outperformed females for dribbling and catching gross motor skills.

Differences between gender are observed in some other abilities too. For example, Gadzic and Milanov (2021) examine the differences in abilities where boys were better in two tests: backwards obstacle course and bent arm hang, and girls in the sit and reach test. However, boys were better in coordination and upper body muscular endurance, while girls had a significant advantage in flexibility.

Touwen (1976, after Piek et al., 2012) observed noticeable' differences between boys and girls in developing their motor milestones in childhood. For example, he found that boys seemed to walk or sit earlier than girls, while girls previously developed functional skills such as vocalization and catching. Furthermore, ecosystem theory to understand motor ability has yielded some exciting correlations between child, family, and environment, suggesting that early motor development is influenced by parental support and the child's immediate environment (Barnett et al., 2013). These gender differences can be attributed to stereotypical practices in the school and home environment that support physical activity and play patterns that facilitate the development of specific movement skills. This could, for example, relate to the influence of gender on toy selection for play (Dinella, Weisgram, & Fulcher, 2017), with toys traditionally associated with boys who more often include sports equipment. In contrast, toys commonly associated with girls are dolls, imagined characters, caretaking duties and creative manual dexterity tasks (Pomerleau, Bolduc, Malcuit, & Cossette, 1990).

2.3.3 Motor proficiency in relation to intelligence

Intelligence is described as the ability to learn from experience and understand one's thought processes. The intelligence in children is the ability to adequately adapt to their environment, as different types of a social and cultural environment may require different degrees and types of adaptation. Plhakova (1999) defines intelligence as "individual level and quality of thought processes, which are manifested in solving various problems, whose spectrum ranges from routine, everyday tasks, through unusual practical solutions, to highly theoretical abstract questions. Therefore, intelligence refers to the level of cognitive abilities manifested in various situations (p. 48). "

For examining the intelligence of preschool and elementary school children in Serbia, in terms of school maturity, Raven's progressive colour matrices (CPM) test is used the most frequently (Đorđić, Tubić, & Jakšić, 2016). Regarding the correlation of Raven's progressive colour matrices with other tests for the same purpose, the correlation coefficients between the results of the same subjects obtained using the Bine-Simon scale or Wechsler Intelligence Scale for Children test vary between 0.54 and 0.88, depending on the age and sample size (Fajgelj, Bala, & Tubić, 2007). This is because the sets of CPM were designed to differentiate degrees of intellectual maturity by quantifying a child's ability to make comparisons and reasoning by analogy. School readiness includes maturation and the necessary experience. Maturity for starting school comprises, in addition to biological, the psychological development of the child: intellectual, emotional and social. Relative psychological maturity for starting school is acquired by learning and practising in the preschool period in the family, preschool institution, and peer group (Brkić, 2011). At the core of this factor is the ability to solve problems that require insight—the amount of efficient information in non-volatile memory. Success in solving those problems for which earlier experience is necessary depends on this factor.

Bala & Katić (2009) survey included a sample of 333 preschools at the time of school enrollment. The cognitive aspect of functioning gave a better correlation with motor functioning in females than in male children. Motor functioning correlated better with morphological growth and development in male children, while cognitive functioning was relatively independent. The obtained results are not wholly in line with the existing concept of characteristics of preschool children and partially confirm the theory of integral development of children (Bala & Katić, 2009). Đorđić, Tubić, & Jakšić (2016) investigated the relationship between physical development and motor development and intellectual maturity in 72 children 5 to 6 years old. They found a positive association between physical development with two motor tasks, obstacle course and broad jump, but intelligence was not related to the other two domains.

Kirkendall (1976) considered the idea of integrated development to be sustainable. He pointed out to 205 respondents aged 8 and 9 that there are significant differences between groups of respondents with above-average, average and below-average cognitive status, in favour of above-average ones, especially in coordination tasks. For example, the coordination of the legs consisted of a jump with a rhythmic change of legs. At the same time, hand coordination was hand-holding and detachment in 4, 6 and 8 bars.

Recent research by Klupp et al. (2021) revealed non-significant relations between children's ball skills and intelligence or four components of the WISC-IV test. Similarly, associations between balance skills and intelligence were non-significant (except for perceptual reasoning) and the interaction terms. Therefore, this study mainly focused on manual dexterity and its relation to children's intelligence. A positive correlation is found in typically developed children and a stronger correlation in ADHD children (Klupp et al., 2021). Jenni, Chaouch, Caflisch, & Rousson (2013) said that the correlation between motor and intellectual domains in healthy children is mainly independent. They found weak correlations in performance in the pegboard tasks and visuomotor intelligence and the connection between movement and intelligence in boys.

Zeng et al. (2017) review examining the effectiveness of various physical activity programs on motor skills and cognitive development in healthy children 4–6 years. Ten of fifteen studies reported significant improvements in motor performance. Next, four of five studies investigating the relationship of physical activity on cognitive development showed significant and positive changes in academic achievement, language learning, attention, and working memory (Zeng et al., 2017).

Since the motor delay is understood to be explained by intellectual abilities, at least in part, Smits-Engelsman & Hill (2012) tried to answer research questions concerning the relationship between IQ and motor skills. Furthermore, to make some guideline criteria for clinical decision making. IQ and motor skill data were analyzed from 460 children identified with/without motor difficulties from clinical and educational settings. Results indicated that typical and atypical motor skill was seen at all IQ levels. IQ scores explained 19% of the variance in motor outcomes. For each standard deviation lower IQ, a mean loss of 10 percentile motor points should be expected. Although individuals with a lower IQ more often showed poorer motor performance than those with a higher IQ, motor skill at all proficiency levels was seen in all IQ categories (Smits-Engelsman & Hill, 2012).

A study from Brazil by Barbacena, van Petten, Ferreira, & de Castro Magalhães (2019) investigated the relationship between motor and cognitive abilities in children with developmental coordination disorders, those at risk and typically developed children (Barbacena et al., 2019). Coordination test, MABC-2 test, Raven intelligence test, DCDQ Parent Questionnaire were measured on a sample of 402 children aged 7 to 10 years. Of the total sample, 8.7 % were identified as having DCD. No significant difference was found in the total percentile intelligence score between DCD and non-DCD groups. However, a significant association have been found in children at risk and the non-DCD group. Children at risk have scored more likely below the mean at the cognitive level. In the severe DCD group, there is an association between manual dexterity and the cognitive level. Children who were in a deficit of manual dexterity are more likely to score below the mean at the cognitive level. Overall, there is a significant difference in DCD and non-DCD groups in cognitive level, manual dexterity and cognitive level, TTS and cognitive level. Characteristics of children with motor coordination deficits vary in cognitive performance, and group heterogeneity may have contributed to this result.

However, comparing the results from one study with cognitive abilities and motor skills is challenging since tasks, instruments, and components vary from study to study. A review from van der Fels et al. (2015) used broad concepts of cognitive skills and motor skills, resulting in a detailed overview of the relationship between motor and cognitive skills. Fine motor skills, bilateral body coordination, and timed performance in movements have the strongest relations with cognitive skills.

Oberer et al. (2017) study the relationship between motor coordination and executive functions in 156 preschool children. Specifically, the relationship between gross and fine motor skills and executive functions is related to possible background variables (SES, physical activity). The internal structure of motor skills was investigated and confirmed the theoretically assumed gross and fine motor skills subdivision. Significant correlations have been found in both gross and fine motor skills correlated with executive functions. The background variables SES and physical activity seemed to have no significant impact on the executive functions and motor skills (Oberer et al., 2017).

2.4 Motor skill deficit - Developmental Coordination Disorder

Developmental coordination disorder (DCD) refers to a condition expressed as an impairment in the development of motor coordination that cannot be attributed to other medical disorders, intellectual disability, primary sensor, or motor neurology (American Psychiatric Association [APA], 2013). A primary characteristic of DCD is difficulty learning and performing everyday tasks in all aspects of life (at home, at school, when playing). These practical difficulties are usually inconsistent with the child's chronological age, intellectual ability, learning abilities. According to the Diagnostic and Statistical Manual of Mental Disorders fifth edition (DSM–5; APA, 2013), DCD diagnosis involves the following four criteria:

a) The acquisition and implementation of coordinated motor skills are below the expected standard compared to their age match peers who have the same learning and application conditions. Difficulties manifest clumsiness (e.g., dropping or bumping into objects) and slowness and inaccuracy in performing motor skills (e.g., they have difficulty catching objects, using scissors or cutlery, handwriting or drawing, participating in sports activities or riding a bike).

b) Motor skills deficit significantly and persistently affect daily activities appropriate to the chronologic age (for example, self-care) and interfere with academic/school success, professional and vocational activities, leisure activities and games.
c) The onset of symptoms of coordination difficulties occurs at an early stage of development.
d) Deficit of motor skills cannot be better explained by intellectual disability or visual impairment. Likewise, they cannot be attributed to neurological disorders affecting movements, such as cerebral palsy, muscular dystrophy, or other degenerative disorders (pp. 77-78).

The estimated prevalence of DCD is between 2% and 6% in school-aged children (Cleaton, Lorgelly, & Kirby, 2020), and a further 10% have the condition at a mild level (Gibbs, Appleton, & Appleton, 2007). Kokštejn, Musálek, Šťastný et al. (2017) investigated motor competence in preschoolers at the end of the preschool period and found 2.5% of children with the possible presence of DCD and 10.7% of children with a risk of movement difficulties. The prevalence of developmental coordination disorders (DCD) in Greek children was 5.4%, some motor difficulties demonstrated 6.3%, and 88.4% were above the 15th percentile, indicating no motor problems (Giagazoglou et al., 2011). However, in Serbia, there is no accurate data on the prevalence of DCD because no study has dealt with this problem and data collection, except for a theoretical review of DCD and problem-solving in educational settings (Djordjic, 2010; Tošić & Todorović, 2019). And still is more often use term dyspraxia in practice, than isolated problem as DCD. Polovina and Polovina (2009) said that this pervasive disorder is rarely recognized in our conditions, rarely diagnosed and therefore rarely treated, despite possible long-term consequences. Developmental Coordination Disorder Questioner (DCDQ) has been applied in a recent study on Serbian children and showed good reliability and validity for screening children with coordination problems (Golubović, Kalaba, & Maksimović, 2018).

Children under five years of age should not be diagnosed with developmental coordination disorder, primarily due to the instability of the development of children between the ages of 2 and 5 (Sugden, & Wade, 2013). In most cases, the diagnosis is made between 6 and 12 (Barnhart, Davenport, Epps, & Nordquist, 2003). Most of these children are not identified, and among children with a diagnosis, about 25% are identified in preschool, and the remaining 75% are in the first years of schooling (Gibbs et al., 2007). Because the effects of DCD appear to be so far-reaching, and early life is such a critical period of growth potential, it is essential to emphasize the early identification and intervention of young children suspected of being at risk for DCD (Ruiz-Pérez & Palomo-Nieto, 2018). Parents and teachers play an important role in the early identification of this developmental disorder. They have been an advantage over other professionals because they observe children in various activities, from playing, writing, dressing, and using a variety of accessories (Faught et al., 2008). Still, parent judgements have been more accurate than teachers (Taverna, Tremolada, Bonichini, Intra, & Brighi, 2021).

DCD is often comorbid with other disorders like attention-deficit hyperactivity disorder (ADHD), occurring in approximately 50% of cases (APA, 2013; Gill et al., 2018; Miyahara, Piek, & Barratt, 2006; Sergeant, Piek, & Oosterlaan, 2006), learning disorders as developmental dyslexia (DDL), specific language impairment (SLI), autism spectrum disorder (ASD) and behavioural problems (Cermark, Gubbtay, & Larkin, 2009; Hill, 2001). In addition, studies have also revealed the relationship between motor coordination, executive functions, and working memory, explained by underlying neural mechanisms (Piek, Dyck, Francis, & Conwell, 2007).

The most important is to prevent the consequences of DCD on motor functioning that negatively impact the performance of daily life tasks (Barnett, 2008), as they feel more closed and anxious and less physically and socially capable than their peers (Skinner & Piek, 2001). As already stated, children with developmental coordination disorder generally perform more poorly than other children on various measures reflective of motor control, motor learning, and sensory and perceptual processing.

There is evidence that children with DCD often withdraw from the possibility of physical activity because of their low motor competence (Blank et al., 2012). As a result, they are much less likely to participate in organized and free play activities than their peers. Skills deficits may be less noticeable at an early age because movement requirements are low. However, skills requirements increase with age, and children with motor difficulties lag further behind (Wall, 2004). The result is that joint participation delays skill development, which increases withdrawal from active play. Therefore, early recognition of poor activity performance and participation and other related factors in the preschool phase is essential to promote a successful transition and integration into the primary school environment (Wong, 2002). In addition, the main benefit of early identification could lead to guidance and encouragement to engage in typical childhood activities that increase social participation, self-esteem, and self-efficacy (Missiuna, Rivard, & Bartlett 2003).

2.4.1 Diagnosis and treatment of developmental coordination disorder

Different professionals diagnose DCD as part of a multidisciplinary team, and some experts have more experience with DCD than others. Assessment is within the competence of physiotherapists, occupational therapists and clinical psychologists. Blank et al. (2012) recommended gathering information by examining the role of medical history and interviews, screening by questionnaires, clinical examination and valid motor performance tests. General practitioners perform an initial examination of the child and determine their earlier development and current functioning (Missiuna, Gaines, McLean, DeLaat, Egan, & Soucie, 2008). In addition, the paediatrician excludes other possible diseases and conditions that could result in motor awkwardness. They can then refer the child to an occupational therapist or multidisciplinary team for a broader assessment. It is also necessary for the special educator to rule out learning difficulties. Finally, specialists gather information (interviews, questionnaires as DCDQ and MABC-2 checklist) from the child, parents and school to see how these difficulties affect daily life. The most often used tests for fulfilling criteria A in diagnosis are The Movement Assessment Battery for Children 2nd edition / MABC-2 (Henderson, Sugden & Barnett, 2007), Bruininks-Oseretsky Test of Motor Proficiency / BOT-2 (Bruininks & Bruininks, 2005) or Test of Gross Motor Development 3 / TGMD3 (Ulrich, 2013).

All treatments used in working with students with DCD can be divided into process-oriented treatments (bottom-up approach), task-oriented treatments (top-down approach), traditional occupational therapy treatments, and biomedical interventions. What is essential is that all treatments show success, and task-oriented treatment stands out as the most successful (Blank et al., 2012; Offor, Ossom Williamson, & Caçola, 2016). Niemeijer, Smits-Engelsman, & Schoemaker (2007) have developed Neuromotor Task Training (NTT) in physiotherapy based on a cognitive neuroscience approach to motor control. It combines motor learning and the ecological principle of skill development through repeated learning sessions, environmental constraint manipulations and tasks (Smits-Engelsman et al., 2013). Task-Oriented treatment approaches tend to improve motor skills by learning them while working on the particular task that causes the child difficulty (Hendrson, Sugden, & Barnett, 2007; Smits-Engelsman et al., 2013)—for example, teaching specific motor skills, such as buttoning a jacket and walking upstairs without falling or hitting. Parents and teachers tag the tasks in which a child has movement difficulties on which intervention will focus. This type of treatment is considered the most effective because it allows the student to concentrate on the task instead of its components and practice simpler motor patterns by practising one motor task (Blank et al., 2012, Sugden & Henderson, 2007). Also, by making a polygon, a child learns certain patterns of movement through repeating them. It comes to the point that activity planning is almost reflexive. The more movements (bending, jumping, turning, crawling under an obstacle), the more sensory experiences lead to better motor planning.

A meta-analysis by Offor et al. (2016) supports the notion that task-oriented approaches, traditional and contemporary physical therapy interventions are effective treatment methods for children with DCD. Another traditional method is core stability training, which improves balance, coordination, strength, proximal stability and extremity function (Bhayani & Singaravelan, 2012). Contemporary physical therapy has a lot in common with adaptive physical activities intervention contexts for children with DCD. For example, contemporary physical therapy uses novel methods, including aquatic therapy, rebound training with trampolines to improve balance and stability, interactive metronome training, hippotherapy with horses, and active virtual gaming method (for review, see Gonsalves, Campbell, Jensen, & Straker, 2015). For example, Addy (1996) said that jumping on a trampoline has a specific effect on the body, stimulating the sympathetic and vestibular systems and the proprioceptors, consequently developing muscle tone. The results showed improved motor coordination and balance due to rebound therapy Giagazoglou, Sidiropoulou, Mitsiou, Arabatzi, & Kellis (2015). Lange (2108) said that successful treatment could be expected if the child is involved in all life flows and the school environment.

2.4.2 Children with DCD in physical education and sport classes

The main characteristics of the developmental coordination disorder in the motor domain are poor postural control (moderate hypotension or hypertension, poor distal control, static and dynamic balance), difficulties in motor learning (learning new skills, movement planning, adaptation to change, automation) and poor sensorimotor coordination (limb coordination, use of feedback, strategic planning) - (Geuze, 2005; Henderson et al., 2007). These problems are often identified in physical education classes or when participating in some sport activity. For example, students with DCD have difficulty changing clothes before and after physical education classes, which results from limited fine motor skills as difficulty tying shoelaces and buttoning buttons (Sugden & Henderson, 2007; Sugden & Wade, 2013). Often the problem occurs in distinguishing the front and back of clothing. In addition, issues with posture and balance condition them to sit while preparing for physical education classes (Djordjic, 2017).

Lavay (2005) and Missiuna (2003) explained they need much more effort to learn new motor skills, but often that effort does not result in success. Repeated failures lead to frustration. Problems with coordination and attention make it even more challenging to learn new motor skills. When given a task, it is noticed that there is a long-term latency between the set task and the performance of motor activity. Due to latency, students act lazy or disobedient, and they are not aware of it. Thus, they feel that they are required to be excessive speed and dexterity. Compering themselves with others, they think they are in too much hurry and are overwhelmed and nervous (Faught et al., 2008; Missiuna et al., 2006; Skinner & Piek, 2001).

It has been noticed that in the physical education class or sport-recreative environment, clumsy children more often demonstrate behaviour unrelated to the task and enjoy physical activity less. Because of their clumsiness, they often stumble over objects and collide with other children, making them exposed to potential teasing and ridicule (Faught et al., 2008). They rate their physical competencies as low. That is why additional problems often occur: bad relationships with peers, low self-esteem, internalizing problems (anxiety and bad mood, depression (Missiuna et al., 2006).

Physical education teachers can significantly contribute to the recognition and assessment of DCD because they are educated to observe and assess movement, lead the process of motor learning and accompany students in a variety of motor situations (Lange, 2018). For physical education teachers, an important criterion for whether a child has DCD or is just developing slower than the average child is the speed of progress with exercise. If the child improves relatively quickly with practice, there is likely no DCD (Đorđić, 2010). In clumsy children, the existence of a spiral of failure is evident: due to clumsiness, children avoid participating in physical activity. Because of movement problems, children tend to avoid physical activity and are susceptible to secondary impairments, including decreased strength and power (Missiuna, Rivard, & Bartlett, 2003). Less participation in physical activity leads to lower fitness, contributes to obesity and provides fewer opportunities to practice motor skills, resulting in even weaker skills. The formation of an inactivity cycle may expose clumsy children to a higher risk of cardiovascular disease in adulthood (Faught et al., 2008).

Sometimes educators try to reduce the teaching load for these children, which results in lowered academic expectations. Students with DCD usually do not need a modified program, but certain adjustments are enough. Children must be offered the opportunity to learn or improve motor skills and to know how to utilize them correctly in school and life, at home, and in preparatory sports activities (Válková & Morisbak, 2006). The organization of the PE class must allow all children to participate, make choices, express themselves and evolve as individuals (Bianco & Santarelli, 2006). Some modifications and adaptation strategies within the teaching of physical education are well explained by Ball (2002), Block (2007) and Válková (2010).

3 AIM AND HYPOTHESIS

The study's main aim is to determine the level of motor proficiency and differences in motor skills of preschool children aged 5 to 7 from the Republic of Serbia according to age, gender, cognitive level, and participation in organized physical activities.

Accordingly, the following operational tasks were set in the research:

- to determine the basic characteristics of anthropometric status preschool children age 5 to 7 related to the age, gender, and organized physical activity for boys and girls.
- the determine characteristics of preschool children age 5 to 7 related to cognitive level (IQ rank).
- to investigate the level of motor competence in preschool children from Serbia according to Manual (Henderson et al., 2007).

Specific tasks aim related to groups divided according to age, gender, cognitive level and participation in organized physical activities:

- to establish the characteristics of each group according to the level of motor competence in manual dexterity, aiming and catching, balance and total test score.
- to determine homogeneity and characteristics of each group of preschool children related to manual dexterity age, aiming and catching balance and total test score.
- to determine the contribution of the motoric variable to the characteristics and to establish the distance between groups in each chapter.

3.1 Hypothesis

H_1 There is an expectation of statistical difference in motor proficiency of preschool children aged 5 to 7.

H_{1-1} There is a statistically significant clearly defined boundary in motor proficiency between preschool children aged 5 to 7.

H_{1-2} There is an expectation of statistically significant age differences in manual dexterity, aiming and catching, balance and the total test score of preschool children age 5 to 7.

H_2 There is an expectation of a statistically significant difference in motor proficiency of preschool children related to gender.

H_{2-1} There is a statistically significant clearly defined boundary in motor proficiency between preschool children related to gender.

H_{2-2} There is an expectation of statistically significant differences in manual dexterity, aiming and catching, balance and the total test score of preschool children related to gender.

H_3 There is an expectation of a statistically significant difference in motor proficiency of preschool boys related to participation in organized physical activity.

H_{3-1} There is a statistically significant clearly defined boundary in motor proficiency between preschool boys related to participation in organized physical activity.

H_{3-2} There is an expectation of statistically significant differences in manual dexterity, aiming and catching, balance and the total test score between preschool boys related to participation in organized physical activity.

H_4 There is an expectation of a statistically significant difference in motor proficiency of preschool girls aged 5 to 7 related to participation in organized physical activity.

H_{4-1} There is a statistically significant clearly defined boundary in motor proficiency between 5 to 7 years preschool girls related to participation in organized physical activity.

H_{4-2} There is an expectation of statistically significant differences in manual dexterity, aiming and catching, balance and the total test score between 5 to 7 years preschool girls related to participation in organized physical activity.

H_5 There is an expectation of a statistically significant difference in motor proficiency between preschool children at different cognitive levels according to the Raven test.

H_{5-1} There is a statistically significant clearly defined boundary in motor proficiency between preschool children at different cognitive levels.

H_{5-2} There is an expectation of statistically significant differences in manual dexterity, aiming and catching, balance, and the total test between preschool children at different cognitive levels.

4 METHODS AND MATERIALS

4.1 Participants

One hundred and seventy-five children (male N=84 and female N= 91) age in months 60 to 94 (mean 77 ± 6.4) were selected from kindergarten and sports clubs in the city of Niš, region South of Serbia. Following the design of the study based on participation in organized physical activity, the sample of boys is divided into three subsamples: Control group (n=25), football (n=30) and Judo-sports school (n=29). The girls' sample is divided into 3 subsamples: Control group (n=41), rhythmic gymnastics (n=25) and sports school (n=25). The children from these sports clubs were enrolled in their activities during the whole school year. Since the data was collected in May, the criterion was to have attended at least 75% of classes since September.

The control groups were children from kindergarten who did not participate in sports activities except for those in the kindergarten curriculum. The football group was training frequently, three to four times per week (winter-summer, indoor-outdoor), duration 60 minutes. The program has a pedagogical "fun-football-concept", adjusted football for preschool age. The rhythmic gymnastics group has a program for a younger group practising the basics of rhythmic gymnastics and learning group choreography, while the older group practices with requisites ball, hoop and rope. Classes were two to three-time per week for 60 minutes. The sports school group consists of participants from two groups (one is mixed in boys with judo-elements). The program has been designed explicitly with various activities for preschoolers, with and without requisites, to properly learn and improve fundamental motor skills besides basic gymnastics elements. Classes were three times per week for 60 minutes. All programs are supervised by physical educators and coaches with 30 years of experience working with children.

4.2 Instruments

4.2.1 Anthropometry

All children underwent screening anthropometry with portable anthropometry (by Martin) and tetra-polar bioelectrical impedance device Omron BF511 (Kyoto, Japan).

4.2.2 Movement Assessment Battery 2nd edition (MABC- 2)

The Movement Assessment Battery for Children-2 (Henderson et al., 2007) has two components for gathering information, a checklist and a performance test. A checklist has the form of a questionnaire about everyday tasks, and it is intended for, i.e. parents and teachers, to rate the child's non-motor and motor competence in predictable and unpredictable environments. The second one is the performance test which has been used in this study as a research tool. MABC-2 is an assessment used to identify children with motor difficulties or who might be "at-risk" of developmental coordination disorder in clinical settings. The MABC-2 test assesses in the three motor domains: Manual Dexterity (MD), Aiming & Catching (AC), and Balance (BAL) within eight test items that differ from age bands (ABs); 3–6 years old (AB1), 7–10 years old (AB2), and 11-16 years (AB3). AB1 for 5 to 6 years and AB2 for 7 years old are used for this study. Individual tasks are presented in Table 1.

Table 1 *Individual tasks for age band 1 (AB1) and age band 2 (AB2) in the MABC-2 performance test*

MABC-2 tasks	AB 1 (3–6 years)	AB 2 (7–10 years)	Raw Scores
Manual Dexterity (MD)			
MD1	Posting coins	Placing pegs	Completion time in secs.
	Preferred hand *Non-preferred hand*	*Preferred hand* *Non-preferred hand*	
MD2	Threading beads	Threading lace	Completion time in secs.
MD3	Drawing trail 1	Drawing trail 2	N. of errors
Aiming and Catching (AC)			
AC1	Catching beanbag	Catching with two hands Tennis ball	N. of correct catches max. 10
AC2	Throwing beanbag onto the mat	Throwing beanbag onto the mat	N. of correct throws max. 10
Balance (BAL)			
BAL1 (Static)	One-leg balance	One-board balance	N. of secs maintaining balance (max 30)
	Best leg *Another leg*	Best leg Another leg	
BAL2 (Dynamic)	Walking heels raised	Walking heel-to-toe forwards	N. of correct steps (max 15)
BAL3 (Dynamic)	Jumping on Mats	Hopping on mats	N. of correct jumps/hops out of 5
		Best leg *Another leg*	

The raw score can be converted to a standard score (SS) provided for each age group for every item. The Movement ABC- 2 enables the examiner by summarising standard scores to obtain component scores (CS) and again component standard scores or percentile for each domain, i.e. MD (sum of 3 MD items), AC(sum of 2 AC items), BAL (sum of 3 items), and a Total Test Score (sum of all eight items). The component scores allow the tester to compare the child's abilities in the individual domain. The TTS gave a complete picture of child movement maturity. It can be converted to a percentile score according to the MANUAL norms (Henderson et al., 2007) and a traffic light system that describes the level of a child's motor competence. A score at or below the 5th percentile is classified as the *red zone* indicating a significant movement of difficulty. A score between the 5th and 16th percentile is classified as the *amber zone*, indicating a possible risk of movement difficulty. From the 25th percentile to the 99.9 percentile, this score is classified as the *green zone*, the zone of a typically developed child.

A Czech version of this test is standardized by Pssotta (2014). However, at that time, this project was ongoing and English version and norms have been used since this test is not standardised for the Serbian population. Therefore, the test was translated for examiners, although they were fluent in English. Instructions were explained to children in the Serbian language.

4.2.3 Raven's progressive colour matrices (CPM)

Raven's Coloured Progressive Matrices (CPM; Raven, 1956) are standard nonverbal g-factor or fluid intelligence tests. They are an alternative to standard progressive matrices (SPM) and are intended for children aged 5 to 11. The first version from 1947 was revised in 1956, and this version is still used today in both clinical and research settings. The test consists of 36 tasks divided into three sets, with 12 tasks in each set. Set A is based on complementing continuous structures and is related to visual-perceptual abilities. Set B requires the discovery of an analogy between the elements, while set AB is introduced to reduce the transition in the direction of opinion. Within each set, items are arranged in terms of increasing difficulty. The sets of CPM were designed to differentiate degrees of intellectual maturity by quantifying a child's ability to make comparisons and reasoning by analogy.

The number of corrected answers was taken for further analysis, and obtained percentile score and IQ ranks regarding age and norms, according to Tubić, Fajgelj and Bala (2007) for Serbian preschoolers. This reliability was above 0.85 in the age group of 6 to 11 years and 0.75 in 5 years (Fajgelj et al., 2007). The CPM is used for individual or group testing, and participants have 60 minutes to complete the test. For this study, interest is only at the cognitive level. Therefore, no further analysis was conducted about CPM in this study.

4.3 Procedure

Children were tested individually. Anthropometric characteristics were measured first, followed by a performance test. The assessment required a quiet environment not to disturb participants during the testing. Manual dexterity tasks took place in the classroom with a suitable table while aiming & catching and balance tasks were performed in the school gym. All tasks were clearly explained and demonstrated. The child had two attempts for each task. If the child score below the 16^{th} percentile, they have been tested once again after two or three weeks. Raven test was assessed separately with the school psychologist.

The study was approved by the Ethical Commission of Faculty of Physical Culture, Palacky University Olomouc. Data are collected during the internship in cooperation with the Faculty of Sport and Physical Education University of Niš, Serbia. The examiners were PhD students, postgraduate in Adapted Physical Activity from Czech and Serbia, experienced with MABC- 2 and the previous version of this test (MABC), and school psychologists. The study was conducted following the principles established by the Helsinki Declaration of the World Medical Association (WMA). All parents and guardians have signed a written form confirming participation.

4.4 Data collection and Statistical analysis

A descriptive statistic is applied to determine basic characteristics of participants Mean (M), standard deviation (SD). Different cut-off points have been made on component scores and TTS for this study design to describe group characteristics. Children are categorized into three groups: below-average (scores below and equal to 9 SS/37 percentile), average (10 SS to 12 SS, 50 to 75 percentile), and above-average (scores equal to and above 13 SS/ 84 percentile). Descriptive statistics crosstabs show the level of motor proficiency for each group concerning their scores. Pearson's $\chi 2$ test for continency tables and proportions is used for an association between variables and significant differences between and within groups.

The data on the contingency tables were scaled. Therefore, Multivariate analysis of variance (MANOVA) and discriminant analysis are applied to the scaled data as multivariate procedures follow up with the univariate Roy test and Post Hoc Bonferroni (Huberty & Olejnik, 2006; Stevens, 2002; Tatsuoka, 1971). The Pearson contingency coefficient (c) from 0-1 and eta square (η^2) are estimated effect sizes 0.01, 0.06, 0.14 as small, medium, large. In addition, a discriminant coefficient was calculated to identify potentially significant contributors to discrimination among variables. An indicator of the similarity and difference between groups has been presented by Mahalanobis distance and Cluster tree. The statistical significance was set at $p < 0.05$. The data were analyzed in IBM SPSS Statistics for Windows, Version 21.0. and the statistical program of Smartline agency (Dolga, Novi Sad, Serbia).

5 RESULTS

First of all, descriptive statistics of participants have presented the basic characteristics of anthropometric status related to the age, gender, and organized physical activity, characteristics of preschool children 5 to 7 years old to a cognitive level related to IQ rank and characteristics of motor competence level according to manual.

Table 2 *Anthropometric characteristics of the 5 to 7 years old children related to age, gender, and organized physical activity*

	Groups	n	Weight (kg)		Height (cm)		BMI (kg/m^2)	
			M	SD	M	SD	M	SD
Age	5 years old	39	20.24	3.53	112.71	5.40	15.88	2.04
	6 years old	98	25.17	4.35	122.89	5.50	16.59	2.14
	7 years old	38	26.66	4.28	126.30	5.05	16.66	2.00
Gender	Boys	84	24.64	4.91	121.80	7.49	16.54	2.26
	Girls	91	24.35	4.68	121.32	6.97	16.45	1.96
Boys	Control group	25	24.68	5.29	123.44	6.15	16.12	2.47
OPA	Football	30	24.07	4.39	121.33	8.91	16.27	1.14
	Judo-Sports school	29	25.21	5.18	120.97	6.94	17.17	2.80
Girls	Control group	41	24.63	4.67	121.8	6.22	16.51	2.17
OPA	Rhythmic gymnastics	25	24.16	4.89	120.6	7.80	16.56	1.94
	Sports school	25	24.08	4.64	121.2	7.45	16.24	1.64

Note. M- mean, SD- standard deviation, BMI- body mass index, n- participants per group, OPA- organized physical activity

In Table 2 are presented the basic anthropometric characteristics of participants. We can notice similar SD in all age groups in all age-related parameters. Thus, growth trends are differences between 5 and 6 years old, for weight 4.93 kg and 10.18 cm in height, and between 6 and 7 years old, only 1.49kg and 3.41cm. There are no differences between boys and girls' mean in anthropometric characteristics. However, boys from judo sports schools have a higher body mass index of 17.17, indicating overweight. Based on BIM rank concerning participants' age (Table 30, Appendix 1), 2.3% were underweight, 66.8% were normal healthy weight, 18.3% were overweight, and 12.6% of children were obese.

Table 1 *Descriptive statistics of IQ ranks scores related to age in 5 to 7-year children*

	Superior		High average		Average		Low average	
	IQ>120		IQ110-119		IQ90-109		IQ89-80	
	n	%	n	%	n	%	n	%
Age 5	15.	39.5*	4.	10.5	15.	39.5	4.	10.5
Age 6	9.	9.1	32.	32.3*	53.	53.5	5.	5.1
Age 7	7.	18.4	9.	23.7	19.	50.0	3.	7.9
Total	31	17.7	45	25.7	87	49.7	12	6.9

Table 3 shows that 6,9% of preschoolers fall in lower average IQs, 49,7% high average IQs, 25.7%, and 17.7% have superior IQ. Following the data, we can see that as many as 39.5 % of five-year-old are classified in the superior IQ range.

Table 4 *Level of motor proficiency based on the total test score (TTS) and traffic light system, norms according to the MABC-2 Manual (Henderson et al., 2007)*

	n	Significant movement difficulty TTS ≤ 5th percentile	'At risk' of movement difficulty TTS 6–16th percentile	No movement difficulties TTS > 16th percentile
Boys	84	2 (2.4%)	7 (8.3%)	75 (89.3%)
Girls	91	-	6 (6.6%)	85 (93.4%)
Total	175	2 (1.2%)	13 (7.4%)	160 (91.4%)

Table 4 shows the prevalence of DCD in Serbian preschoolers was 1.2% (n=2), and the prevalence for being at risk of movement difficulty is 7.4%. (n=13). Therefore, 91.4% of preschoolers scored in the green zone, denoted typically developed children. Significant movement difficulty was found in 2 boys and no girls. Prevalence to be at risk of motor difficulty was found in 7 boys (8.3%) and 6 girls (6.6%). The descriptive statistics to individual tasks are presented in Table 31, Appendix 1.

Following the previously established design of the research, the thematic unit of the motor proficiency of the preschool children in relation to age, gender, organized physical activity in boys and girls, and cognitive level will be analyzed. In that way, following chapters, the first part will show the numerical and percentage representation of the level of motor competency of the analyzed parameters with age, gender, organized physical activity in boys and girls, and cognitive level. Then, in the second part, the difference between the groups will be analyzed, i.e. hypotheses will be proved or rejected to assess the obtained results and the expediency of further consideration, determine the directions and methodological priorities of their processing. Then, if there are conditions for that, the characteristics of each group will be defined, the distance and homogeneity between them will be determined. Finally, the obtained results will be graphically displayed.

5.1 Analysis of differences in motor proficiency of preschool children aged 5 to 7

The thematic unit of the motor ability in preschool children related to age will be analyzed. The analysis will be conducted on the domain of motor abilities: Manual Dexterity (MD), Aiming and Catching (AC), Balance (BAL), and Total Test Score (TTS) on a sample of 175 children, which consists of 3 subsamples: five-years-old (n=39), six-years-old (n=98), and seven-years-old (n=38).

5.1.1 Descriptive statistics the level of motor proficiency of preschool children aged 5 to 7 related to MD, AC, BAL and TTS

Table 5 shows the level of motor skills Manual Dexterity, Aiming & Catching, Balance and Total Test Score in percentage (%) concerning scores they achieved on MABC-2 test. Attention is being drawn to significant differences between and within groups. The descriptive procedure can only suggest some individual motor skills characteristics, while the significant difference between the groups related to motor proficiency will be analyzed further.

There is insufficient evidence to suggest an association between age groups and manual dexterity (p=.315), aiming and catching (p=.114), balance (p = .441), and total test score (p=.289) Pearson's coefficient of contingency (c) showed very low to low correlations.

Manual dexterity. In manual dexterity, below-average scores range from 15.8%-33.3%, whereas five-year-olds are more likely to score below the 50 percentile. Average scores range 30.8%-43.9% for six-years-old, above-average range scores range from 33.7%-44.7 for seven-year-olds. Thus, it could be seen how manual dexterity skills slightly increase with age.

Aiming & catching. In total, below 50 percentile on aiming and catching scored 66 children (37.7%), ranging 21.1%-44.9%. Six-year-old (44.9%) were more likely to score below average, and that frequency was significantly higher than in seven-year-old preschool children. On the other hand, seven-year-olds were more likely to score on average (50%) than six-year-olds (30.6% p=.036). The range for children who scored on and above 84 percentile were 23.1%-28.9%.

Balance. Sixty-five children scored below average on balance; scores range from 28.9%-41.8% for six-year-old children. Average scores range from 25.5%-38.5% for five-years-old, above-average scores from 28.2%-34.2% for seven-years-old.

Total test score. By inspecting the presented table, it is possible to notice that the average scores (46.2%) in five-year-olds is significantly higher than the frequency of below-average scores (20.5% p = .019). The frequency above average scores (47.4%) in seven-year-olds is significantly higher than the frequency of below average (13.2% p = .002). Overall, 41 children (23.4%) scored below the norm of the Total Test score. The 50 percentile and above reached 79.5% of five-year-olds, 71.4% of six-year-olds, and 86.8% of seven-year-olds.

Table 5 *Descriptive statistics contingency tables for motor proficiency between preschool children aged 5 to 7*

MABC-2		Below average		Average		Above average			
		n	%	n	%	n	%	p	c
MD	5 years old	13.	**33.3***	12.	30.8	14.	35.9	.315	.162
	6 years old	22.	22.4	43.	43.9	33.	33.7		
	7 years old	6.	15.8	15.	39.5	17.	44.7		
AC	5 years old	14.	35.9	16.	41.0	9.	23.1	.114	.202
	6 years old	44.	**44.9***	30.	30.6	24.	24.5		
	7 years old	8.	21.1	19.	**50.0***	11.	28.9		
BAL	5 years old	13.	33.3	15.	38.5	11.	28.2	.441	.145
	6 years old	41.	41.8	25.	25.5	32.	32.7		
	7 years old	11.	28.9	14.	36.8	13.	34.2		
TTS	5 years old	8.	20.5	18.	**46.2**	13.	33.3	.289	.166
	6 years old	28.	28.6	35.	35.7	35.	35.7		
	7 years old	5.	13.2	15.	39.5	18.	**47.4**		

Note: MD- manual dexterity, AC- aiming and catching, BAL- balance; TTS- Total test score, Below Average score ≤37 percentiles, Average 50-75 percentiles, and Above average ≥84 at MABC-2 test, c- Pearsons coefficient of contingency, p-probability $\chi2$ test

5.1.2 The significant difference in motor competence in preschool children aged 5 to 7

This part will prove or reject the claim that preschool children significantly differ in motor competence according to their age.

MANOVA showed a significant multivariate effect F (8, 338) =2.001, p=.046, between four variables of motor proficiency and groups, and significant discriminant analysis F (8, 338) =1.980, p=.048 indicates a clearly defined boundary in motor competence between age groups (Table 6). Therefore, Hypothesis H_1 and Hypothesis H_{1-1} have been accepted based on the significant values.

Table 6 *MANOVA and discriminant analysis significant differences in motor competence between preschool children related to age*

Analysis	n	F(8, 338)	p
MANOVA	4	2.001	.046
Discriminative	4	1.980	.048

Furthermore, a univariate test (Table 7) has found a significant difference between 5 to 7 years old children in aiming and catching F(2,172)=3.161, p=.045, η^2=.035 small effect size. Thus, 7-years old were better at aiming and catching than 6-years old. Therefore, based on the result, Hypothesis H_{1-2} has been accepted. Furthermore, the discriminative coefficient indicates the contribution to discrimination is the greatest in aiming and catching (.039), manual dexterity (.031) and balance (.028), and TTS (.024).

Table 7 *Univariate Roy test significant differences between gender to manual dexterity, aiming and catching, balance, and total test score*

	F(2, 172)	p	η^2	c.disc
MD	1.922	.149	.022	.031
AC	3.161	**.045**	.035	.039
BAL	1.876	.156	.021	.028
TTS	2.539	.082	.029	.024

Note: MD- manual dexterity, AC- aiming and catching, BAL- balance, TTS- total test score, η^2- effect size coefficient, c. disc- discriminative coefficient

5.1.3 Characteristics and homogeneity of preschool children age 5 to 7 related to MD, AC, BAL, and TTS

Next, the logical sequences of the research are to determine the characteristics and homogeneity of each age group and the distance between them. The fact that discriminant analysis p = .048 means a clearly defined boundary between groups. It is possible to determine each group's characteristics in all three domains and an overall score of motor competence.

Table 8 *Characteristics and homogeneity of boys from the control group, football, and judo- sports school related to MD, AC, BAL, and TTS*

MABC-2	5years	6years	7years	contribution %
AC	moderate	lower	higher* [1]	32.0
MD	lower	moderate	higher	25.4
BAL	moderate	lower	higher	23.0
TTS	moderate	lower	higher* [2]	19.6
n/m	19/39	54/98	22/38	
%	48.7	55.2	57.9	

Note: hmg - homogeneity; contribution % - contribution of variable, MD- manual dexterity, AC- aiming and catching, BAL- balance, TTS- total test score

According to data, children of different ages were different in some domains of motor competence (Table 8). Specific skills appeared to be the best discriminators, aiming and catching with 32%, manual dexterity 25.4% and balance skills with 23%, total test score19.6%. The characteristics of five-year-olds have 19 of 39 children, and homogeneity is 48.7% (smaller). Group has the following properties, for manual dexterity lower, aiming & catching, balance and TTS it is moderate. The characteristics of six-year-olds 54 out of 98 children have homogeneity 55.1% (smaller), which means that this group has properties: lower in aiming & catching, balance and TTS, for manual dexterity it is moderate. Seven-year-olds have the characteristics of 22 out of 38 children, and homogeneity is 57.9% (lower) because 16 children have other characteristics. Therefore, this group has higher scores in all domains and TTS.

5.1.4 Measures of similarities or differences between preschool children aged 5 to 7 related to motor proficiency

Another indicator of similarities or differences was obtained by calculating the Mahalanobis distance between the groups. Distances of different spaces can be compared. The distances from Table 9 indicate the slightest differences between girls from sports school and rhythmic gymnastics 5 and 6 years olds D2= .38 (moderate). The greater differences are between 6 and 7 years old D2= .68 (larger distance).

Table 9 *Distance (Mahalanobis) between children from 5 to 7 years in relation to motor proficiency*

	Age 5	Age 6	Age 7
Age 5	.00	.38	.63
Age 6	.38	.00	.64
Age 7	.63	.64	.00

Based on the presented dendrogram in Figure 1, it can be noticed that the closest are Age 5 and Age 6 with a distance of .38, and the biggest difference is between Age 5 and Age 7, a distance of .70.

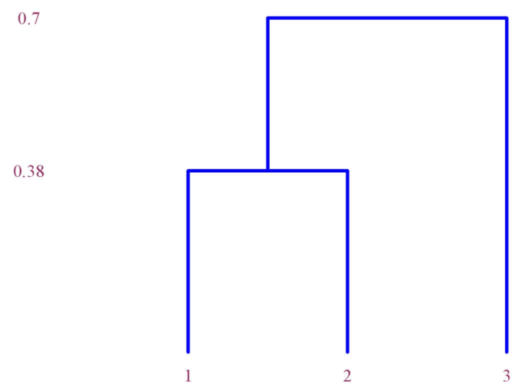


Figure 1. Dendrogram, a cluster of 5 to 7 years old preschoolers -Age 5(1) Age 6 (2) Age 7 (3)

The position and characteristics of preschool children age 5 to 7 with the three most discriminatory variables, Based on the graphical display of the ellipse (confidence interval), it is possible to use the intermediate position and characteristics of each of the three groups of preschoolers from age 5, age 6, and age 7 related to Total Test Score, AC, MD, Bal Component Scores (Cs).

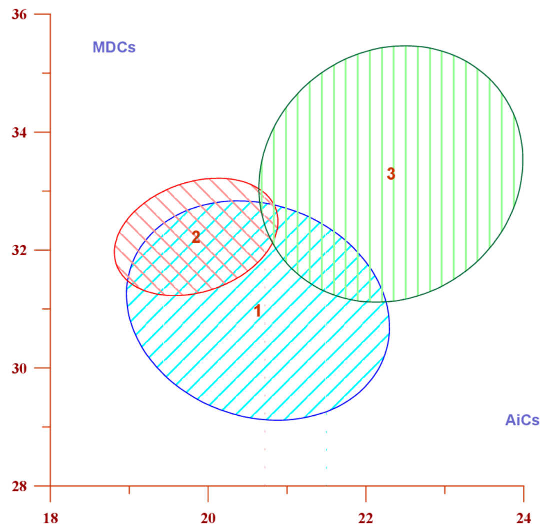


Figure 2. Ellipses (confidence intervals) of children from 5 to 7 years in AC and MD- Age 5(1), Age 6 (2), Age 7 (3), aiming and catching (AiCs) and manual dexterity (MDCs).

It can be observed (Figure 2) that six-year-olds (2) in aiming and catching (AC) have the lowest value, and seven-year-olds (3) have the highest value. Compared to manual dexterity (MD), five-year-olds (1) have the lowest value, and seven-year-olds (3) have the higher value.

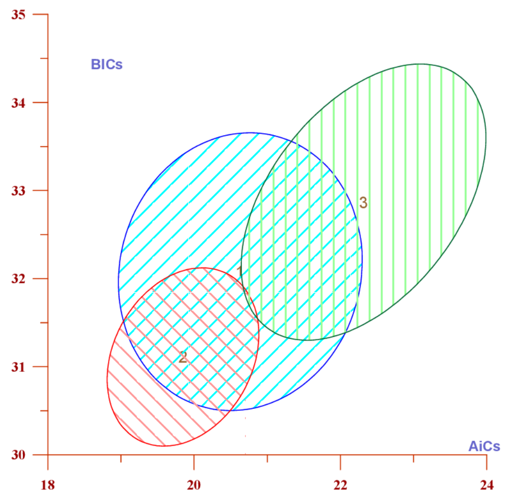


Figure 3. Ellipses (confidence intervals) of children from 5 to 7 years in AC and BAL - Age 5 (1), Age 6 (2), Age 7 (3), aiming and catching (AiCs) and balance (BlCs)

In figure 3, it can be observed that to aiming and catching and balance, six-year-olds (2) have the lowest value, and seven-year-olds (3) have the highest value.

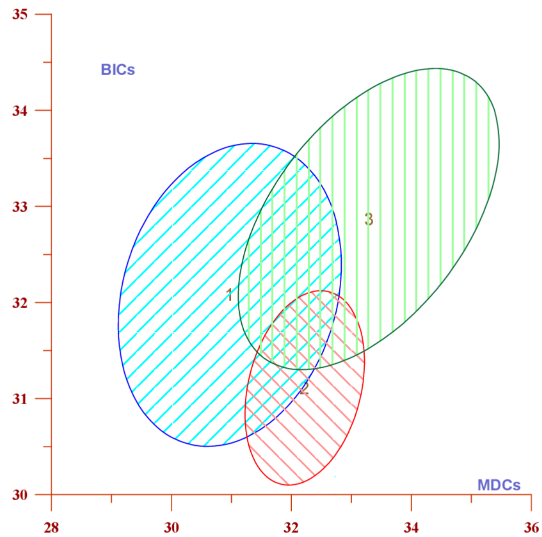


Figure 4. Ellipses (confidence intervals) of children from 5 to 7 years in MD and BAL-Age 5 (1), Age 6 (2), Age 7 (3), manual dexterity (MDCs), and balance (BlCs)

In Figure 4, five-year-olds (1) have the lowest manual dexterity scores and the highest value seven-year-olds (3). About the balance, six-year-olds (2) has the lowest value and the highest value seven-year-olds (3).

5.2 Analysis of differences in motor proficiency of preschool children related to gender differences

The thematic unit of the motor ability in 5 to 7 years old children related to gender will be analysed. The analysis will be conducted on the domain of motor abilities: Manual Dexterity (MD), Aiming and Catching (AC), Balance (BAL), and Total Test Score (TTS) on a sample of 84 boys and 91 girls.

5.2.1 Descriptive statistics the level of motor proficiency of preschool boys and girls related to MD, AC, BAL and TTS

Table 8 shows the level of motor skills Manual Dexterity, Aiming & Catching, Balance and Total Test Score in percentage (%) concerning boys and girls scores.

Attention is being drawn to significant differences between and within groups. The descriptive procedure can only suggest some individual motor skills characteristics, while the significant difference between the groups related to motor proficiency will be analysed further.

Table 10 *Descriptive statistics contingency tables for motor proficiency between boys and girls (N=175)*

MABC-2		Below average		Average		Above average			
		n	%	n	%	n	%	p	c
MD	Boys	24.	28.6	39.	**46.4***	21.	25.0	**.009**	.226
	Girls	17.	18.7	31.	34.1	43.	**47.3***		
AC	Boys	25.	29.8	36.	42.9	23.	27.4	.108	.157
	Girls	41.	**45.1***	29.	31.9	21.	23.1		
BAL	Boys	40.	**47.6***	26.	31.0	18.	21.4	**.005**	.237
	Girls	25.	27.5	28.	30.8	38.	**41.8***		
TTS	Boys	23.	27.4	33.	39.3	28.	33.3	.385	.104
	Girls	18.	19.8	35.	38.5	38.	41.8		

Note: MD- manual dexterity, AC- aiming and catching, BAL- balance; TTS- Total test score, Below Average score ≤37 percentiles, Average 50-75 percentiles, and Above average ≥84 at MABC-2 test, c-Pearsons coefficient of contingency, p-probability $\chi 2$ test

Manual dexterity. There is a correlation between gender and manual dexterity p=.009 since c = .226 correlation is low. 39 boys (46.4%) out of a total of 84 scored average, which is significantly higher than the frequency below the average (n = 24, 28.6% p = .018), and than above average (n = 21, 25 , 0% p = .004). In girls, the prevalence above average (n = 43, 47.3%) is significantly higher than the frequency below average (n = 17, 18.7% p = .000). This frequency was also significantly higher than in boys (25.00% p = .003).

Aiming and Catching. Girls (45.05%) were more likely to score below average, and this frequency was significantly higher than boys (29.76% p=.038). On the other hand, 42.9 % of boys have results on average. However, insufficient evidence suggests no association between gender and aiming and catching p = .108, Pearson's coefficient of contingency c=. 157 correlation is very low.

Balance. Based on proportion, regarding the level of balance, boys (47.6%) were more likely to score below average than average (n=26, 31.0% p=.028) and above-average (n=18, 21.4% p=.000). In contrast, girls were more likely to score above average (n=38, 41.8%) than below average (n=25, 27.5% p=.044). The range for the average scores was 30.7% -31%. Association between balance and gender have been found p=.005, c=.237 correlation was low.

Total Test score. Association has not been found between gender and overall score since p=.385, c=.104 correlation is very low. Note that when we say that someone has scored below average, it means that they have scored below the norm of standard score 10, i.e. below 50 percentile. 19.8% of girls and 27.4% of boys have scored below average in this study. Average scores have ranged from 38.5% - 39.3%, above-average scores, range 33.3% to 41.8% regarding to girls.

5.2.2 The significant difference in motor competence in preschool according to gender

In this part, the claim that there is a significant difference between preschool girls and boys in motor competence will be proved or rejected.

Table 11 *MANOVA and discriminant analysis significant differences in motor competence between preschool children related to gender*

Analysis	n	F (4,170)	p
MANOVA	4	5.461	.000
Discriminative	4	5.441	.000

MANOVA showed a significant multivariate effect F (4,170) =5.461, p<.001, between four variables of motor proficiency and groups, while significant discriminant analysis F (4,170) =5.441, p<.001 indicates a clearly defined boundary in motor competence between preschool children related to gender (Table 11). Therefore, main Hypothesis H2 and Hypothesis H2-1 have been accepted based on the significant values.

Table 12 *Univariate Roy test significant differences gender-related to manual dexterity, aiming and catching, balance, and total test score*

	F (1,173)	p	η^2	c.disc
MD	11.209	**.001**	.061	.036
AC	1.719	.191	.010	.032
BAL	8.429	**.004**	.046	.048
TTS	5.087	**.025**	.029	.002

Note: MD- manual dexterity, AC- aiming and catching, BAL- balance, TTS- total test score, Ƞ2- effect size coefficient, c. disc- discriminative coefficient

Univariate test (Table 12) has found a significant difference between boys and girls in manual dexterity F (1,173) = 11.209, p = .001, η^2=.061, balance F (1,173) = 8.429, p = .004, η^2=.046, and Total Test Score F (1,173) = 5.087, p = .025, η^2=.029.

Post Hoc confirmed significant differences between gender in favour of the girls in manual dexterity mean differences, balance and Total test score. Based on significant results Hypothesis H_{2-2} has been accepted.

AC was a latent variable, but discriminant analysis included it in interpretation. The discriminative coefficient indicates the contribution to discrimination between boys and girls concerning motor skills, i.e., the difference is the greatest in manual dexterity (.036) and balance (.048), and aiming and catching (.032).

5.2.3 Characteristics and homogeneity of the boys and girls related to MD, AC, BAL, and TTS

Next, the logical sequences of the research are to determine the characteristics and homogeneity of each group and the distance between them. The fact that p = .001, discriminant analysis, means a clearly defined boundary between boys and girls. It is possible to determine each group's characteristics in all three domains and an overall score of motor competence.

Table 13 *Characteristics and homogeneity of the boys and girls related to manual dexterity, aiming and catching, balance, and total test score*

	Boys	Girls	contribution %
BAL	lower	higher *	40.7
MD	moderate	higher*	30.5
AC	higher	lower	27.1
TTS	lower	higher*	1.7
n/m	47/84	55/91	
Hmg %	56.0	60.4	

Note: hmg - homogeneity; contribution % - contribution of variable, MD- manual dexterity, AC- aiming and catching, BAL- balance, TTS- total test score

Specific skills appeared to be the best discriminators between gender, balance skills with 40.7%, manual dexterity 30.5%, aiming and catching with 27.1%. However, other variables influenced total test scores. The homogeneity in boys is 56.0% (smaller) and 60.4% (higher) in girls. Girls scored higher in manual dexterity, balance and TTS. At the same time, boys characteristics were slightly better in aiming and catching. Overall, 72,6% of boys and 80,2% of girls scored on and above 50 percentiles.

Mahalanobis distance showed a moderate distance D^2=0.77 between boys and girls motor competence.

5.3 Analysis of differences in motor proficiency of preschool boys related to participation in organized physical activity

The thematic unit of the motor ability in 5 to 7 years old boys related to their participation in organised sports activities will be analysed. The analysis will be conducted on the domain of motor abilities: Manual Dexterity (MD), Aiming and Catching (AC), Balance (BAL), and Total Test Score (TTS) on a sample of 84 boys, which consists of 3 subsamples: Control group (n=25), Football (n=30), and Judo & Sports school (n=29).

5.3.1 Descriptive statistics the level of motor proficiency of boys from the control group, football and sports school related to MD, AC, BAL and TTS

Table 14 shows the level of motor skills Manual Dexterity, Aiming & Catching, Balance and Total Test Score in percentage (%), of each group concerning their scores. Again, attention is being drawn to significant differences between and within groups.

Table 14 *Descriptive statistics contingency tables for motor proficiency between boys oriented to organised physical activity*

MABC-2		Below average		Average		Above average			
	Boys	n	%	n	%	n	%	p	c
MD	Control group	8.	32.0	13.	52.0	4.	16.0	.659	.167
	Football	7.	23.3	15.	50.0	8.	26.7		
	Sports school	9.	31.0	11.	37.9	9.	**31.0**		
AC	Control group	13.	**52.0***	11.	44.0	1.	4.0	**.002**	.412
	Football	3.	10.0	13.	43.3	14.	**46.7***		
	Sports school	9.	**31.0"**	12.	41.4	8.	**27.6"**		
BAL	Control group	13.	52.0	6.	24.0	6.	24.0	.531	.190
	Football	11.	36.7	11.	36.7	8.	**26.7**		
	Sports school	16.	**55.2**	9.	31.0	4.	13.8		
TTS	Control group	11.	**44.0***	10.	40.0	4.	16.0	**.037**	.330
	Football	3.	10.0	14.	46.7	13.	**43.3***		
	Sports school	9.	**31.0"**	9.	31.0	11.	**37.9"**		

Note: MD- manual dexterity, AC- aiming and catching, BAL- balance; TTS- Total test score, Below Average score ≤37 percentiles, Average 50-75 percentiles, and Above average ≥84 at MABC-2 test, c-Pearsons coefficient of contingency, p-probability $\chi 2$ test

Manual dexterity. In the domain of manual dexterity, half of the participants achieved average in the football group (50%) and the control group (52%). Judo- sports school group has weakly expressed characteristics above average. Association between groups related to fine motor skills has not been found $\chi2(4)=2.419$, $p = .659$ Pearson's coefficient of contingency was very low c= .167.

Aiming and catching. Considering differences in the groups, 52% of the participants in the control group scored below average, based on proportion is significant for the analysis since only one participant from 25 reached a score above average**.** Boys from the football group showed a positive trend by reaching higher scores 46.7% above- average and 43.3% average; they were good at aiming and catching. Improvement is clear in boys from football, moderate in a judo-sports school group and minimal with boys from the control group who do not participate in the organised sports activity.

Based on $\chi2(4)=17.197$, $p = .002$, there is an association between boy's groups and aiming and catching tasks since the c= .412 correlation is moderate. Boys from the control group were likely to have scored ≤ 37 percentile (below average) than football players (10%) $p=.001$, and football players were more likely to have higher and equal scores to 84 percentile (above average) than a control group $p=.001$.

Balance. In the case of balance, we can notice that in all groups high percentage of respondents between 36.6% and 55 .2% result below average. In the control group, 13 boys (52%) out of a total of 25 had a score below average, according to the proportions significantly higher than the frequency average (24%, $p = .047$) and above average (24%, $p = .047$). In Football, below average (36.6%) and above-average is more represented (26.67%). In a Judo- sports school, the frequency below average (55.2%) is significantly higher than the frequency above average $p = .002$. However, insufficient evidence suggests no association between groups and balance $p = .531$, Pearson's coefficient of contingency c=. 190 correlation is very low.

Total Test Score. By proportion within groups, 44% of boys from the control group scored below average, significantly higher than the frequency above average $p = .036$. In Football frequency of the average scores, 46.7%, is significantly higher than the frequency below average (10%, $p = .003$). As well. 43,3% of participants from that group reach the TTS above average. In Judo- sports school, 38% scored above average.

The difference between the groups: 44% of boys from the control group scored below-average, significantly higher than the frequency in the football group (10%, p = .006). For the average, the most frequent were boys from football (46.7%), as well for the above-average (43.33%), which is significantly higher than the frequency of the control group (16%, p= .033). Association has been found between groups and overall score since $\chi 2(4)=10.232$, p=.037, c= .330 correlation is low.

5.3.2 The significant difference in motor competence between preschool boys according to their participation in organised physical activity

In this part, the claim that preschool boys have a significant difference in motor competence according to their participation in organised physical activity will be proved or rejected.

Table 15 S*ignificant differences in motor proficiency between preschool girls according to their participation in organised physical activity*

Analysis	n	F (8,156)	p
MANOVA	4	2.844	**.006**
Discriminative	4	2.887	**.005**

MANOVA showed a significant multivariate effect F (8,156) =2.844, p=.006, between four variables of motor proficiency and groups, while significant discriminant analysis F (8,156) =2.887, p=.005 indicates a clearly defined boundary in motor competence between groups. Therefore, based on the significant values, Hypothesis H_3 and Hypothesis H_{3-1} have been accepted.

Table 16 *Univariate Roy test significant differences between groups related to manual dexterity, aiming and catching, balance, and total test score*

	F (2,81)	p	η^2	c.disc
MD	.893	.413	.013	.021
AC	10.524	**.000**	.204	.142
BAL	1.215	.302	.028	.021
TTS	4.923	**.010**	.101	.006

Note: MD- manual dexterity, AC- aiming and catching, BAL- balance, TTS- total test score, Ƞ2- effect size coefficient, c. disc- discriminative coefficient

Univariate test (Table 16) has found a significant difference in some domains of motor competence between groups of respondents in aiming & catching (F (2,81) = 10.524, p = .001, η^2=.204) and Total Test Score (F (2,81) = 4.923, p = .010, η^2=.101), hypothesis H_{3-2} has been accepted. No statistically significant differences were observed in motor performance between the groups in manual dexterity and balance. MD and BAL were latent variables.

Post Hoc confirmed significant differences between football and the control group, where boys attending football were significantly better in aiming & catching $p<0.001$ and had a better Total test score $p= .010$. Furthermore, the discrimination coefficient indicates the most potent contribution to discrimination between groups concerning motor skills, i.e., the difference is the greatest in aiming & catching (.142).

5.3.3 Characteristics and homogeneity of the control, football and judo-sports school groups

On the previous analysis of a sample of 84 boys, following the methodology, logical sequences of the research are to determine the characteristics and homogeneity of each group and the distance between them. The fact that $p = .004$, discriminant analysis, means a clearly defined boundary between groups. It is possible to determine each group's characteristics in all three domains and an overall score of motor competence. The property of each subsample in the group is defined mainly by AC because the feature's contribution to the characteristics is 74.7% (Table 17).

Table 17 *Characteristics and homogeneity of boys from the control group, football, and judo- sports school related to MD, AC, BAL, and TTS*

	Control group	Football	Judo- sports school	Contribution %
AC	lower*	higher*	lower " higher "	74.7
BAL	-	-	-	11.1
MD	-	-	-	11.1
TTS	lower*	higher*	lower " higher "	3.1
n/m	20/25	18/30	21/29	
Hmg %	80.0	60.0	72.4	

Note: hmg - homogeneity; contribution % - contribution of variable, MD- manual dexterity, AC- aiming and catching, BAL- balance, TTS- total test score

The control group's characteristics have 20 out of 25 respondents. Homogeneity is 80.0% (higher), which means that five respondents have other characteristics than their group characteristics. Mainly they had achieved scores lower (AC*, TTS*) and average. The football group's homogeneity is 60.0% (higher), and 12 boys have other characteristics. Mostly they scored average and higher (AC*, TTS*). Characteristics of judo-sports school have 21 of 29 respondents. Homogeneity is 72.4% (higher) because eight respondents have other characteristics. Mostly they resulted in all levels through all domains, except balance, where they performed poorly.

5.3.4 Measures of similarities or differences between the control group, football, and judo- sports school related to motor proficiency

By calculating the Mahalanobis distance between the groups, another indicator of similarities or differences was obtained. Distances of different spaces can be compared. Here, the smaller distance is between judo-sports school and football groups (D^2=.70, moderate), and the greatest distance is between the football and control group (D^2=1.27, larger).

Table 18 *Distance (Mahalanobis) between the control group, football, and judo-sports to motor proficiency*

	Control group	Football	Judo- sports school
Control group	.00	1.27	.80
Football	1.27	.00	.70
Judo-sports school	.80	.70	.00

The dendrogram Figure 5 shows subsamples' clustering (grouping) according to the analysed parameters based on mutual distances. Based on the cluster tree, it can be noticed that boys from football and judo-sports schools have grouped as similar with .70, while the control group differs the most 1.17.

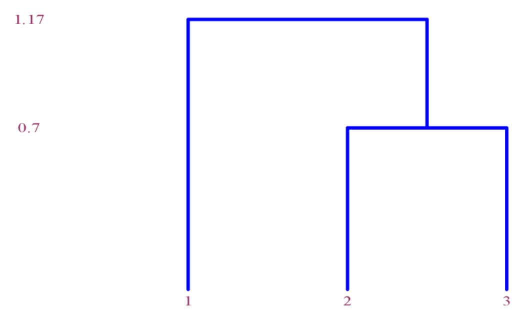


Figure 5. Dendrogram, a cluster of preschool boys motor competence related to participation in OPA – Control group (1) Football (2) Judo – sports school (3)

The position and characteristics of boys motor competence with the three most discriminatory variables, the ellipses show the relationship and characteristics of each group of boys Control group (1) Football (2) Judo / Sports school (3), with the three most discriminatory features: AC, BAL, MD.

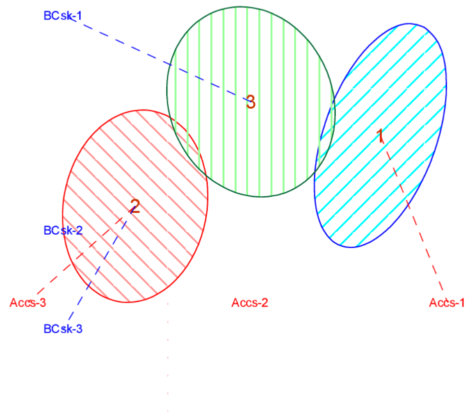


Figure 6. Ellipses (confidence intervals) of boys related to OPA in AC and BAL- Control group (1), Football (2), Judo / Sports school (3), aiming and catching (ACCs) and balance (BCCs).

In figure (6), it can be seen that the subsample Football (2) is the most represented by an *above-average* with the AC axis. For the subsample Control group, (1) the most represented is *below average*. Above-average dominates for the Football (2) subsample with the BAL axis, and *below-average* dominates for the Judo / Sports school (3).

In figure 7, it can be seen that with the AC axis, the subsample Football (2) is the most represented by three *above average*, and for the subsample Control group (1), the most represented is *below average*. On the other hand, with the MD axis, three above-average dominates for the Judo / Sports school (3) subsample, and 2 average dominates for the Control group (1).

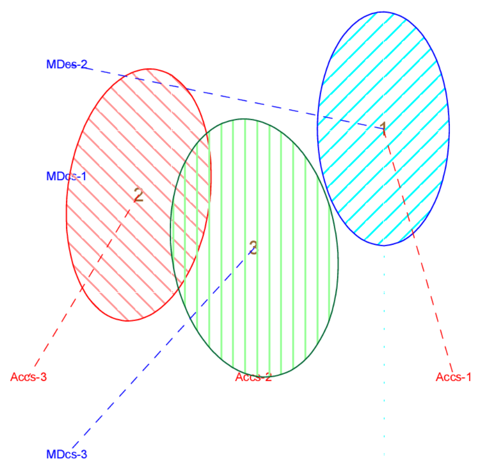


Figure 7. Ellipses (confidence intervals) of boys related to OPA in AC and MD- Control group (1), Football (2), Judo / Sports school (3), aiming and catching (ACCs) and manual dexterity (MDCs).

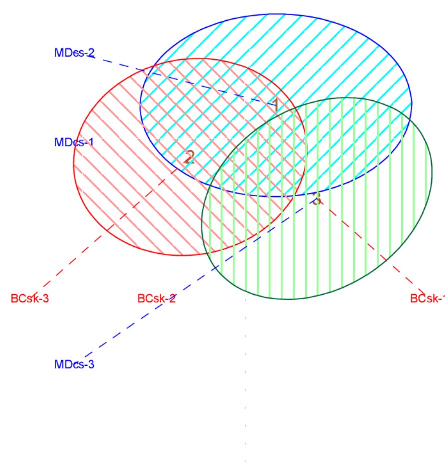


Figure 8. Ellipses (confidence intervals) of boys related to OPA in BAL and MD- Control group (1), Football (2), Judo / Sports school (3), balance (BCCs) and manual dexterity (MDCs).

In figure 8, it can notice more similarities between groups, boys from Judo - sports school had a balance below average and manual dexterity *above average;* the control group had *the average manual dexterity*, boys who participated in football had balance characteristics *above average*.

5.4 Analysis of differences in motor proficiency of preschool girls related to organised physical activity

The thematic unit of the motor ability in 5 to 7 years old girls related to their participation in organised sports activities will be analysed. The analysis will be conducted on the domain of motor abilities: Manual Dexterity (MD), Aiming and Catching (AC), Balance (BAL), and Total Test Score (TTS) on a sample of 91 girls, which consists of 3 subsamples: Control group (n=41) Rhythmic gymnastics (n=25) and Sports school (n=25).

5.4.1 Descriptive statistics the level of motor proficiency of girls from the control group, rhythmic gymnastics and sports school related to MD, AC, BAL, and TTS

Table 19 shows the level of motor skills Manual Dexterity, Aiming & Catching, Balance and Total Test Score in percentage (%), of each girls group concerning the level of their scores of MABC-2 test. Attention is being drawn to significant differences

Table 19 *Descriptive statistics contingency tables for motor proficiency between girls oriented to organised physical activity*

MABC-2	Girls	Below average		Average		Above average			
		n	%	n	%	n	%	p	c
	Control group	9.	22.0	12.	29.3	20.	48.8	.742	.145
MD	R.gymnastics	5.	20.0	8.	32.0	12.	48.0		
	Sports school	3.	12.0	11.	**44.0**	11.	44.0		
	Control group	25.	**61.0***	12.	29.2	4.	9.8	**.001**	.354
AC	R.gymnastics	6.	24.0	8.	32.0	11.	**44.0***		
	Sports school	10.	40.0	9.	36.0	6.	24.0		
	Control group	14.	**34.1**	11.	26.9	16.	39.0	.273	.231
BAL	R.gymnastics	5.	20.0	6.	24.0	14.	**56.0***		
	Sports school	6.	24.0	11.	**44.0**	8.	32.0		
	Control group	13.	**31.7***	16.	39.0	12.	29.3	**.042**	.313
TTS	R.gymnastics	1.	4.0	9.	36.0	15.	**60.0***		
	Sports school	4.	16.0	10.	40.0	11.	44.0		

Note: MD- manual dexterity, AC- aiming and catching, BAL- balance; TTS- Total test score, Below Average score ≤37 percentiles, Average 50-75 percentiles, and Above average ≥84 at MABC-2 test, c-Pearsons coefficient of contingency, p-probability $\chi 2$ test between and within groups. The descriptive procedure can only suggest some individual motor skills characteristics, while the significant differences between groups related to motor proficiency will be analysed further.

Manual dexterity. Most of the girls who had excellent manual dexterity scored above the average range from 44% - 48.8, and average range from 29.3% to 44%. Below average scored 12% - 22% of participants. Association between groups related to fine motor skills has not been found [$\chi2(4)= 1.967$, $p = .742$] Pearson's coefficient of contingency was very low c= .145.

Aiming and catching. In total, 29 girls score on average, ranging in groups from 29.3% - 36 %. The majority of girls from the control group, 61% and 40% from the sports school group, score below average. Based on proportion, this frequency was statistically significant in the control group than the frequency of average (n=12, 29.3% p=.005) and above-average (n=4, 9.8% p=.000). The Rhythmic gymnastics (44%) were more likely to score above average than girls from the control group. There is an association between aiming and catching tasks and girls groups since the $\chi2(4)=13.034$, p=.011, Pearson's coefficient of contingency showed a low correlation c=.354.

Balance. There is not enough evidence to suggest an association between groups and balance $\chi2(4)=5.142$, $p = .273$, Pearson's coefficient of contingency c=. 231 correlation is low. However, 56% of the girls who attended rhythmic gymnastics reached an above-average score, and that frequency was significantly higher than average scores (n=6, 24.0% p=.025) and below-average scores (n=5, 20.0% p=.012). They were slightly better than girls from the control group (34.1% below average, 39% above average) and sports school (44% average, 32% above average).

Total test score. Based on the final results, 31.7% of girls from the control group scored below average, significantly higher than the rhythmic group (4.00% p=.016). Average scores range from 36% to 40%. The 96% of rhythmic gymnastics scored above 50 percentile. Since only one girl scored below the norm, they were more likely to score $\geq$84 percentile p.= 010. 84% of girls from sports school score 50 percentile and above, frequency above average was significant p=.036 since four respondents scored on and below 37 percentile. Association has been found between groups and total test score since $\chi2(4)=9.889$, $p = .042$ c= .313 correlation is low.

5.4.2 The significant difference in motor competence between preschool girls age 5 to 7 according to their participation in organised physical activity

This chapter will prove or reject the claim that preschool girls significantly differ in motor competence according to their participation in organised physical activity.

Table 20 *MANOVA and discriminant analysis significant differences in motor competence between preschool girls according to their participation in organised physical activity*

Analysis	n	F (8,170)	p
MANOVA	4	2.719	**.008**
Discriminant	4	2.686	**.008**

Based on results $F(8,170)=2719$, $p=.008$ (MANOVA) and discriminant analysis $F(8,170)=2.686$, $p=.008$ means that there is a significant difference and a clearly defined boundary in motor competence between preschool girls according to their participation in organised physical activity. Therefore, based on the significant values, Hypothesis H_4 and Hypothesis $H_{4\text{-}1}$ have been accepted.

Table 21 *Univariate Roy test significant differences between groups related to manual dexterity, aiming and catching, balance, and total test score*

	F (2,88)	p	η^2	c. disc.
MD	.983	.378	.001	.021
AC	7.277	**.001**	.139	.074
BAL	1.739	.182	.027	.043
TTS	5.394	**.008**	.105	.041

Note: MD- manual dexterity, AC- aiming and catching, BAL- balance, TTS- total test score, Ƞ2- effect size coefficient, c. disc- discriminative coefficient

Hypothesis $H_{4\text{-}2}$ has been accepted as well. Univariate test (Table 21) has found a significant difference in some domains of motor competence between groups of respondents in aiming & catching $F(2,88)=7.277$, $p<.001$, $\eta^2=139$ and TTS $F(2,88)=5.394$, $p=.008$, $\eta^2=.105$. Post Hoc confirmed significant differences girls attending rhythmic gymnastics were significantly better in aiming & catching $p<0.001$ and had a better Total test score $p= .006$. The coefficient of discrimination indicates the most powerful contribution to discrimination between groups in AC (.074), BAL (.043), TTS (.041). MD and BAL were latent variables, but discriminant analysis included them in the processing.

5.4.3 Characteristics and homogeneity of the control, rhythmic gymnastics, and sports school groups

Based on previous considerations and analysis of a sample of 91 girls, the logical sequence of the research is to determine the characteristics and homogeneity of each group of respondents and the distance between them. The fact that p = .008, discriminant analysis, means that there is a clearly defined boundary, and it is possible to determine the characteristics of each group with specific motor skills.

Table 22 *Characteristics and homogeneity of girls from the control group, rhythmic gymnastics, and sports school related to MD, AC, BAL, and TTS*

	Control group	Rhythmic gymnastics	Sports school	Contribution %
AC	lower *	higher *	-	41.4
BAL	-	higher *	-	24.0
TTS	lower *	higher *	-	22.9
MD	-	-	-	11.7
n/m	26/41	18/25	14/25	
%	63.4	72.0	56.0	

Note: hmg - homogeneity; contribution % - contribution of variable, MD- manual dexterity, AC- aiming and catching, BAL- balance, TTS- total test score

Aiming & Catching most defines the property of each subsample because the feature's contribution to the characteristics is 41.4%, followed by BAL (24.0%) and TTS (22.9%). According to participation in organized physical activity, preschool girls were significantly different in some domains of motor competence. Specific skills appeared to be the best discriminators, aiming and catching with 41.4%, balance skills with 24%, and total test score 22.9%.

Based on the above, it can be said that the homogeneity of the control group is 63.4% (higher), which means that 15 of 41 girls have other characteristics than the characteristics of their group. This means that respondents whose characteristics are similar to the characteristics of the control group, and their membership in the group is unknown, can be expected with a reliability of 63.4% to belong to the control group, i.e., it is possible to make a forecast with some reliability. Girls from the control group mainly had achieved scores significantly lower in aiming & catching and total test score. Moreover, 61% expressed poor aiming and catching skills. In addition, 68.3% scored above 50 percentile on the Total Test Score.

The homogeneity of the rhythmic gymnastics group was higher (72.0%). Seven girls of 25 had other characteristics. However, they had achieved significantly higher aiming & catching scores and total test scores. In addition, 80% scored above 50 percentiles on balance and 96% on the total test score.

Characteristics of sports schools have 14 out of 25 girls. Homogeneity was 56.0% (smaller). They mostly had resulted from the average and higher average. In addition, 84% scored above 50 percentiles on the Total Test Score.

5.4.4 Measures of similarities or differences between the control group, rhythmic gymnastics, and sports school related to motor proficiency

Another indicator of similarities or differences was obtained by calculating the Mahalanobis distance between the groups. The distances from the table indicate that the slightest differences are between girls from sports school and rhythmic gymnastics D^2= .73 (moderate), and the greater differences are between rhythmic gymnastics and control group D^2=1.05 (larger distance).

Table 23 *Distance (Mahalanobis) between the control group, rhythmic gymnastics, and sports to motor proficiency*

	Control group	Rhythmic gymnastics	Sports school
Control group	.00	1.05	.78
Rhythmic gymnastics	1.05	.00	.73
Sports school	.78	.73	.00

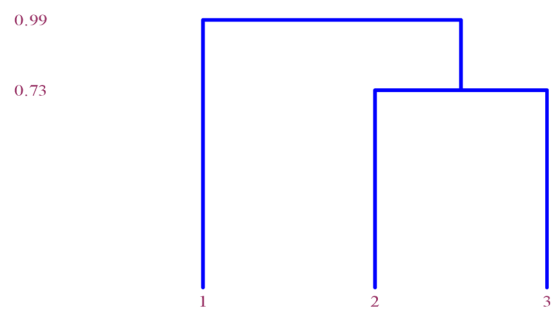


Figure 9. Dendrogram, a cluster of preschool girls motor competence related to participation in OPA – Control group (1) Rhythmic gymnastics (2) Sports school (3)

Based on the presented dendrogram, it can be noticed that the closest are rhythmic gymnastics and sports school with a distance of .99, and the most significant difference is between the control group and Rhythmic gymnastics, with a distance of .73

Position and characteristics of girl's motor competence with the three most discriminant variables, the ellipses show the relationship and characteristics of each of the three most discriminative features: Aiming and catching (AC), Balance (BAL), Total test score (TTS).

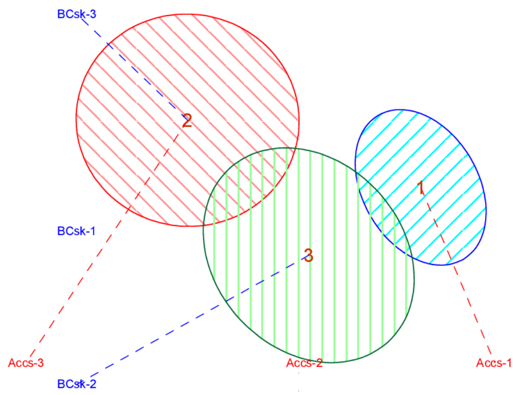


Figure 10. Ellipses (confidence intervals) of girls related to OPA in BAL and AC-Control group (1), Rhythmic gymnastics, (2), Sports school (3); The abscissa (horizontal axis) is aiming and catching (ACCs), and the ordinate (vertical axis) is Balance (BCCs).

In Figure 10, it can be noticed that with the AC axis, the subsample rhythmic gymnastics (2) is the most represented above average, and for the control group (1) is the most represented below average. On the other hand, with the BAL axis, for the sports school group (3) is dominated by the average, and for rhythmic gymnastics (2), it is dominated by the above average.

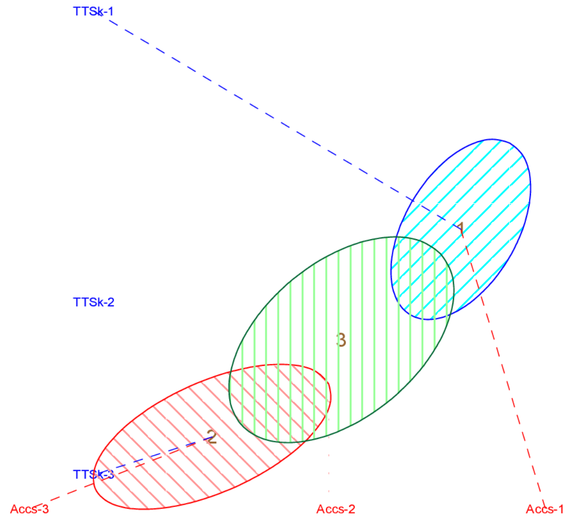


Figure 11. Ellipses (confidence intervals) of girls related to OPA in BAL and AC-Control group (1), Rhythmic gymnastics, (2), Sports school (3). The abscissa (horizontal axis) is AC, and the ordinate (vertical axis) is TTS.

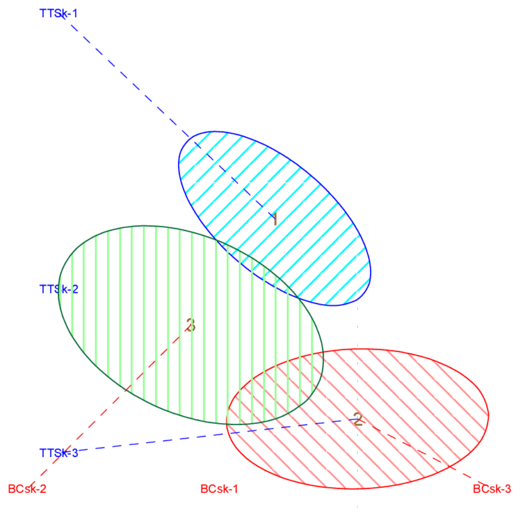


Figure 12. Ellipses (confidence intervals) of girls related to OPA in BAL and AC-Control group (1), Rhythmic gymnastics, (2), Sports school (3); The abscissa (horizontal axis) is BAL (BCsk), and the ordinate (vertical axis) is TTS (TTSk).

In Figure 11, it can be noticed that with the AC axis, the subsample rhythmic gymnastics (2) is the most represented above the average, and for the control group (1) is the most defined below the average. On the other hand, with the TTS axis, for subsample rhythmic gymnastics (2), dominates above average, and for the control group (1), dominates below the average.

Insight into Figure 12 BAL axis shows that sports school (3) is the most represented in average scores. However, the subsample rhythmic gymnastics (2) is the most represented by above-average scores. On the other hand, for subsample, rhythmic gymnastics (2) dominates above average with the TTS axis, and for the control group (1) dominates below average.

5.5 Analysis of differences in motor proficiency between preschool children at different cognitive level

The analysis will be conducted on motor skills, manual dexterity, aiming & catching, balance, and total test score, on a sample of 175 preschool children age 5 to 7. Children were divided according to intelligence quotient based on Raven's manual in 4 subsamples: superior rank IQ> 120 (n = 31), high average IQ 110-119 (n = 45), average IQ 90-109 (n = 87) and lower average IQ 80-89 (N = 12).

5.5.1 Descriptive statistics the level of motor proficiency of preschool children at different IQ levels according to the Raven test

Table 24 shows the level of motor skills Manual Dexterity, Aiming & Catching, Balance and Total Test Score in percentage (%), of each IQ group concerning the level of their scores of MABC-2 test. Attention is being drawn to significant differences between and within groups. The descriptive procedure can only suggest some individual motor skills characteristics, while the significant difference between the groups related to motor proficiency will be analysed further.

Manual dexterity. Association between groups with different IQ related to fine motor skills has not been found, p = .642 Pearson's coefficient of contingency was very low c= .154. In manual dexterity, the above-average score range from 25% - 48.4%, and the average range from 32.3% to 44.4%. Below average scored 17.8% - 33.3% of participants. Children with superior IQ were more likely to score ≥84 percentiles. Children with a high average IQ, under 50 percentile, while 33.3% from the lower average IQ scored equal and below 37 percentile on manual dexterity.

Table 24 *Descriptive statistics contingency tables for motor proficiency between preschool children at different IQ levels according to the Raven test*

		Below average		Average		Above average		p	c
		n	%	n	%	n	%		
MD	IQ>120	6.	19.4	10.	32.3	15.	**48.4**	.642	.154
	IQ 110-119	8.	17.8	20.	**44.4**	17.	37.8		
	IQ 90-109	23.	26.4	35.	40.2	29.	33.3		
	IQ 80-89	4.	**33.3**	5.	41.7	3.	25.0		
AC	IQ>120	6.	19.4	13.	41.9	12.	**38.7***	**.019**	**.283**
	IQ 110-119	17.	37.8	14.	31.1	14.	**31.1"**		
	IQ 90-109	34.	**39.1"**	35.	40.2	18.	20.7		
	IQ 80-89	9.	**75.0***	3.	25.0	0.	.0		
BAL	IQ>120	7.	22.6	10.	32.3	14.	**45.2***	.060	.254
	IQ 110-119	23.	**51.1"**	12.	26.7	10.	22.2		
	IQ 90-109	28.	32.2	31.	35.6	28.	32.2		
	IQ 80-89	7.	**58.3***	1.	8.3	4.	33.3		
TTS	IQ>120	4.	12.9	9.	29.0	18.	**58.1***	.065	.252
	IQ 110-119	12.	26.7	17.	37.8	16.	35.6		
	IQ 90-109	19.	21.8	38.	**43.7**	30.	34.5		
	IQ 80-89	6.	**50.0***	4.	33.3	2.	16.7		

Note: MD- manual dexterity, AC- aiming and catching, BAL- balance; TTS- Total test score, Below Average score ≤ 37 percentiles, Average 50-75 percentiles, and Above average ≥84 percentiles at MABC-2 test, c- Pearsons coefficient of contingency, p-probability $\chi 2$ test

Aiming and Catching. The 75.00% of children whose IQ was lower average rank were more likely to score ≤ 37 percentile. Based on the proportion that frequency was significantly higher than other groups: average IQs (39.1% p=.021), higher average IQs (37.8% p=.025), superior IQs (19.35% p=.001). Furthermore, neither one child from this group scored greater and equal to 84 percentile. On the other hand, children with high average IQ and superior IQs were more likely to achieve above-average and average scores in aiming and catching tasks. There is an association between aiming and catching tasks and IQ groups since the p=.019, Pearson's coefficient of contingency showed a low correlation c=.283.

Balance. The children with the lower average IQ (58.3%) and higher average IQ (51.1%) were more likely to score ≤ 37 percentile (below average). On the other hand, superior IQs were more likely to score ≥84 percentiles (above average), and this frequency was significantly higher than in the high average IQ group (22.2% p=.038).

There is no association between balance tasks and IQ groups since the p=.060, Pearson's coefficient of contingency showed a low correlation c=.254.

Total test score. In children with a different intelligence quotient, the total test score results range from 12.9%-50% for ≤ 37 percentile, 29%-43.7% for a score between 50 to 70 percentiles, and 16.7% - 58.1% for scores ≥84 percentile. Children with superior IQs were more likely to score ≥84 percentiles on total test scores than children with Average IQs (34.5% p=.023) and Lower average IQs (16.7% p=.019). On the other hand, children with lower average IQs (50.00%) were more likely to score ≤ 37 percentile on the total test score, and that frequency was significantly higher than in children with Average IQs (21.8% p=.038) and Superior IQs (12.9% p=.013). However, there is no association between Total Test Score and IQ in children the p=.065, Pearson's coefficient of contingency showed a low correlation c=.252.

5.5.2 Significant differences in motor competence between preschool children at different cognitive levels

This part will proved or reject the claim that there are significant differences in motor competence between preschool children at different cognitive levels according to the Raven CPM test.

Table 25 *Significant differences in motor competence between preschool children at different cognitive levels*

Analysis	n	F(4,170)	p
MANOVA	4	4.212	**.003**
Discriminative	4	4.182	**.004**

Based on the values of $F(4,170)=4.212$, $p = .017$ (MANOVA analysis) and $F(4,170)= 4.182$ $p = .016$ (discriminant analysis), Hypothesis H_5 and Hypothesis H_{5-1} have been accepted, which means a difference and a clearly defined boundary in motor competence between preschool children at different cognitive levels.

Table 262 *Univariate Roy test significant differences between groups at different cognitive levels related to manual dexterity, aiming and catching, balance, and total test score*

	F (3,171)	p	η^2	c. disc.
MD	2.193	.091	.037	.011
AC	4.846	**.003**	.065	.046
BAL	3.638	**.014**	.060	.034
TTS	4.200	**.007**	.069	.000

Note: MD- manual dexterity, AC- aiming and catching, BAL- balance, TTS- total test score, Ƞ2- effect size coefficient, c. disc- discriminative coefficient

Univariate test (Table 26) has found a significant difference in some domains of motor competence between groups of respondents in aiming & catching $F(3,171)=4.846$, $p=.003$, $\eta^2=.065$, Balance $F(3,171)=3.638$, $p=.014$, $\eta^2=.060$ and TTS $F(3,171)= 4.200$, $p=.007$, $\eta^2=.069$. The discrimination coefficient indicates that the largest contribution to discrimination in children of different cognitive levels with motor skills is AC (.046) and BAL (.034). Hypothesis H_{5-2} has been accepted; it means a significant difference between children at the different cognitive levels in AC, BAL and TTS.

5.5.3 Characteristics and homogeneity of the groups at different cognitive levels related to manual dexterity, aiming and catching, balance, and total test score

Next, the logical sequences of the research are to determine the characteristics and homogeneity of each group and the distance between them. The fact that p = .004, discriminant analysis, means a clearly defined boundary between groups. It is possible to determine each group's characteristics in all three domains and an overall score of motor competence.

According to data, children with different cognitive levels were significantly different in some domains of motor competence (Table 27). Specific skills appeared to be the best discriminators, aiming and catching with 50.6% and balance skills with 37.4%. Thus, these two domains influenced differences in the total test score.

Table 27 *Characteristics and homogeneity of the groups at different cognitive levels related to MD, AC, BAL, and TTS*

	Superior	High average	Average	Lower average	contribution %
AC	higher *	higher "	lower "	lower *	50.6
BAL	higher *	lower"	average*	lower *	37.4
MD	-	-	-	-	12.0
TTS	higher *	-	-	lower *	.00
n/m	20/31	29/45	51/87	9/12	
%	64.52	64.44	58.62	75.00	

Note: hmg - homogeneity; contribution % - contribution of variable, MD- manual dexterity, AC- aiming and catching, BAL- balance, TTS- total test score

The homogeneity of the superior IQ group was 64.5%. 20 children out of 31 had significantly higher scores in aiming and catching, balance, and TTS. Characteristics of the group higher-average IQ have 29 out of 45 respondents, and homogeneity is 64.4%. They scored slightly higher in aiming and catching but lower for balance. As it could be assumed, the most significant deviation exists in the classification of the average IQ group. As a result, the homogeneity was lower, 58.6%. Children from this group had slightly poorer aiming and catching competence but significantly better balance than the lower average group. On the other hand, the lower-average IQ group had a higher homogeneity of 75%. They had significantly poorer scores for aiming and catching, and total test score then superior IQ group and balance compering then superior and average IQ.

5.5.4 Measures of similarities or differences between the groups at different cognitive levels related to motor proficiency

By calculating the Mahalanobis distance between groups based on the IQ, the rank of the respondents, another indicator of similarities or differences, was obtained. Distances of different spaces can be compared. The distances from the table indicate that the smallest distance between groups with rank IQ. 90-109 and IQ 110-119 D2 = .53 (moderate) and the most distant are IQ 80-89 and IQ> 120 D2 = 1.38 (higher).

Table 28 *Distance (Mahalanobis) between groups at different cognitive levels to motor proficiency*

	IQ>120	IQ 110-119	IQ 90-109	IQ 80-89
IQ>120	.00	.65	.56	1.38
IQ 110-119	.65	.00	.53	.95
IQ 90-109	.56	.53	.00	.86
IQ 80-89	1.38	.95	.86	.00

Based on the presented dendrogram (Figure 13), it can be noticed that the closest are IQ 110-119 and IQ. 90-109 with a distance of .53, and the most significant difference is between IQ> 120 and IQ. 80-89, distance 1.32

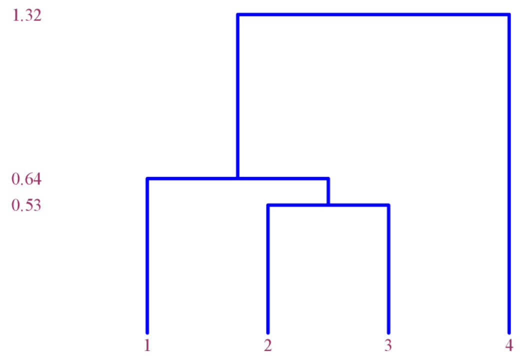


Figure 13. Superior IQ>120 (1) High average IQ 110-119 (2) Average IQ. 90-109 (3) Lower average IQ. 80-89 (4)

Position and characteristics of cognitive level groups to motor competence with the three most discriminant variables, the ellipses show the relationship and characteristics of each group concerning IQ. The rank of the respondents with the three most discriminatory characteristics of motor skills: Aiming and catching (AC), balance (BAL), Manual dexterity (MD). Looking at Figure 14, it can be seen that with the AC axis, the IQ> 120 (1) subsample is the most represented above average, and for the IQ. 80-89 (4) sub-sample is the most represented below average. On the other hand, with the BAL axis, for subsamples IQ> 120 (1) dominates above average, and for IQ. 80-89 (4) dominates below average.

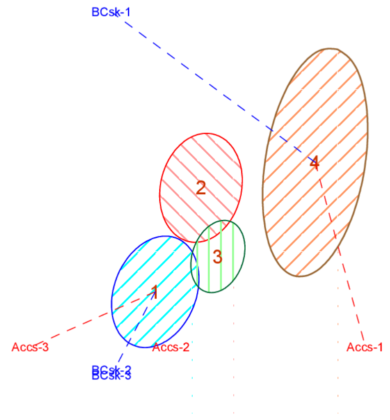


Figure 14. Superior IQ>120 (1) High average IQ 110-119 (2) Average IQ. 90-109 (3) Lower average IQ. 80-89 (4); The abscissa (horizontal axis) is Aiming and catching (AC), and the ordinate (vertical axis) is Balance (BAL).

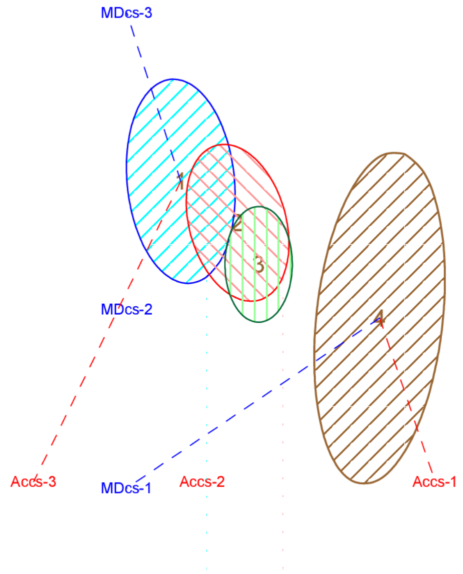


Figure 15. Superior IQ>120 (1) High average IQ 110-119 (2) Average IQ 90-109 (3) Lower average IQ 80-89 (4); The abscissa (horizontal axis) is Aiming and catching (AC), and the ordinate (vertical axis) is manual dexterity (MD).

Figure 15 shows, that the IQ> 120 subsample is the most represented above the average with the AC axis, and the IQ 80-89 is the most represented below the average. On the other hand, with the MD axis, for subsample IQ 80-89 dominates below average, and for IQ> 120 dominates above average.

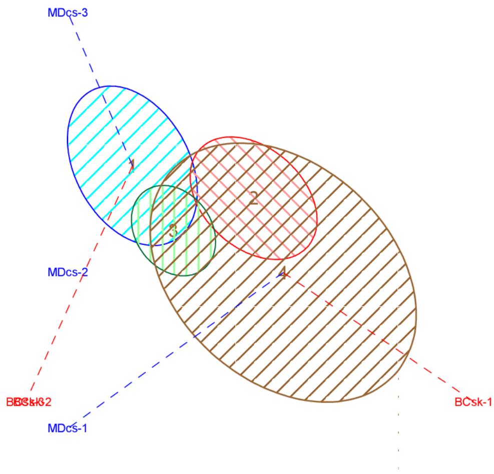


Figure 16. Superior IQ>120 (1) High average IQ 110-119 (2) Average IQ. 90-109 (3) Lower average IQ 80-89 (4); The abscissa (horizontal axis) is the BAL, and the ordinate (vertical axis) is the MD

Inspecting Figure 16 shows that with the BAL axis, IQ> 120 is the most represented above the average, and for the IQ 80-89 subsample, it is the most represented below the average. On the other hand, with the MD axis, for subsample IQ 80-89 dominates below average, and for IQ> 120 dominates above average.

6 DISCUSSION

From the total sample of 175 preschools from Serbia, 1.2% (n=2, boys 2.4%) scored at or below the 5^{th} percentile according to MANUAL (Henderson et al., 2007), which denotes significant movement difficulties. In addition, 7.4% have a total test score in the amber zone (8,3% of boys and 6.6% of girls), between the 5^{th} and 16^{th} percentile, which suggests the child might be" at-risk "of having a movement difficulty. In contemporary research, the estimated prevalence of DCD is between 2% and 6% in school-aged children (Cleaton, Lorgelly, & Kirby, 2020). A further 10% have the condition at a mild level (Gibbs, Appleton, & Appleton, 2007). DCD has also been shown to be more common in males than in females which is confirmed in previous studies in the ratio of 1.7 - 3:1 (Harris, Mickelson, & Zwicker, 2015). Similar to our findings, (Kokštejn et al., 2017) investigated motor competence in preschoolers at the end of the preschool period and found 2.5% of children with the possible presence of DCD and 10.7% of children with a risk of motor difficulties. The prevalence of developmental coordination disorders (DCD) in Greek children was 5.4%, some motor difficulties demonstrated 6.3%, and 88.4% were above the 15th percentile, indicating no motor problems (Giagazoglou et al., 2011). When we compare our results with previous researchers, the prevalence of DCD in our sample is lower, and a high number of children is in the green zone 91.4% (male 89.3%, female 93.4%). It can also be taken into account that almost half of the sample were sport participants and that prevalence might be slightly higher than we just examined kindergartens. However, the prevalence of DCD in Serbia has not been studied previously, except a theoretical review and problem-solving in educational settings (Djordjic, 2017; Tošić & Todorović, 2019), so this study contributes with new important information. Polovina and Polovina (2009) said that this pervasive disorder is rarely recognized in our conditions, seldom diagnosed and therefore rarely treated, despite possible long-term consequences. Still, in Serbia is widely in use diagnosis along with dyspraxia. Having a valid instrument as a MABC-2 test and checklist could help detect children with movement difficulties early. Developmental Coordination Disorder Questioner (DCDQ) has been applied in a recent study on Serbian children and showed good reliability and validity for screening children with coordination problems (Golubović et al., 2018). Relative to the norm-referenced classification of motor skills, the Serbian sample score distribution showed that MABC-2 Test could be used with UK norms. However, standardization is to be confirmed in the following study. It is recommended to compare the norm with the Czech version as well.

By summarizing the results of the whole study Table 29, it can be noticed the contribution to the relation of motor proficiency with 1) the whole C5 Cognitive level characteristics is 26.5%, 2) of the whole C3 Organized physical activity boys characteristics is 23.5%, 3) of the whole C4 Organized physical activity girls characteristics are 19.9%, 4) the contribution of the whole C2 Gender characteristics is 16.1%, 5) the contribution of the whole C1 Age characteristics is 14.0%.

Table 29 *Contribution of the whole study*

	Distance	Contribution %	Between	With
C5	1.32	26.5	Cognitive level	Motor proficiency
C3	1.17	23.5	Organized physical activity boys	Motor proficiency
C4	.99.	19.9	Organized physical activity girls	Motor proficiency
C2	.80	16.1	Gender	Motor proficiency
C1	.70	14.0	Age	Motor proficiency

6.1 Motor proficiency of preschool children related to age

This chapter follows differences in motor skills of preschool children according to age. Unfortunately, we did not have enough large samples in 5 and 7 years old to compare age by gender with the motor skills domain, so we investigated these two factors separately. Specific tasks of this research were related to establishing the characteristics of each age group according to the level of motor competence in manual dexterity, aiming and catching, balance and total test score. Furthermore, to determine which motor skill the best discriminate between groups. Multivariate ANOVA was significant at p=.046 and discriminative analysis at 048 in age groups. However, significant differences between age groups have only been found between aiming and catching p=.045 with a small effect size where 7 years old was better than 6 years old in aiming and catching skills. No differences have been found in manual dexterity, balance and TTS, although mean scores are slightly higher in 7 years old. Two Czech studies investigated motor competence in preschool children. One dealt with preschool children as well as our research towards the end of the preschool period (Kokštejn, Musálek, Šťastný, 2017), and the other included children throughout the preschool period

(Kokštejn, Musálek, & Tufano, 2017). Kokštejn, Musálek, & Tufano (2017) research showed no differences in TTS, MD, and BAL in 5 to 6 years old. More evidence has been found in previous studies. Increasing age has been found to be the most consistent determinant of all aspects of motor competence (Barnett et al., 2016; Giagazoglou et al., 2011; Ojari, Arabameri, Ghasemi, & Kashi, 2019; Venetsanou, & Kambas, 2011) and can be interpreted by the rapid progress caused by the biological processes of development during the period between four and eight years of age and master at 9 to 10 (Butterfield, Angell, & Mason, 2012; Halmová & Šimonek, 2020, Ojari et al., 2019).

Nevertheless, age was the predictive factor for developing the children's fine motor skills (Manna, Pal, Prakash, & Dhara, 2018) and object control skils However, in the earliest years, motor development is more influenced by biological maturation, and later, it is more influenced by practice and opportunities. Therefore, the relationship between age and gross motor competence may change through the developmental periods of early childhood, preschool age, middle childhood, and adolescence.

6.2 Motor proficiency of preschool children related to gender

This chapter purpose was to determine differences in motor skills of preschool children according to gender. Regarding motor proficiency, the homogeneity in boys is 56.0% (smaller) and 60.4% (higher) in girls. Overall, 72,6% of boys and 80,2% of girls scored on and above 50 percentile, indicating that a high number of children have well-developed motoric skills. Contrary to our study, Kokštejn et al. (2017) reported that 64% of boys and 81.6% of Czech preschool girls had a MABC-2 score in the 50th percentile or lower.

All Hypothesis H_2, $H_{2\text{-}1}$ and $H_{2\text{-}2}$ are accepted. Multivariate ANOVA and discriminative analysis were significant at p=.000 regarding gender differences. Further analysis has shown girls scored significantly higher in manual dexterity p = .001 medium effect size, balance, p = .004 and TTS p = .025 small effect size. At the same time, boys characteristics were slightly better in aiming and catching, but no significant differences are found in AC. Hardy et al. (2010), LeGear et al. (2012) and Van Waelvelde et al. (2008) said that boys and girls generally do not differ in total test scores in preschool rather in individual motor skills. This is confirmed in our study. Although boys and girls statistically differ in TTS, discriminant coefficient showed the contribution of specific skills balance skills with 40.7%, manual dexterity 30.5%, aiming and catching with 27.1% who were the best discriminators. All these variables influenced differences in total test scores.

Our results align with other studies that find that girls' fine motor skills were better than boys (Flatters, Hill, Williams, Barber, & Mon-Williams, 2014; Manna et al., 2018; Morley et al., 2015). In addition, Flaters et al. (2014) stated that this situation change with age favouring boys. Regarding balance skills, our results are in line with other studies that confirm girls have better static and dynamic balance (Kokštejn, Musálek, & Tufano, 2018; Psotta, Hendl, Kokštejn, Jahodová, & Elfmark 2015; Rodríguez-Negro et al., 2021) and better scores in locomotor skills (Foulkes et al., 2015; Hardy et al., 2010). Psotta et al. (2015) found out that Czech girls established the mature static balance at 7, while the Czech boys by two years later. In studies by Singh et al. (2015) and Van Waelvelde et al. (2008), balance skills have been shown to be similar between gender in early preschool age. Notwithstanding, some identify better locomotor skills in boys (Piek et al., 2012; Spessato et al., 2013).

Like in our studies, boys have been found to better on aiming and catching on average but not significantly (Kokštejn et al., 2017; Olesen et al., 2014; Venter, Pienaar, & Coetzee, 2015). However, numbers of studies confirm strong evidence that boys have been better in manipulative and object control skills (Foulkes et al., 2015; Goodway, Robinson, & Crowe, 2010; Hardy et al., 2010; Rodríguez-Negro, Huertas-Delgado, & Yanci, 2021; Spessato, Gabbard, Valentini, & Rudisill, 2013). In contrary, some studies showed no differences in object control skills between gender (LeGear et al., 2012; Šalaj et al., 2019; Van Waelvelde et al., 2008). Two Czech studies that investigated motor competence in preschool children, one dealt with preschool children as well as our study towards the end of the preschool period (Kokštejn, Musálek, Šťastný, 2017), and the other included children throughout the preschool period (Kokštejn, Musálek, & Tufano, 2017). Kokštejn et al. (2017) research showed no 6-year-old boys outperformed girls in AC as we found the same.

It can be assumed that different social and environmental factors between genders might impact motor skills performance owing to a reduced level of practice, primarily among girls (Giagazoglou et al., 2011; Hardy et al., 2010). A review by Oliver, Schofield, & Kolt (2007) reported that boys are more physically active during preschool years than girls. Thus, identifying children who do not prefer active play and have motor problems may allow targeted interventions to support their motor learning and participation in active play and promote physical activity and fitness later in life (Kantomaa et al., 2011). Girls give up sports earlier, are more demanding and more sensitive to the environment when it comes to physical activity.

Girls are more prone to fine motor skills by playing with dolls and dressing them in tiny clothes, imagined characters, caretaking duties, thus practising fine motor skills, precision and imaginary (Pomerleau, Bolduc, Malcuit, & Cossette, 1990). They like to string beads and do creative things. Boys like to play with building toys like Lego, vehicles, sports equipment, and weapons and are associated with the competition (Dinella et al., 2017). However, they will need higher activity of the whole body more often, and the most common choice is ball games and team sports. Moreover, gender differences in toy have been linked to gender differences in the development of children activity levels (Eaton,Von Bargen & Keats, 1981), spatials skills (De Lisi & Wolford, 2002), and gross and fine motor skills (Pellegrini & Smith, 1998).

One possible explanation is the practice opportunities promoted by the influence of cultural factors. For example, boys are predominantly involved in motor activities involving object control during childhood, especially ball games. At the same time, girls culturally prefer activities that predominantly involve fine motor skills and are more verbal than motor behaviours. When choosing sports activities for preschool children, there are particular preferences between the sexes. The most popular activities in girls are dance, ballet, and rhythmic gymnastics (Popović, Đorđević, Popović, 2009), while boys prefer to participate in contact sports such as martial arts and invasive sports games such as football (Gutierrez & Garcia- Lopez 2012).

6.3 Motor proficiency of preschool boys according to participation in organised physical activity

The results of this study reveal significant differences in motor proficiency of 5 to 7 years preschool boys according to their participation in organised sport-recreative activities. The children who attended football were significantly more skilful in aiming & catching and had substantially better total test scores than children from kindergarten who did not participate in organised physical activity. No differences have been found in manual dexterity or balance. Results of judo-sport school were moderate, and according to their motor competence, they were more similar to football group characteristics than the control group. The discrimination coefficient explained the most significant differences in boys' capabilities in aiming and catching, with a discriminate contribution of 74,4%.

Our results are consistent with the other studies by Nazario and Vieira (2014), Ribeiro-Silva, Marinho, Brito, Costa, and Benda (2018) and Vallence et al. (2019), where children who participated in organised physical activity had better overall scores related to the requirements of each sport discipline than nonparticipants. In addition, Galen et al. (2021) highlights the positive effects of football classes in preschoolers on the overall morphological status and some FMS. After a nine-month health promotion program, a significant increase in coordination ability, flexibility, and static balance was noted.

Thus, boys from the control group were likely to score ≤ 37 percentile (below average) than football players in aiming and catching, and the total test score. On the other hand, based on proportions, the football group scored significantly above average than the control group, which means they were more likely to have scores ≥84 percentile (above average) than a control group in AC and TTS. In total, 27.4% of boys had a TTS score below the 50 percentile, 39.3% between 50 and 75 percentile, 33.3% on and above the 84 percentile. However, contrary to our findings, this study reports a high percentage of boys, 64%, who had a TTS in the 50th percentile or lower (Kokštejn, Musálek, Šťastný, et al., 2017).

A recent study from Denmark (Vallence et al., 2019) in 6 to 12 years did not find an association between children enrolled in soccer with precision throw, balance, and an overall score just into shuttle run and Anderson test. Handball was associated with precision throw, an overall score. Nazario & Vieira (2014) investigated the motor performance of Brazilian children 8 to 10 years old in PE classes, rhythmic gymnastics, handball and indoor football. In their study, according to the criteria of test TGMD-2, below the level expected for age, as "very poor", were classified children who only attend physical education classes. Children who attended rhythmic gymnastics and handball were classified as "below average", and those enrolled in indoor soccer were classified as "average" (Nazario & Vieira, 2014). How effective the sports context program might be on motor development also depend on individual factors: program and teachers (experience, knowledge, motivation, organisation), the effect of the hours spent in sports per week (Fransen et al., 2012), environmental condition and family factors (SES, parents support, siblings) (Krombholz, 2006; Venetsanou & Kambas, 2010).

Although balance did not show significant differences in the current study between groups, the results showed that 50% to 52% of boys from the control and judo-sport school group had a poor balance. Hence, the need is to include more specific exercises and games for preschool-age boys to improve balance skills. One of the possible reasons for boys from judo sports school that could influence poor balance is that the Mean BMI in this group was 17.2 (SD 2.8), indicating overweight. Previous studies reported a negative association between balance and overweight (Kakebeeke et al., 2021; Musalek et al., 2017; Nervik, Martin, Rundquist, & Cleland, 2011).

A longitudinal study by Barnett, Salmon & Hesketh (2016) investigated early childhood physical activity as a predictor of motor skill competence in 19 months, 3.5 years, and five years. They conclude that more time in MVPA at early preschool-age contributes to locomotor skill and perceptions of skill ability, but MVPA was not a predictor of actual or perceived object control skill (Barnett et al., 2016). This was confirmed with the following study in children 4 to 8-years-old (Barnett, Ridgers, Salmon, 2015), which was supplemented by findings that exist an association between object control skills and PA in older children, as well as that the perceived ball skill abilities appear to relate to actual competence. Contrastingly, another two studies with preschool-aged children found that object control skills were associated with physical activity levels in boys (Cliff, Okely, Smith, & McKeen, 2009; Temple et al., 2016).

Like our study, Temple et al. (2016) found that boys who participated in organised sport and active recreation predicted object control skills. The same author emphasises that the prevalence of participation in team sports was significantly higher for boys. Furthermore, participation in physical activities has been a predictor of both locomotor and object control skill scores and active recreation of stork (one leg balance). These relationships were not apparent among the girls (Temple et al., 2016).

Previously cited studies related to motor skills and organised sports mainly concerned school-age children (Nazario & Vieira, 2014; Vallence et al., 2019). Further studies linked to PA and motor development in preschool had intervention design studies based on a psychomotor program for preschoolers similar to sports school (Radošević et al., 2018; Venetsanou and Kambas 2010; Zimmer et al., 2008). Parallel to the current study, all showed an impact of sport and physical activity (as a dynamic environmental context) related to particular motor skills and overall performance scores. Ribeiro-Silva et al. (2018) said that "the best motor performance does not come from a specific design of the intervention, but from a cross-sectional analysis of the everyday life of a child who had already been practising sports". Similar to our findings, Ribeiro-Silva et al. (2018) conclude that children who participated in sports programs had more opportunities to practise and have shown normal development compared to their peers who did not participate in sports. Logically, different types of PA may have different associations with skills. It is also likely that participation in certain activities using particular skills may lead to higher associations with that type of skill competence.

Future research may further explore the nuances of the relationship between PA and gross motor competence to determine precisely which types of activities better contribute to which types of motor competence (and vice versa) at different ages. Also, the PE curriculum in Serbian kindergartens can be supplemented with exercises improving balance and ball skills, with different sizes and material balls and various targeting games. The main task of physical education is to help children acquire the basic fundamental movements needed to participate in a wide range of physical activities throughout life. Without this basic motor competence, it will be difficult for children to choose an active lifestyle in adolescence and adulthood. Combined or multilateral exercise gives much better results in motor skill efficiency variables compared to individual exercise

6.4 Motor proficiency of preschool girls according to participation in organised physical activity

This chapter discusses differences found in motor skills of preschool girls according to participation in organized physical activities divided into three groups: rhythmic gymnastics, sports school and control group. Specific tasks of this research were related to establishing the characteristics of each group according to the level of motor competence in manual dexterity, aiming and catching, balance and total test score. Furthermore, to determine which motor skill the best discriminate between groups. As a result, Multivariate ANOVA and discriminative analysis were significant at p=.008. Further analysis has shown significant differences have been found in girls attending rhythmic gymnastics in aiming & catching on the upper bound of moderate effect size (η^2=139), and total test score moderate effect size (η^2=.105) compared to girls who did not participate in organized physical activity. Thus, all proposed Hypotheses have been accepted.

The homogeneity of the control group in girls is 63.4% (higher), which means that 15 of 41 girls have other characteristics than the characteristics of their group. However, girls from the control group mainly had achieved scores significantly lower in aiming & catching and total test score. Moreover, 61% expressed lower than average aiming and catching skills. The homogeneity of the rhythmic gymnastics group was higher (72.0%). Seven girls of 25 had other characteristics. They had achieved scores significantly higher aiming & catching and total test score. In addition, a higher amount of the girls who practised rhythmic gymnastics scored above 50 percentile on balance (80%). Characteristics of sports schools have 14 out of 25 girls. Homogeneity was 56.0% (smaller). They mostly had resulted from the average and above average. The total test score of ≥ 50 percentile scored 68.3% girls in the control group, 84% in the sports school group, and 96% in rhythmic gymnastics.

Based on the presented dendrogram in Figure 9, it can be noticed that the closest are rhythmic gymnastics and sports school with a distance of .73, and the most significant difference is between the control group and rhythmic gymnastics, with a distance of .99

Our results confirm our expectations and previous findings that children involved in structured and organized physical activity have better-developed motor competence, gross motor skills and manipulative skills (Djordjević, Valková, Nurkić, Djordjević, & Dolga, 2021; Hardy, O'Hara, Rogers, St George, & Bauman, 2014; Krombholz, 2006; Šalaj, Krmpotić, & Stamenković, 2016). Moreover, children who consistently engage in sports from 6 - 7 years of age during the following years showed better levels of coordination than children who only partially participated or did not participate in the sports-recreational environment (Vandorpe et al., 2012). Our results align with Ribeiro-Silva (2016) study, where girls who practised rhythmic gymnastics had higher scores in the object control subtest and motor quotient than girls who practised swimming. Furthermore, this difference in the performance of object control skills in girls impacted the motor quotient measure (Ribeiro-Silva, 2016). Those findings were similar to our results, as specific skills appeared to be the best discriminators, aiming and catching with 41.4%, balance skills with 24%, and total test score 22.9%.

Apart from regular training, the probable reason why girls from rhythmic gymnastics have improved scores in aiming and catching is the perception of this aesthetic-coordinative sport. Practising rhythmic gymnastics in girls encourage the need to learn new skills with apparatus, such as throwing a ball in the air and catching, manipulating a hoop and a ribbon, skipping a rope in free time. Šalaj et al. (2019) found significant differences in gross motor quotient and locomotor skills in the selected girls compared to the non-selected girls from artistic gymnastics. However, results from this study suggest that the female competition program in preschool-age favourites the development of locomotor but not manipulative motor skills, and they propose a multilateral exercise program (Šalaj et al., 2019). This conclusion can be applied to our girls from sports school, although 84% had good results on the total test score, 40% of girls had aiming and catching skills below average.

The control group of girls, as could be assumed, had the statistical significance of the differences because that group did not have additional physical activities to improve the overall result. Different studies have shown that preschool children spend their school time in three different contexts: traditional classes, physical education (PE), and free schoolyard play (Flôres et al., 2019). Physical education classes or schoolyards play at preschool are the only environmental opportunity to play sports, games, gymnastics, and dance for many children. However, since motor competence does not develop naturally (Drenowatz, 2021); instead, it requires instruction and purposeful practice, feedback, in addition to free play (Logan et al., 2019). Our research indicates preschool PE should propose more physical activity in girls and skill practice time, especially on-task regarding object control or ball skills. Autor agrees with the previous state of Drenowatz (2021) that children may not be exposed to movements that promote the development of manipulative skills during daily activities, and facility control skills may not be as integrated with daily PAs as locomotor skills and stability skills. Exercise is an essential condition for the creation of motor habits. Therefore, starting with children on some sports activities is recommended, of course, very carefully chosen for young children (Parízková, 2016). When proper motor habits and skills are introduced on time, a sound basis for later performance and interest in exercise is created.

To improve balance and fine and gross motor coordination during early childhood is challenging, and to make progress, children at that young age can only do it through the tasks and vigorous play that sports schools can provide (Djordjevic, 2021;

Ribeiro-Silva et al., 2018). Our results confirm previous claims that sports practice contributes to the development of motor capabilities and influences individual differences in children's scores (Busquets et al., 2018). Additionally, as Berk (2008), we notice that the children's sports school program improves and upgrades previously acquired motor experiences. Further, our findings can contribute to understanding how important it is to promote object control skills games for girls and older preschoolers generally. Therefore, when thinking about the individual's global motor development process, especially in acquiring fundamental motor skills, it may be essential to present to children sports modalities that contain motor skills that involve object control. Also, encourage children's participation in other activities that involve the practice of this category of motor skills. Thus, it is suggested that the specificity would be a consequence of each sport modality but that all modalities can present general benefits effects for the motor development of children. Furthermore, the practice of oriented sports activities showed that it could contribute to the global motor development of children of both sexes.

6.5 Motor proficiency of preschool children related to the cognitive level

This chapter study aimed to compare the motor proficiency between preschool children with different cognitive abilities (fluid intelligence) and find variables that best differentiate between the four cognitive groups. As a result, there are significant differences between groups of different cognitive statuses in some domains of motor competence in favour of highly intelligent children to lower average IQs; in aiming & catching, balance, and total test score, all moderate effect sizes. In previous studies, the general association between cognitive and motor skills have been related to higher intelligence scores with higher levels of fine motor skills (Klupp et al., 2021). However, our study did not support these findings. Mahalanobis distances showed lower average IQs were the most distant from all groups. Conversely, the closest distance was between high average and average IQs.

According to data, children with different cognitive levels were significantly different in some domains of motor competence. The homogeneity of the superior IQ group was 64.5%. 20 children out of 31 had significantly higher scores in aiming and catching, balance, and TTS. Characteristics of the group higher-average IQ have 29 out of 45 respondents, and homogeneity is 64.4%. They scored slightly higher in aiming and catching but lower for balance. As it could be assumed based on previous studies (Kirkendall, 1976), the most significant deviation exists in the classification of the average IQ group. As a result, the homogeneity was lower, 58.6%. Children from this group had slightly poorer aiming and catching competence but significantly better balance than the lower average group. On the other hand, the lower-average IQ group had a higher homogeneity of 75%. They had significantly poorer scores for aiming and catching, and total test score then superior IQ group and balance compering then superior and average IQs.

Finally, half of the lower average IQ group scored below the 50th percentile on TTS, and only two participants reached the score ≥ 84 percentile on the MABC-2 total test score. Conversely, 87.1% of children with superior IQ's have scored ≥ 50 percentile (29% at 50 to 75 percentile and 58.1 % ≥ 84 percentile) on TTS. Our results align with previous research confirming that children with lower IQ scores often show lower motor skill levels than those with a higher IQ (Kirkendall, 1976; Smits-Engelsman & Hill, 2012). However, like Smits-Engelsman & Hill (2012), we concluded that motor skill proficiency levels are seen across the IQ range. In investigating the relation of motor and intellectual abilities, one of the first studies was that of Kulcinskia (1945; after Popovic, Valkova, Popovic, & Dolga, 2019), which established that the association of intelligence and learning of basic motor tasks is higher when the intellectual level of examinees is higher. Furthermore, Mayer Burger & Mayer (1984) investigated motor abilities in gifted and normal children. The gifted children performed significantly better than the average group on overall fine motor ability, gross motor ability, and general motor proficiency ratings. Kirkendall (1976) considered the idea of integrated development to be sustainable. He pointed out significant differences between respondents with above-average, average and below-average cognitive status, in favour of above-average ones, especially in coordination tasks. At the core of this examined factor, fluid intelligence, are the ability to solve problems that require insight and depend on the amount of effective information in permanent memory (Brkić, 2011). Success in solving those problems for which earlier experience is necessary depends on this factor. Orlić, Cvetković, & Jakšić (2010) explained that the inferiority of persons with a lower level of cognitive abilities is reflected in solving complex motor tasks, probably due to the lower level of CNS integration, which significantly affects the speed of information flow. Complex motor tasks have a greater connection with cognitive abilities (van der Fels et al., 2015), i.e. they are at a higher level, including cognitive processes. Conversely, performing simple motor tasks is at a lower, elementary level, where the participation of intellectual processes is reduced to a minimum (Orlić et al., 2010).

Specific skills appeared to be the best discriminators in our study sample, aiming and catching with 50.6% and balance skills with 37.4%. Thus, these two domains influenced differences in the total test score. One implication is that gross motor skill acquisition in early childhood may be a better predictor of cognitive performance at school than fine motor skills (Ali, Pigou, Clarke, & McLachlan, 2017). Piek et al. (2008) showed that gross motor skills in children aged four months to four years were a significant predictor of cognitive performance when children reach school from age 6 to 11 years, while fine motor skills were not. Contrastingly to our study, previous research by Klupp et al. (2021) revealed non-significant relations between children's ball skills and intelligence or four components of the WISC-IV test. Similarly, associations between balance skills and intelligence were non-significant (except for perceptual reasoning) and the interaction terms. Therefore, this study mainly focused on manual dexterity and its relation to children's intelligence, where a positive correlation is found in typically developed children and a stronger correlation in ADHD children (Klupp et al., 2021).

It is important to mention that in our sample, from 15 children at 'risk' of DCD, 20% were lower average IQs, 33.3% average and high average, and 13.3% superior IQs. Thus, the results showed the heterogeneous profile of children at 'risk' of DCD in the cognitive domain. Barbacena et al. (2019) also stated that children with motor coordination deficits vary in cognitive performance, and heterogeneity of the DCD group has contributed to the result. However, they found significant differences in DCD and non-DCD groups in cognitive level, and manual dexterity and TTS to cognitive level.

It should be borne in mind that this is a period of intensive growth and development, that some children have already reached school maturity at the age of six or seven, and that this process is still ongoing for some. That is why there are tests where a psychologist can assess whether the child is mature enough to start school or whether it is necessary to postpone the start for a year.

Limitation of the study

The limitation of this study could relate to the lack of information on children's motor competence at the beginning of enrollment in sports. Also, it is missing data on how long they had been involved in a particular sport. The criterion was approximately six months, but some children had already participated in the same the previous school year. A further limitation is that the MABC-2 test is not standardized for the Serbian population. Instead, we used the British norm. Although it could be challenging to use the Czech version of MABC-2 that came up late that year, it would be better to compare which norms are more suitable for Serbian children, mainly because Serbia and the Czech Republic have similar cultures and habits. Another limitation lies in the test items, and scaling differs between age bands, and we used AB1 and AB2 that also differ in task difficulty, but the only component score was the same for all age groups.

Recommendations

Regarding the psychomotor development and maturation of children, motor learning, successful participation in the classroom and physical education, an effort is aimed at supporting preschool children with developed and low motor skills to regularly participate in various sports after school hours and promote fundamental motor skills. Assessment is a crucial element of every program development to discover a child's skills and abilities to develop short-and long-term goals as a guideline for a child's development (teaching, component tasks modification, evaluation). In particular, experienced coaches and PE teachers have great expertise in breaking down movement skills into their parts to simplifying, modifying and adapting games that encourage maximum participation of children with lower motor competence. Knowledge of the basic principles of growth and development of children is the basis for planning goals and quality programs of special sports activities. The foundation of any well-designed program is an understanding of the significant basic needs of children. A successful teacher must respect the laws of motor development and the principles of psychomotor learning when planning and choosing special sports activities. He must know the theory of preschool sports, biological characteristics of children's development, various children's abilities and needs, and adjust the process individually. This study highlighted that organised physical activity greatly influences motor development at preschool age, primarily through sport context. Our findings support the theory that specific physical activity drives the acquisition of particular types of motor skills. An effort should be made for girls and children who do not participate in sport to improve aiming and catching, i.e., object control skills. And for preschool, boys, accent need to be put into developing their balance skills.

7 CONCLUSIONS

The study's main aim is to determine the level of motor proficiency and differences in motor skills of preschool children aged 5 to 7 from Serbia according to age, gender, cognitive level, and participation in organized physical activities. The prevalence of DCD in Serbian preschoolers from the city Niš was 1.2%, and the prevalence for being at risk of movement difficulty is 7.4%. Therefore, 91.4% scored in the green zone from the total sample. Regarding age differences, only seven-years-old have been found to outperform six-year-olds in aiming and catching significantly. Girls scored significantly higher in manual dexterity medium effect size, balance and TTS small effect size. At the same time, boys characteristics were slightly better in aiming and catching, but no significant differences are found in AC. Concerning organized sport, both boys from football and girls rhythmic gymnastics were significantly better than control groups in aiming & catching and Total Test Score from medium to large effect size. However, 50% to 52% of boys from the control and judo-sport school group had balance below 50^{th} percentile, while 61% of the control group girls scored below the norm in aiming and catching skills. Different cognitive statuses have shown significant differences in some domains of motor competence in favour of superior intelligent children to lower average IQs; in aiming & catching, balance, and total test score, all moderate effect sizes. It should be borne in mind that this is a period of intensive growth and development, that some children have already reached school maturity at the age of six or seven, and that this process is still ongoing for some. Since aiming & catching, and balance were the most discriminative variables in all groups, our findings can contribute to understanding how important it is to promote object control skills games for girls and non-participants in OPA generally. To improve balance and fine and gross motor coordination during early childhood is challenging, and to make progress, children at that young age can only do it through the tasks and vigorous play that sports practice can provide. Finally, the implications are addressed for parents, physical education teachers, early childhood educators and physical activity policymakers and recommend structured physical activity experiences that promote motor competence in all preschoolers.

8 SUMMARY

The study's main aim is to determine the level of motor proficiency and differences in motor skills of preschool children aged 5 to 7 from Serbia according to age, gender, cognitive level, and participation in organized physical activities. Specific aims of this research were related for each chapter establish the characteristics of the groups according to the level of motor competence, to determine the contribution of the motoric variable to the characteristics, homogeneity, and distance between groups. In addition, to investigate the prevalence of DCD in Serbian children at the end of the preschool period.

One hundred and seventy-five children (male N=84 and female N= 91) aged in months 60 to 94 (mean 77 ± 6.4) were selected from kindergarten and sports clubs in the city of Niš, region South of Serbia. They were further divided into groups according to age, gender, participation in organized physical activity by gender, and cognitive level. The motor competence was assessed with the MABC-2 performance test (Henderson et al., 2007) in the three motor domains: Manual Dexterity (MD), Aiming & Catching (AC), and Balance (BAL), and Total Test Score (TTS) were obtained in the end. In addition, cognitive abilities were assessed with Raven's Coloured Progressive Matrices (CPM; Raven, 1956).

Descriptive statistics crosstabs used for each group's level of motor proficiency concerning their scores, Pearson's $\chi2$ test for continency tables and proportions are used for an association between variables and significant differences between and within groups. The data on the contingency tables were scaled. Therefore, MANOVA and discriminant analysis are applied to the scaled data as multivariate procedures follow up with the univariate Roy test and Post Hoc Bonferroni. The Pearson contingency coefficient (c) and eta square (η^2) are estimated effect sizes 0.01, 0.06, 0.14 as small, medium, large. A discriminant coefficient was calculated to identify potentially important contributors to discrimination among variables. An indicator of the similarity and difference between groups has been presented by Mahalanobis distance and Cluster. The statistical significance was set at $p < 0.05$. The data were analyzed in IBM SPSS Statistics for Windows, Version 21.0. and the statistical program of Smartline agency (Dolga, Novi Sad, Serbia).

The prevalence of DCD in Serbian preschoolers from the city Niš was 1.2%, and the prevalence for being at risk of movement difficulty is 7.4%. Therefore, from the total

sample, 91.4% scored in the green zone. Regarding age differences, only seven-years-old have been found to outperform six-year-olds in aiming and catching significantly. Girls scored significantly higher in manual dexterity medium effect size, balance and TTS small effect size. At the same time, boys characteristics were slightly better in aiming and catching, but no significant differences are found. The best discriminators between gender were balance skills with 40.7%, manual dexterity 30.5%, aiming and catching with 27.1%. Concerning organized sport, both boys from football and girls rhythmic gymnastics were significantly better than control groups in aiming & catching and Total Test Score from medium to large effect size. The discrimination coefficient explained the most significant differences in boys' capabilities in aiming and catching, with a discriminate contribution of 74,4%; in girls aiming and catching with 41.4%, total test score and balance skills with 22.9%- 24%. However, 50% to 52% of boys from the control and judo-sport school group had a poor balance, while 61% of the control group girls scored below the norm in aiming and catching skills. Different cognitive statuses have shown significant differences in some domains of motor competence in favour of superior intelligent children to lower average IQs; in aiming & catching, balance, and total test score, all moderate effect sizes. Specific skills appeared to be the best discriminators, aiming and catching with 50.6% and balance skills with 37.4%. Thus, these two domains influenced differences in the total test score.

To improve balance and fine and gross motor coordination during early childhood is challenging, and to make progress, children at that young age can only do it through the tasks and vigorous play that organized PA can provide. Since aiming & catching, and balance were the most discriminative variables in all groups, our findings can contribute to understanding how important it is to promote object control skills games for girls and older preschoolers generally. Finally, the implications are addressed for parents, physical education teachers, early childhood educators and early childhood and physical activity policymakers and recommend assessment, structured physical activity experiences that promote motor competence in all preschoolers.

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APPENDIX

Appendix 1.

Table 3 *Descriptive statistics BMI rank (Underweight, Normal, Overweight and Obese) related to age in 5 to 7 years old children*

	Underweight		Normal		Overweight		Obese	
	n	%	n	%	n	%	n	%
Age 5	2.	5.3	28.	**73.7**	3.	7.9	5.	13.2
Age 6	1.	1.0	62.	62.6	23.	**23.2***	13.	13.1
Age 7	1.	2.6	27.	71.1	6.	15.8	4.	10.5
Total	4	2.3	117	66.8	32	18.3	22	12.6

Table 31 *Descriptive statistics of Item Standard scores related to age in 5 to 7-year children*

	5-years old		6-years old		7-years old	
Items	M	SD	M	SD	M	SD
MD1	10.47	2.91	11.03	2.21	12.10	2.33
MD2	11.16	2.63	11.11	2.89	10.47	3.68
MD3	9.40	2.99	10.01	2.28	10.50	2.81
AC1	10.00	2.77	9.91	3.47	11.60	3.44
AC2	10.32	2.66	9.84	2.78	10.76	2.98
Bal1	10.18	2.93	11.38	2.71	11.55	2.72
Bal2	10.26	2.74	9.16	3.19	10.87	2.22
Bal3	11.63	1.36	10.64	1.57	10.50	2.76

Appendix 2. **Consent** ***Serbian version***

Fakulta tělesné kultury

Univerzita Palackého
v Olomouci

Osnovne informacije za roditelje i staratelje dece uključene u testiranje

Poštovani roditelji, staratelji!

Želimo da vas zamolimo za saradnju na projektu koji realizuje Fakultet za fizičku kulturu, Univerziteta Palackeho u Olomucu iz Češke u saradnji sa Fakultetom za sport i fizičko vaspitanje, Univerziteta u Nišu. ***„Istraživanje motorike kod dece, urasta 5 do 7 godina, koja su uključena u organizovanu fizičku aktivnost“*** je naziv projekta koji ima za zadatak praćenje razvoja motorike i kretnih sposobnosti dece predškolskog i mlađeg školskog uzrasta u Srbiji i Češkoj.

Cilj ovog projekta je prikupljanje informacija o razvoju motorike i karakteristike pokreta pri izvođenju svakodnevnih aktivnosti u trenutnoj populaciji dece predškolskog i mlađeg školskog uzrasta. Ove informacije su važne za proširivanje znanja o razvoju motorne funkcije kod dece i da se utvrdi odgovarajuća metodologija za njihovu evaluaciju. Procena nivoa motoričkih sposobnosti je veoma bitna za razvoj deteta može da identifikuje individualne potrebe i ukaže na potrebnu pomoć pri učenju i savladavanju određenih zadatka u obdaništu, školi, organizovanim aktivnostima, ili u okviru obrazovanja u porodici.

Sam program ipitivanja sadrži **jednostavne i zabavne zadatke,** koji su za decu predškolskog uzrasta **prirodni i normalni** – ubacivanje novčića u kutiju, nizanje kockica (perli), crtanje, hvatanje i bacanje džakčića na cilj, stajanje na jednoj nozi (ravnoteža), hodanje po liniji na prstima ili peta-prsti, poskoci po žuto plavim kockastim strunjačama (slično „školicama“). Svi ovi zadaci su standardizovani u brojnim zemljama u svetu i osim za potrebe istraživanja, što je kod nas slučaj, koriste se u dijagnostici koordinacije i motoričkih sposobosti kod dece, uzrasta od 3 do 16 godina. Takođe, biće izmerena telesna težina i visina vašeg deteta. Osnovni demografski podaci o deci i roditeljima će biti sakupljeni putem odgovarajućeg upitnika od strane roditelja.

Merioci ovog projekta su studenti doktorskih studija Fakulteta za sport i fizičko vaspitanje Univerziteta u Nišu, a nosioc ovog projekta je diplomirani student istoimenog fakulteta, Mgr. ***Ivana Đorđević,*** sada doktorant na Fakultetu fizičke kulture, Univerziteta Palackog u Olomoucu. Učešćem na ovom ispitivanju zdravlje vašeg deteta nije ugroženo. Ispitivanje nije u suprotnosti sa važećim zakonodavstvom i međunarodnim smernicama za ispitivanja koja uključuju decu. Projekat je bio odobren od strane etičke komisije. Procena motoričkih sposobnosti biće realizovana u prostorijama obdaništa ili sportske školice, u vreme treninga koje vaše dete posećuje.

Kao zakonski staratelj deteta imate pravo da prisustvujete merenju, ali ne da ometate. Vaše dete može u bilo kom trenutku da odustane od učešća ukoliko ono to želi. Isto tako poštujemo vašu odluku, ukoliko smatrate da vaše dete ne učestvuje. Prikupljeni podaci će biti iskorišćeni samo za potrebe istraživanja, u okviru celokupnog uzorka, a individualni podaci o detetu neće biti dostupni trećim licima. Ukoliko se slažete sa navedenim, molimo da potpišete Saglasnost u Prilogu (druga strana lista).

Unapred se zahvaljujemo na razumevanju i saradnji.

Mgr. Ivana Đorđević
Rukovodilac Projekta
e-mail:hacienda018@hotmail.com
tel. 0693283988

____
__

Individualna saglasnost

Dajem saglasnost - ne dajem saglasnost

O učešću mog deteta na gore navedenom istraživačkom projektu:

„Istraživanje motorike kod dece, urasta 5 do 7 godina, koja su uključena u organizovanu fizičku aktivnost“

Ime i prezime deteta: ____

Datum i mesto rođenja:
____

Ime i prezime zakonitog zastupnika deteta (roditelj/staratelj):
____

Adresa: ____

Telefon: ____

Svojeručni potpis

roditelja/staratelja

____

Appendix 3. **Consent** ***English version***

Dear parents, guardians!

We would like to ask you to cooperate on a project implemented by the Faculty of Physical Education, Palackejo University in Olomouc, Czech Republic, in cooperation with the Faculty of Sports and Physical Education, University of Nis. "Research of motor skills in children aged 5 to 7, who are involved in organized physical activity" is the project's name, which aims to monitor the development of motor skills and mobility of children of preschool and primary school age in Serbia and the Czech Republic.

This project aims to gather information on the development of motor skills and characteristics of movement in performing daily activities in the current population of preschool and young school children. This information is important to expand knowledge about motor function development in children and establish an appropriate methodology for their evaluation. Furthermore, assessing the level of motor skills is very important for the child's development. It can identify individual needs and indicate the necessary help in learning and mastering certain tasks in kindergarten, school, organized activities, or family education.

The examination program itself contains fun and straightforward tasks, which are natural and normal for preschool children - inserting coins into the box, stringing beads, drawing, catching and throwing bean-bag on the target, standing on one leg (balance), walking in a line on the toes or heel-toes, jumps on yellow-blue square mats (similar to "schools"). All these tasks are standardized in many countries in the world, and except for research purposes, which is the case in our country, they are used to diagnose coordination and motor skills in children aged 3 to 16 years. Also, your child's body weight and height will be measured. Basic demographic data on children and parents will be collected through an appropriate questionnaire by parents.

The measurers of this project are doctoral students at the Faculty of Sports and Physical Education, University of Nis, and the holder of this project is a graduate student of the Faculty of Sports of the same name, Mgr. Ivana Djordjevic, now a doctoral student at the Faculty of Physical Education, Palacky University in Olomouc. By participating in this test, your child's health is not endangered. The examination does not conflict with applicable legislation and international guidelines for examinations involving children. The project was approved by the ethics committee. The assessment of motor skills will be realized in the kindergarten or sports school premises during the training that your child attends.

As the child's legal guardian, you have the right to attend the measurement but not to interfere. Your child can opt-out at any time if they wish. We also respect your decision if you feel that your child is not participating. The collected data will be used only for research purposes within the entire sample, and individual data on the child will not be available to third parties. If you agree with the above, please sign the Consent in the Attachment (second page of the list).

We thank you in advance for your understanding and cooperation.

Mgr. Ivana Đorđević
Resposible for project
e-mail: hacienda018@hotmail.com
tel. 0693283988

____

Individual consent

I give consent – I do not give consent

About my child's participation in the above research project:

“Assessment of motor development in 5-7-year-old children involved in organized physical activities

Name and Surname of child: ____

Date of birth: ____

Name and surname of the child's legal representative (parent / guardian):____

Addresu: ____

Telephon: ____

Signature of the parent/guardian

____