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Assessment of Motor Development in Preschool Age: A Review of Assessment Tools

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Abstract

Introduction. This paper reviews tools used in psychological research to assess motor development in preschool children. This review discusses the concepts of motor development in children, including the following four components of motor development: physical activity, physical fitness, fundamental movement skills, and motor competence. The study describes the instruments used to assess each of these components. **Theoretical justification.** Searching for research on the subject of the review was carried out using the Elibrary and ResearchGate information platforms, as well as Scopus and Web of Science databases of information analysis resources. Special attention has been paid to research over the last 10 years. This review examined instruments for assessing physical activity and physical fitness (hardware tools and the Prefit test), and also described the most common tools for assessing fundamental movement skills and motor competence, including *Movement Assessment Test Battery for Children–2, Test of Gross Motor Development–2, Bruininks–Oseretsky test–2, Körperkoordinationstest für Kinder, Zurich Neuromotor Assessment*. **Discussion.** This review enabled the systematization of the existing instruments for assessing motor development in preschool age and the comparison of their limitations and the requirements for implementation. According to analysis, the *Movement Assessment Test Battery for Children–2* is the most convenient and informative tool to examine children in Russian kindergartens. This review is particularly important because it identifies and discusses the main areas of psychological research that apply the considered assessment tools. The prospects for further research using these instruments are described.

Keywords

motor development, physical activity, physical fitness, fundamental movement skills, motor competence, preschool age, tools, assessment

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Introduction

The study of motor development in children is an established area of research in child psychology (Bernstein, 1947; Zaporozhets, 1986; Goryacheva & Kuznetsova, 2016). In psychological research, the factors of motor development are considered as objectively observable manifestations of mental processes that provide purposeful, coordinated, and voluntary movements of a child (Goryacheva & Kuznetsova, 2016; Gorshkova & Ryzhova, 2019). In other words, movement coordination, accuracy, and efficacy help to assess the ability of children to self-regulate their bodies and movements.

The demand for tools for a reliable assessment of motor development in preschool age is due to a number of factors. First, preschool age is critical in terms of the formation of motor skills and habits associated with physical activity. Motor skills and habits are essential for cognitive development and are fundamental to health and social functioning throughout life (Malina, 2001). Secondly, the assessment of motor development is important for the timely detection of disorders and delays in motor development to plan further correctional interventions. In addition, disturbances and delays in motor development are often observed in mental and speech therapy disorders, and are sometimes their cause (Tomilov, 2019; Skoblo & Trushkina, 2022; Solovieva, Baltazar Ramos, & Quintanar Rojas, 2021). Thirdly, according to research results, digitalization represents a risk to the full-fledged physical activity of children (Kovalev & Starostina, 2020; Veraksa, Kornienko, Chichinina, Bukhalenkova, & Chursina, 2021; Belova & Shumakova, 2022; Sysoeva & Yaroshevskaya, 2022), which makes the study of motor development in children especially relevant. However, there are currently no Russian-language reviews of research that systematize and discuss the tools for assessing motor

development in preschool children. Thus, the lack of information and the importance of the issue determined the relevance of this review. In preschool education programs, great attention is always paid to the motor development of children, including activities for maintaining a normal level of physical activity, developing physical fitness components, and acquiring motor skills (From birth to school, 2019). This confirms the exceptional importance of the issue.

Basic components of motor development

Most studies distinguish the following four basic components of child motor development: physical activity, physical fitness, fundamental movement skills, and motor competence (Konstantinova, 2016; Reisberg, Riso & Jürimäe, 2021; Batez et al., 2021; Bai, Huang & Ouyang, 2022; Malambo, Nová, Clark & Musálek, 2022).

Physical activity combines all the movements that individuals perform in their life activities (Runova, 2004). In other words, these are any body movements produced by skeletal muscles that result in energy expenditure (Ortega, Ruiz, Castillo, & Sjostrom, 2008). Physical activity includes unstructured (outdoor games, any movements, etc.) and structured (for example, physical education) types of movement.

Physical fitness is the level of development of physical fitness components (strength, speed, agility, and flexibility) and a characteristic of the status of such parameters as body composition and cardiorespiratory fitness (Kolimechkov, 2017; Oberer, Gashaj & Roebers, 2018).

Fundamental movement skills are the abilities to perform an organized series of movements automatically. The development of fundamental movement skills helps solve motor tasks optimally, focusing on the movement result rather than the components of this movement. Fundamental movement skills involve various parts of the body and include maintaining balance, running, jumping, galloping, catching, throwing a ball, kicking a ball (kicking a ball at a target), etc. (Yakovleva & Yudina, 2003). Fundamental movement skills develop between the ages of 1 and 7 years and are acquired through play and imitation (Staples, MacDonald, & Zimmer, 2012). Fundamental movement skills are the basis for achieving high motor skills, including the achievement of sporting excellence (Wick et al., 2017).

Motor competence is the next component of motor development (Scheuer, Herrmann & Bund, 2019). The term 'motor competence' describes the level at which a child can perform fundamental movement skills (Utesch, Bardid, Büsch, & Strauss, 2019). Motor competence is a latent construct because it cannot be directly observed or assessed. The level of development of motor competence is assessed on the basis of success in acquiring motor skills, which are determined by age norms (Herrmann, Heim & Seelig, 2019). The development of motor competence is a prerequisite for the development of sport-specific skills, as well as for other highly coordinated activities (Wälti et al., 2022).

Motor development in preschool childhood

Movement is one of the main manifestations of life activities, providing the possibility of an active interaction between individuals and the environment throughout their lives (Ermolaeva & Baranova, 2015). Motor development is most active during the preschool years (Stuhr, Hughes, & Stöckel, 2020).

During preschool age, motor development is important for both children's health and their cognitive and personality development (Ortega et al., 2008; Becker, McClelland, Geldhof, Gunter, & MacDonald, 2018; Ivleva, 2020; McNeill, Howard, Vella, & Cliff, 2020; Contreras-Osorio et al., 2021; Kushniruk, 2021; Kochukhova et al., 2021; Veraksa, Tvardovskaya, Gavrilova, Yakupova & Musálek, 2021; Bai et al., 2022). Movement enables children to actively interact with the environment, which has a positive effect on their cognitive development (Piaget & Inhelder, 1966). Thus, to explore the object-spatial environment, a child needs sufficiently developed motor skills. On the other hand, movement provides sensorimotor stimulation, increased blood flow, and oxygen supply to the brain, which also contributes to cognitive development in childhood (van den Berg, Saliasi, de Groot, Chinapaw & Singh, 2019; Korneev, Bukinich, Matveeva, & Akhutina, 2022). Studies have shown that motor development is associated with the development of regulatory functions (Veraksa et al., 2020; Tvardovskaya, Gabdulkhakov, Novik, & Garifullina, 2020), which in turn are an important predictor of children's success in school education and socialization (Best, Miller & Jones, 2009; Barenberg, Berse & Dutke, 2011; Chichinina & Gavrilova, 2022; Bukhalenkova, Almazova, & Veraksa, 2022; Dolgikh, Bayanova, Shatskaya, & Yakushina, 2022; Oshchepkova & Akhutina, 2022). In addition, motor development contributes to the successful implementation of the leading activity in preschool age – role-playing activity (Karabanova, 2005). Furthermore, in preschool age much of communication and learning is naturally achieved through imitation, which success is facilitated by motor development (Staples et al., 2012).

Relationship between motor development and mental development of children

Motor development components are often included as main or control variables in psychological studies involving preschool children. Thus, many studies examine the relationship between motor development and the development of regulatory functions in preschool children (Barenberg et al., 2011; Vandenbroucke, Seghers, Verschueren, Wijtzes & Baeyens, 2016; Wen et al., 2018; Kuzik, Naylor, Spence & Carson, 2020; McNeill et al., 2020; Veraksa et al., 2021; Li et al., 2022; Bai et al., 2022; Malambo et al., 2022; Spanou, Stavrou, Dania & Venetsanou, 2022; Zhang et al., 2022). Research has also focused on the relationship between motor and cognitive development (Kuzik et al., 2020; St Laurent, Burkart, Andre & Spencer, 2021; O'Hagan et al., 2022). Another common issue is the relationship between motor development and children's academic achievement (Mavilidi, Okely, Chandler, Cliff, & Paas, 2015; Oberer et al., 2018; Batez et al., 2021; Reisberg et al.,

2021; St Laurent et al., 2021). The relationship between motor development components and children's psychosocial development and psychological well-being has also been studied (Kuzik et al., 2020; McNeill et al., 2020; Visser et al., 2020; Salaj & Masnjak, 2022). A separate research direction aims to analyze the specific characteristics of motor development in children with mental disabilities, such as children with autism spectrum disorders or mental retardation (Staples et al., 2012; Thomas et al., 2022).

Theoretical justification

Aim

This review aims to analyze and systematize the tools used in modern psychological research to assess the main components of motor development in preschool children (motor activity, physical fitness, fundamental movement skills, and motor competence).

In addition to a content-based consideration of the instruments themselves, the task was also to take into account the requirements for their use, as well as to identify the existing limitations. The task was to examine tools from the perspective of focusing on the assessment of the process of movement and the assessment of its results (qualitative and quantitative assessment). This review particularly focused on the importance of assessing each component of motor development for psychological research. In other words, the additional task of the review is to answer the question of how each component of motor development is related to the mental development of children.

Methods

For this study, we selected the most frequently mentioned tools in reviews and empirical studies to assess motor development in preschool children. For each instrument mentioned in the research, corresponding methodological manuals have been found.

The search for publications was conducted using the Elibrary and ResearchGate information platforms, as well as Scopus and Web of Science databases of information analysis resources. The searching strategy was as follows: We selected the publications that examined the relationship between factors of motor and mental development in preschool children. In addition to scientific publications, we have searched for data on the instruments for assessing motor development from textbooks for physical education teachers in preschool institutions.

This review includes instruments for assessing physical activity (including hardware tools), instruments for assessing physical fitness (body composition, cardiorespiratory fitness, and physical fitness components, in particular the Prefit battery), instruments for assessing the level of development of fundamental movement skills and motor competence: Movement Assessment Test Battery for Children–2, Test of Gross Motor Development–2, Bruininks-Oseretsky test–2, Körperkoordinationstest für Kinder, Zurich Neuromotor Assessment.

Results

Instruments for assessing physical activity

To assess physical activity, there are objective (hardware) assessment tools and questionnaires.

The main devices for assessing the level of physical activity are the ActiGraph and pedometers. The ActiGraph monitors rest (sleep) and activity cycles (Zysset et al., 2018; Wen et al., 2018; Reisberg et al., 2021; Malambo et al., 2022). Pedometers provide less complete information. It only takes into account the number of steps. Therefore, it is used less frequently (Vandenbroucke et al., 2016).

Children over 7 years of age usually answer questionnaires to assess physical activity (Tucker et al., 2014). Meanwhile, preschoolers are still unable to correctly estimate the time of their physical activity in minutes or hours. In this regard, the questionnaires for assessing the physical activity of preschool children are more often completed by their parents (Alhusaini, Melam & Buragadda, 2020; Connelly, Manningham & Champagne, 2021; Ha et al., 2022).

Instruments for assessing the level of physical fitness

The physical fitness component includes body composition, cardiorespiratory fitness, and physical performance.

Body composition is assessed using anthropometric indicators. Height, body weight, skin-fold thickness, fat-fold thickness, as well as the girth of certain body circumferences are assessed. Then anthropometric indices are calculated, such as body mass index (BMI), waist-to-height ratio, shoulder muscle circumference, and others (Kolimechkov, 2017). Bioelectrical impedance analysis method is also used to determine body composition.

Cardiorespiratory fitness is the ability of the circulatory and respiratory systems to provide sufficient oxygen to working skeletal muscles during prolonged physical activity (Kolimechkov, 2017). Cardiorespiratory fitness is assessed using maximal oxygen uptake (VO2 max). It is indicated in liters of oxygen per minute (absolute indicator) or relative to body weight in milliliters of oxygen per kilogram of human weight per minute (ml/kg/min) (Kolimechkov, 2017). Moreover, cardiorespiratory fitness can also be assessed using the 20-meter shuttle run test (Beep test), one-mile (1609 meters) walking at a maximum speed followed by heart rate measurement, as well as the Physical Working Capacity 170 (PWC 170) test conducted on a bicycle ergometer to measure physical capacity, at which a heart rate of 170 beats per minute is achieved (Kolimechkov, 2017).

Physical fitness components (strength, speed, agility, and flexibility) reflect the development of the musculoskeletal and nervous systems (Kolimechkov, 2017). The following key tests are commonly used to assess physical performance: (1) standing jump to assess lower extremity strength; (2) raising the body from a supine position to assess

abdominal strength; (3) shuttle running to assess speed and coordination; (4) sitting folds with straight legs to assess flexibility; (5) the Flamingo test to assess balance when one needs to stand on one leg while the other leg is bent at the knee (Shebeko, 2000; Tarasova, 2005; Stepanenkova, 2008; Veraksa et al., 2021).

The most widely used instruments to assess physical fitness components are Prefit (Cadenas-Sanchez et al., 2016), Eurofit (European Physical Fitness Test Battery) (Eurofit, 1993), FitnessGram (Cooper Institute, 2017) and Alpha-fit (Assessing Levels of Physical Activity) (Ruiz et al., 2010). All of these tools also include assessment of body composition and cardiorespiratory fitness. However, only the Prefit battery of tests is used to assess physical fitness in 3–5-year-old children (Kolimechkov, 2017); the other tests are aimed at children aged 6 years (Ruiz et al., 2010).

The Prefit battery uses the following tests*:* (a) the 20-meter shuttle run test to assess cardiorespiratory fitness, (b) hand grip strength to assess muscle strength of the upper extremities, (c) the standing long jump to assess muscular strength of the lower extremities, (d) speed-strength abilities are assessed using 40 m maximum shuttle run test, and (e) the one-leg standing test to assess balance (Cadenas-Sanchez et al., 2016). This test battery takes about 2 hours and 30 minutes to be administered by four assessors in a group of 20 children. However, this period is reduced if more experts conduct the assessment. Compared to girls, preschool boys have higher performance in tasks that assess strength and speed. Compared to boys, girls perform better in tasks that assess balance (Cadenas-Sanchez et al., 2019).

Instruments for assessing fundamental movement skills

Movement Assessment Test Battery for Children–2 (MABC–2)

One common tool for assessing the development of *fundamental movement skills* is the Movement Assessment Battery for Children–2 (MABC–2) (Henderson, Sugden, & Barnett, 2007). The test was created in 1960–1970 by physical education teachers to identify children with motor disorders, as reflected in the original version of the test – Test of Motor Impairment (Henderson et al., 2007). There are variations of the tool for children of different age groups (3–6 years old, 7–10 years old, and 11–16 years old). The instrument provides age standards for every six months from 3 to 4 years of age, and for every year from 4 to 16 years of age. Also, using this tool, children's results can be classified into one of the following three zones: normal development, children at risk for motor disorders, children with motor disorders. For preschool children, assessment is carried out individually and requires 30–40 minutes. For preschool children, the assessment tool contains the following 3 blocks: fine motor skills (three tests: putting coins in a piggy bank at speed, stringing beads on a thread at speed, drawing a route inside given lines); accuracy and dexterity (two tests: throwing a special bag of sand weighing 200 grams at a target 10 times from a distance of 1.8 m, catching the same bag when an

adult throws it to a child 10 times from a distance of 1.8 m); static and dynamic balance (three tests: maintaining balance on one leg, walking on tiptoes along a line for 15 steps, jumping from two legs to two legs from mat to mat at a distance of about half a meter). The instrument also includes a checklist with questions, which implies a qualitative assessment of children's daily motor skills under natural conditions. The checklist should be completed by a person who has been observing the child for a long time – a parent or a teacher. An important advantage of this technique is that it uses checklists to assess not only the results of motor movements, but also the process of their implementation under natural conditions. Another advantage of the test is that the expert uses various means to ensure that the child understands the task. Thus, it combines verbal instructions, visual demonstrations of adult performance and children's test attempts, allowing experts to correct mistakes in understanding tasks. The test manual provides common standards for boys and girls.

Test of Gross Motor Development–Second Edition (TGMD–2)

Test of Gross Motor Development–Second Edition (TGMD–2) is applied to children aged 3 to 10 years and 11 months (the test provides age norms for every six months) (Ulrich, 2000). The first objective to be achieved in the development of the test was to assess the skills often required of children in the process of preschool and primary school education. In addition, in the development of the test, the objective was to make it accessible to specialists from different areas and not require a long mastery. Assessment is also carried out individually and takes 15–20 minutes. The test consists of two subtests, each evaluating six skills. The first subtest (assessing the development of locomotion) includes the following movement skills: running, galloping, long jump with one leg, jump on one leg, horizontal jump with two legs, and sliding to the side. The second subtest includes movement skills for object control: hitting a stationary ball, dribbling a ball, kicking a ball, catching a special bag, throwing a ball from above, and rolling a ball from below. The advantage of the test is that the same tasks are offered for all ages, making it easier to assess progress. The test provides common standards for boys and girls.

Bruininks-Oseretsky test, second edition (BOT–2)

The Bruininks-Oseretsky test, second edition (BOT–2) is a tool for assessing psychomotor development in individuals aged 4 to 21 years (Jírovec, Musálek & Mess, 2019). The test helps to determine the level of development of fundamental movement skills in both typically developing children and children with mental disorders (Jírovec et al., 2019). BOT-2 exists in the full and short forms. Both forms have high reliability, rel = 0.9–0.97 (Jírovetc et al., 2019). The short form is used more often as it requires 15–20 minutes per child, while the long form requires 45–60 minutes (Jírovec et al., 2019). The short form can be used as a screening tool. On the basis of the results of the short form, it can be decided whether further examination is necessary. The test evaluates fine motor skills,

hand coordination, body coordination, strength, and dexterity. In BOT–2, the general standard scores for each subtest are standardized according to gender and age.

Peabody Developmental Motor Scales Second Edition (PDMS–2)

*The Peabody Developmental Motor Scales Second Edition (*PDMS–*2)* is designed for children ages 0 to 5 years of age (Folio & Fewell, 2000). This instrument requires 45–60 minutes per child. Due to its duration, the technique is carried out in several steps with a break or during several days. The main goal of the tool is to identify children with delayed or impaired motor development for their further inclusion in a correctional program. The method contains tasks for both gross and fine motor skills. The technique is primarily intended for young children and takes time, limiting its use for preschool children.

The Körperkoordinationstest für Kinder

The Körperkoordinationstest für Kinder (KTK) (Kiphard & Schilling, 1974) is only available in German, but is widely used throughout the world. The test is used in work with both normally developing children and children with developmental disabilities. The test is aimed at children aged 5–14 years. Testing takes about 20 minutes. The test consists of four tasks: (1) walking backwards on beams of decreasing width from 6.0 cm to 4.5 cm to 3.0 cm; (2) single-leg jumps from side to side for 15 s; (3) moving sideways on wooden boards for 20 s; (4) single-leg high jumps over a foam obstacle with a successive increase in height by 5 cm.

Zurich Neuromotor Assessment (ZNA)

The Zurich Neuromotor Assessment (ZNA) is designed for 3–18-year-old children – ZNA3–5 for 3–5-year-old children and ZNA5–18 for 5–18-year-old children (Kakebeeke et al., 2013; Rousson, Gasser, Caflisch & Largo, 2008). The instrument includes the following tests: tests for fine motor skills, tests for gross motor skills (repetitive movements of the arms, legs and fingers, alternating movements of the arms and legs and sequential movements of the fingers), tests for static balance (stand on one leg with open and closed eyes) and dynamic balance (side jump, chair rise, and standing long jump) (Zysset et al., 2018). The examination is recorded on video, and the speed of the movement is determined from the video recordings using a stopwatch with a tenth of a second accuracy (Zysset et al., 2018). For each subtest, the exact start of the time measurement and the number of measured movements are specified (Zysset et al., 2018). In the ZNA, individual motor tasks are assessed not only quantitatively, but also qualitatively. Thus, the ZNA assesses the connectivity of the movement of the contralateral and ipsilateral limbs, face, head, and body. The rarer the accompanying movements and the less pronounced they are, the better the quality of the movement (Zysset et al., 2018). Concomitant movements are defined as involuntary movements in parts of the body that are not actively involved in task performance (Zysset et al., 2018). The qualitative assessment of the process of performing motor acts, and not only its result, is the strength of this technique.

The main objective of the above instruments for assessing the development of basic motor skills and motor skills is to identify children who are behind their peers in motor development and require special correctional interventions, as well as to further assess the effectiveness of correctional and developmental activities (Ulrich, 2000; Henderson et al., 2007; Jírovec et al., 2019). These tools can be used by kinesiologists, physiotherapists, educators, and psychologists (Ulrich, 2000; Henderson et al., 2007; Jírovec et al., 2019; Wuang, Lin & Su, 2009). These instruments also have great potential for use in longitudinal studies in psychology and other sciences. These methods are suitable for longitudinal studies because they provide age standards for each year or six months, and also because the repetition of the tasks of the tool once over a period of time does not affect the success of its implementation.

The comparison of methods enabled us to conclude that the Movement Assessment Test Battery for Children–2 has the greatest advantage in the assessment of preschool children. In particular, the strength of this technique is that it evaluates both the process of task performance and the results. The Zurich Neuromotor Assessment also involves a qualitative assessment, but it is more difficult to implement than the Movement Assessment Test Battery for Children–2. Another advantage of this technique is that it requires a relatively short time to perform a wide range of tasks.

The assessment of motor competence is carried out on the basis of an analysis of the performance of the instruments intended to assess the development of fundamental movement skills. This is because motor competence precisely reflects the level of mastery of fundamental movement skills.

Discussion

This review described commonly used tools for assessing motor development in preschool children. On the basis of this review, the assessment tools are divided into instruments that assess the process of movement and instruments that assess its results. The requirements for the use of tools and their limitations can also be discussed.

Assessing the result and the process of movement

Among all the described methods, we can distinguish those that assess the process and those that describe the result of movements. Assessing the level of physical activity is always an assessment of the process, while assessing the level of physical fitness is an assessment of the result achieved at a particular moment, an assessment of the current state. In methods that assess the level of development of fundamental movement skills and motor competence, the result of performing movements is primarily assessed. The result is recorded in terms of time spent on the task, distance, number of repetitions, number of hits on the target, number of errors, etc. This is not enough to fully understand the level of motor development of children. For the most informative assessment, observation of the

performance of various movements is also required, that is, a qualitative assessment of the movement process (Staples et al., 2012). After all, coordination, consistency, dexterity, as well as the pace of movement are factors in their effectiveness and indicate success in acquiring various movement skills required for games, writing, sports, dance, and any manipulation with cultural objects (Staples et al., 2012).

Requirements for assessment tools

There are several requirements for the use of instruments to assess the motor development of preschool children.

First, when tools are used to evaluate all components except motor activity, cardiorespiratory fitness and body composition indicators, it is important to create motivating conditions as close to nature as possible (Malina, 2004). For this purpose, game formats are used and praise plays an important role in the execution process. It is important to make sure that the child understands the instructions correctly. This often requires an individual approach. To ensure ecological validity, expert observations of children's movement in natural environment can be used to supplement tests (Staples et al., 2012).

Secondly, experts should pay attention to the physical condition of children during assessment procedures. If there are signs of illness, the examination must be interrupted. The assessment can only be made if the child is in good health.

Thirdly, specialists must create safe conditions for testing – to prevent possible injuries by properly organizing space, warming up before testing, and ensuring that children wear comfortable clothing for movement and wear sports shoes.

Fourthly, assessment procedures require special equipment and a large room.

Limitations of assessment tools

The lack of information on the standard for performing the tasks by children from different countries is a major limitation of the reviewed instruments. However, studies using these assessment tools have shown that cross-cultural differences exist (Saraiva, Rodrigues, Cordovil, & Barreiros, 2013; Ke et al., 2020). Therefore, establishing standards for the application of tools for children from different countries is a prospect for further work.

Moreover, a limitation of some of the instruments described is the absence of separate standards for performing the tasks by boys and girls. Separate standards for boys and girls are given for physical fitness parameters, as well as in the Bruininks-Oseretsky test (BOT-2). However, according to the results of some studies, there are gender differences in the development of fundamental movement skills and motor competence. For example, girls perform better in fine motor tasks and balance tasks of the Movement Assessment Test Battery for Children–2 (Hirata et al., 2018), and boys perform better in throwing and catching a bag (Ke et al., 2020; Rodrigues et al., 2019). We should note that the data on

gender differences are somewhat different in different studies. This issue requires further study and is therefore a promising field of research.

Using considered instruments in psychological research: Associations between each component of motor development and children's mental development

The aim of the study was not only to describe the assessment tools, but also to analyze the use of these methods in psychological research. To this end, let us further consider how each component of motor development is related to the children's mental development.

In the context of the study of the mental development of children, it is important to determine the level of physical activity, especially because physical activity contributes to brain maturation through physiological mechanisms (van den Berg et al., 2019; Veraksa et al., 2021). In other words, the level of physical activity can be a factor affecting the cognitive development of a child.

In psychological research, the assessment of physical fitness is used because this component is also related to the mental development of children. Thus, children who are behind their peers in terms of the development level of this component may have difficulties communicating with peers and conducting joint activities (Larkin & Summers, 2004). Furthermore, children with low physical fitness find it difficult to develop the fundamental movement skills required for cultural exploration (Larkin & Summers, 2004).

Agility is the most 'psychological' parameter of physical fitness. Agility is the coordination of all movements, enabling children to react to tasks and adapt to changes in the environment. In other words, in order to ensure the agility of movements, it is necessary to coordinate work at all levels of construction and correction of movements (Bernstein, 1947; Malanov, 2011). We should note that preschool age is a sensitive period for developing agility (Malanov, 2011). Therefore, it is particularly important to evaluate the level of agility development at this age.

In psychological research, the development of fundamental movement skills is also important, since the formation of fundamental movement skills is a component of the child's mental development. Fundamental movement skills such as running, jumping, throwing, and catching are essential for everyday play (Larkin & Summers, 2004). Due to difficulties in learning fundamental movement skills, the child cannot be sufficiently involved in joint activities with the peers. Insufficient participation in joint activities can lead to insufficient integration into children's teams (Larkin & Summers, 2004). Compared to normally developing children, those with developmental coordination disorders are therefore less likely to play with their peers and more likely to assume the role of observers (Kennedy-Behr, Rodger & Mickan, 2011).

The relationship between the development of fine motor skills and the mental development of children is an independent and extensive subject of psychological research. The level of development of fine motor skills is assessed in both instruments aimed to determine the level of development of fundamental movement skills and methods aimed at assessing the development of motor fitness. Fine motor skills are very important in preschool childhood. Children with fine motor deficits have fewer opportunities to learn and experience the world, difficulties in learning writing, drawing, and other manual activities, and are therefore less popular as game partners (Kennedy-Behr et al., 2011; Tomilov, 2019).

The development of the ability to maintain balance (static and dynamic) is assessed both in terms of physical fitness development (in the Prefit battery) and in terms of fundamental movement skills and motor abilities (MABC-2, KTK, ZNA tests). Maintaining balance is a prerequisite for motor control (Henderson et al., 2007). Static balance is the ability to maintain the posture that a child requires, for example during education activities, where he needs to sit without moving, and during various games, where he needs to freeze. Dynamic balance is the ability to make smooth, precise, and controlled movements at the desired motor speed. This is necessary when mastering any dance, many games, such as hopscotch and any joint physical activity.

In this review of scientific research, we found that *the most common research topic* was the correlation between physical activity and the development of regulatory functions in preschool children (Barenberg et al., 2011; Vandenbroucke et al.,2016; Wen et al., 2018; Kuzik et al., 2020; McNeill et al., 2020; Malambo et al., 2022; Zhang et al., 2022). The relationship between all components of motor development was more often considered to be associated with the cognitive development of preschool children (Mavilidi et al., 2015; Oberer et al., 2018; Kuzik et al., 2020; Reisberg et al., 2021; St Laurent et al., 2021; Batez et al., 2021; O'Hagan et al., 2022) than with the emotional and personal development (Kuzik et al., 2020; McNeill et al., 2020; Visser et al., 2020; Salaj et al., 2022). At the same time, the potential impact of motor development on the emotional and personal development of children is significant. A potential for further research is therefore to study the relationship between all components of motor development and indicators of emotional and personal development in preschool children.

Conclusion

We reviewed tools for assessing the components of motor development in preschool children. This review contributes to the understanding of the four components used to describe motor development – physical activity, physical fitness, fundamental movement skills, and motor competence. We have shown how motor development components are related to mental development in children. This relationship determines the importance of assessing motor development in psychological research and psychological work.

Literature

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Conflict of Interest Information

The authors have no conflicts of interest to declare.