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REVIEW PAPER

PHYSICAL ACTIVITY AND SELF-REGULATION AS A PRECONDITION FOR FUTURE THINKING AND SUSTAINABLE DEVELOPMENT

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Abstract

The Covid-19 pandemic is an unprecedented historical event that has affected all areas of life and changing the lives of people around the world. Therefore, living in the conditions of the “new normality” (Lawrence, 2013) and the “social acceleration” (Rosa & Trejo-Mathys, 2013) encourages a rethinking of the human relations with the world, primarily focusing on the development of conscious and responsible behavior and self-regulation skills. This article focuses on the phenomena of movement and self-regulation for the well-being of society and the development of future thinking competencies. The aim of this work is to reveal the links between the phenomena of physical activity and self-regulation as a precondition for the development of future thinking competencies and sustainable development. Material and methods of research. The argumentative literature review is based on an interdisciplinary approach, the phenomena of physical activity and self-regulation are analysed from the perspectives of social, educational, cognitive sciences and neurosciences. The results of the review show that systematic and planned physical activity is not only a significant measure of a person’s physical and mental health, but a sign of health and physical literacy competencies. Conclusions. Health and physical literacy competencies are closely linked to the development of self-regulatory capacity and are manifested in responsible, well-being and sustainable development-oriented behaviour. Conscious physical activity develops a person’s ability to self-regulate and plan for their future and can therefore be a meaningful means of shaping future thinking skills.

Keywords: *physical activity, self-regulation, executive function, future thinking, socio-emotional competencies, sustainable development*

Introduction

The Covid-19 pandemic is an unprecedented historical event that has affected all areas of life, changing the lives of people around the world in terms of how they communicate with others, work, and study. The pandemic and its management measures, as well as the economic downturn it caused, have negatively impacted the mental health of many people, and created new challenges for those already suffering from mental illness and addiction (Yang et al., 2020). One of the major consequences of a pandemic, i.e., the physical isolation of people has had detrimental consequences for the mental health of people around the world (Giallonardo et al., 2020). People's physical inactivity has increased all over the world. A situation triggered by a pandemic (for example, loneliness, financial uncertainty, anxiety about work, or uncertainty about the future) has caused mental health disorders (for example, increased stress, mental stress, anxiety, and depression) in many people (Lee, 2020). Physical inactivity and poor mental health have become important concerns for the health system (Herbert et al., 2020).

During the pandemic, the importance of the professional qualities of medical, educational, and social professionals became very evident. A successful response to the pandemic was associated not only with medical capacity and competence, but also with the ability of society to cope with the impact of the pandemic (e.g., isolation and containment, family complications, job loss, decreased physical activity, fear and anxiety about the uncertain future etc.) (Guterres, 2020).

The Covid-19 pandemic affected people's lifestyles, social relationships, work habits and learning culture. There is no doubt that long quarantine in the future will have an impact on changes in learning and work culture. In addition to the negative consequences of quarantine, it is also noticeable that, in some cases, learning and working from home can have certain benefits, allowing people to plan their study or work time in person. It is believed that this will change the culture of work and learning in the future.

However, increasing freedom poses a challenge to responsible decision-making and the development of self-regulatory competencies. A person's ability to make socially responsible decisions is becoming an increasing value in thinking about a sustainable world, the well-being of society.

Therefore, living in the conditions of the “*new normality*” (Lawrence, 2013) and the “*social acceleration*” (Rosa & Trejo-Mathys, 2013) encourages a rethinking of the human relations with the world, primarily focusing on the development of conscious and responsible behavior and self-regulation skills. It should be noted that OECD and UNESCO policy documents emphasize the need to develop competencies that will enable the public to be prepared for life in a VUCA-world characterized by: “*volatility* (the nature, speed, volume, magnitude and dynamics of change); *uncertainty* (the lack of predictability of issues and events); *complexity* (the confounding of issues and the chaos that surround any organization) and *ambiguity* (the haziness of reality and the mixed meanings of conditions)” (p. 33) (Horney et al., 2010).

This article discusses how people and society can respond to the challenges of a changing world, how to avoid or mitigate the effects of emergencies by reducing their negative impact on themselves and others. The results of studies conducted during the COVID-19 pandemic period showed (Zinchenko et al., 2020; Pacholik-Żuromska, 2021) that self-regulatory methods can be used to address challenges effectively. Therefore, our review focuses on understanding the mechanisms and effects of self-regulation of human behaviour, revealing the benefits of physical activity for the development of people’s self-regulatory skills and personal well-being for sustainable development and future thinking competencies. The work focuses on the phenomena of movement and self-regulation for the well-being of society and the development of future thinking competencies.

The aim of this work is to reveal the links between the phenomena of physical activity and self-regulation as a precondition for the development of future thinking competencies and sustainable development. The argumentative literature review (Wentzel, 2017) is based on an interdisciplinary approach, the phenomena of physical activity and self-regulation are analysed from the perspectives of social, educational, cognitive sciences and neurosciences.

The review will lead to original research to gain a deeper understanding of the benefits and impact of exercise and physical activity on personal competence development, adaptation to change and the creation of a sustainable world. Human self-regulatory abilities are conceptualized as a value of sustainable behaviour. It is believed that conscious self-regulation can make a significant contribution to the organization of life in new conditions.

Self-regulation and executive function

During the pandemic, many people were forced to change their studies, work, and life habits overnight. For many, distance working, and learning has become a completely new way of life. Significant changes in learning and work are associated with increased time spent at the computer, decreased physical activity, increased/decreased working hours, and an inability to find a balance between work (or study) and family matters (Jaiswal & Arun, 2020). This inevitably affects people's productivity levels and confirms the importance of self-regulation, which is considered an essential aspect of adaptive behaviour (Hofmann et al., 2012).

Self-regulation is the ability to control impulses within oneself. It is both biological (temperament/disposition) and behavioural (personality) (Thomson & Jaque, 2017). Self-regulation refers to rules or principles governing individual behaviour (the functioning of the self) (Bowers et al., 2015). As a multidimensional construct, self-regulation involves behavioural and cognitive processes that allow the individual to optimally manage attention, behaviour, cognitive arousal, or direct it in the desired direction. Korucu et al. (2017) argued that self-regulation skill is necessary both for controlling negative social behaviour and for displaying constructive behaviour and can also affect social behaviours by increasing the ability to understand others' minds. The critical importance of self-regulatory skills is recognized in a variety of contexts (e.g., social behaviour and emotion management, combating harmful habits, learning process, physical activity, elite sports, etc.).

Self-regulation is essentially a matter of altering one's responses, including thoughts, emotions, and actions (Baumeister & Monroe, 2014). Depending on the complexity of the phenomenon, different approaches to self-regulation are distinguished: behavioural-based, temperament-based and a cognitive–neural systems approach. Thomson and Jaque (2017) note, that “*optimal self-regulation is directly related to how well performers manage novel events, a capacity that is influenced by temperament, early developmental experiences, and personality traits*”. However, knowing that human temperament is an innate trait of childhood, the question arises: “*How can you improve your self-regulation skills?*”

Thus, the development of self-regulation in childhood is influenced by the experience of safe attachment. Children's sense of secure attachment is associated with parental resilience to external factors. Resilience is evident when individuals experience difficulties but do not have psychological or physical disorders (Thomson & Jaque,

2017). The behavioural based approach is based on concentration of attention and impulse control by inhibiting or activating control mechanisms (Rothbart & Bates, 2006). Yet the perspective of the executive function is based on the coherence of cognitive processes, including inhibition of dominant response, change in thinking stereotypes, support and manipulation of information, long-term memory used to set goals, plan and solve problems (Miyake et al., 2000). Self-regulation is characterized by a person's ability to consciously set goals and manage their behaviour, using regulation of the cognitive process (planning, modelling of significant conditions, evaluation), regulation of behavioural and personal characteristics (flexibility, independence, reliability) (Morosanova, 2010).

Hofmann et al., (2012), explaining the links between self-regulation and executive function, note that aspects of executive function (working memory operations, behavioural inhibition, and task-switching) are related to self-regulatory mechanisms, and executive function development can improve poor self-regulatory skills. However, the authors also point out that the decrease in the efficiency of the executive function is related to situational risk factors, which emerged from the analysis of socio-psychological aspects of self-regulation.

Studies conducted during the pandemic (Zinchenko et al., 2020) have shown a significant importance of self-regulatory skills for people's lives in quarantine conditions. Individuals with a high level of self-regulation are more successful in atypical and new situations. The success of self-regulation during the quarantine period has manifested itself primarily in lifestyle changes, recognizing and acknowledging the need for quarantine measures. Thus, this study showed that self-regulation during quarantine is related to perceptions of social responsibility. Although optimal self-regulation is directly related to how well a person copes with new events or challenges, it is nevertheless noted (Thomson & Jaque, 2017) that the effectiveness of self-regulation may decrease in the presence of fatigue or stress. However, physical activity helps reduce stress. Therefore, physical activity may be appropriate means to maintain the effectiveness of self-regulation in long-term circumstance, for example during quarantine.

The traditional approach to self-regulation in the context of physical education relies on social cognitive models that provide that people's behaviour is controlled by voluntary beliefs, motives, intentions, and expectations associated with such behaviour (Hagger et al., 2010). This approach reveals that preparation for sports requires attitude, goal setting, planning, effort and introspection in performance, reflection, and

evaluating on the results achieved (McCardle et al, 2018; McCormick et al., 2018). When playing sports and participating in competitions, people develop self-regulatory skills by engaging in activities that require them to cope with unforeseen challenges, playing sports or playing in ever-changing conditions. However, this area has not yet been sufficiently explored.

Movement and executive function

Physical activity has always been a major factor in human evolution throughout the history of human development, shaping our physiology and culture of behaviour. Since ancient times, philosophers have believed that exercise and physical activity are key factors in maintaining a healthy body and mind (Russo, 2003). This idea was actualized in different periods of the history of human development. However, we have only recently begun to understand the effect of physical activity on the human body at the cellular level and are able to analyse the reasons why a passive or sedentary lifestyle is harmful to human health, as well as realize that physical activity can be “the best buy in medicine” (Loprinzi, 2015) or a powerful “medicine” (Di Liegro et al., 2019). It has now become clear that systematic physical activity is an important condition for a healthy lifestyle, physical and mental well-being. Health and physical literacy are increasingly understood as aspects of not only personal, but also social well-being (Lynch & Soukup, 2016; Sentell et al., 2017; Cornish et al., 2020).

According to research in different disciplines, exercise and physical activity or interventions in physical education have a positive effect on human physical and mental health indicators. Individuals who exercise regularly or are physically active have better mood and health status, better functional capacity (Penedo & Dahn, 2005). In addition, physical activity in nature and a sense of connection with nature improve people’s mental health and well-being (Lawton et al., 2017).

Physical activity thus contributes to maintaining and improving brain health at both the structural and functional levels (Chen et al., 2020). Physical activity and exercise are complex behaviours involving repetitive planning, observation, continuous correction, and suppression of unwanted interference (Mullen & Hall, 2015). These same processes are manifestations of executive control and rely on established neural networks involving the prefrontal cortex (Buckley et al., 2014).

The human brain adapts to changing conditions and emerging needs, by changing its functional and structural properties (“neuroplasty”), leading to the learning and acquisition of new skills (Voss et al., 2010; Lin et al., 2018). Studies in humans and animals have

revealed similar evidence that physical activity facilitates neuroplasty in certain brain structures and, as a result, improves cognitive function (Hötting & Röder, 2013) and reduces the likelihood of neurodegenerative processes and diseases (Domingos et al., 2021). Although better physical and mental health of young people is associated with physical activity (Fedewa et al., 2018), positive effects of physical activity on brain structure and function have been found even in the elderly (Domingos et al., 2021), and aerobic exercise improves even the cognitive abilities of older people (Voss et al., 2010).

Human cognitive functions include memory, attention, visual-spatial, and executive functions, while complex cognitive processes include thinking (abstract, cause and effect, creative thinking, and planning) and language functions (Evans, 2003). There is ample evidence that continuous physical activity can enhance executive function (Mullen & Hall, 2015), sport influences changes in the right anterior prefrontal cortex associated with cognitive control (Chaddock-Heyman et al., 2013), and affects self-regulatory mechanisms (Ludwig & Rauch, 2018). Physically active children were also found to have better executive function inhibition (Scudder, 2014) and planning skills (Van der Niet et al., 2015) than children who do not engage in any physical activity.

Thus, data from a variety of studies suggest that physical activity improves brain function and can lead to changes in executive function. However, in terms of inverse effects, data from a study in the elderly (Daly et al., 2014) that confirmed a dynamic two-way relationship between physical activity and executive function are important. Therefore, changes promoted by physical activity can improve executive function abilities, and changes in executive function over time can promote physical activity.

Social-emotional regulation

The pandemic and self-isolation have completely changed human relationships, i.e., the culture of learning, working, and communicating. Natural communication has been replaced by digital means. People spend more time at the computer both at work and in school, as well as in their free time. Communication has become “flat” or two-dimensional, because when we communicate, we see only the image of the interlocutor and hear the voice, but not the interlocutor in the space of the conversation. Such communication loses the relationship and physicality that are still common to us, which can change a person's attitude to the world. The problems of social isolation became apparent during telecommuting. The social distancing caused by the quarantine has

affected the emotional and mental health of many people. Bullying is becoming more common in cyberspace and during distance learning.

The formation of a new digital communication culture is changing the quality of traditional human communication and collaboration, which is supported by social and emotional skills. Social emotional skills can be improved, but this requires live contact and experience of being in real interaction with others. Therefore, the development of these skills is becoming increasingly important in the context of digitalisation.

The digitalization of work and education has opened access to new sources of learning and information, expanded the diversity of cognition and provided greater opportunities for choice and learning from other cultures. Culture is understood as the totality of unique human characteristics, experiences, knowledge, and values. With increasing diversity of experiences and cultures, empathy is becoming increasingly important when working and communicating between groups of people from different cultures (Meeks, 2020; Stevens et al., 2020). The period of pandemic is seen by scientists as an evolution of the concept of empathy, studying the phenomenon of empathy not only from a sociological perspective but also from a neuroscience perspective (Salandó, 2020).

Social emotional competencies are essential for successfully coping with changing conditions, communicating, and collaborating, and making socially responsible decisions. Understanding the importance of these competencies, identifying, and describing them contributes to personal well-being and growth, which strengthens relationships with others. “Emotional development involves increased ability to feel, understand and differentiate progressively more complex emotions, as well as the ability to self-regulate them in order to adapt to the social environment or to accomplish present or future goals” (p. 7) (Rueda & Paz-Alonso, 2013).

Many cognitive skills that fall under the headings of executive function have counterparts at the social and emotional levels, such as impulse suppression and problem solving. However, researchers and educational practitioners have traditionally not seen executive function as an important variable in developing social emotional abilities (Riggs et al., 2006). Empirical studies have identified relationships between brain executive function and social emotional abilities. However, the concept of social and emotional education in the education system is new. Although physical activity improves EF and the content of physical activity exercises includes many activities (e.g., various forms of play, relay, and conscious attention practices) that contribute to the

development of social emotional abilities, educational practitioners and researchers still lack these opportunities.

Participation in physical activity or sports exercises is based on people's involvement in activities and the experience of positive emotions, and therefore has a very significant educational and human identity formation effect. Leisure, play, or competition play deep emotions - from the joy of sports, the joy of new discoveries, learning and experiencing to the joy of victory or disappointment in losing. People engage in physical activity and sports activities, constantly communicating and collaborating in changing conditions, and must constantly address emerging challenges and make decisions. Therefore, physical activity is a bleak field for the manifestation and development of social skills. People engage in physical activity and sports activities, constantly communicating and collaborating in changing conditions, and must constantly address emerging challenges and make decisions. Studies (Cañabate et al., 2018) show that the promotion of cognitive activity through physical education lessons through reflection methods promotes high self-knowledge (recognition, appreciation, and perception of positive emotions) and has an impact on personal well-being and peer development. Therefore, the context of physical education is an excellent space for developing self-awareness, self-control, social awareness, communication and collaboration skills, and the ability to make responsible decisions (Ciotto & Gagnon, 2018).

Movement and future thinking

Human beings have a remarkable ability to transcend the constraints of the current environment and activities, wherein they mentally transport themselves not only into the past, but also into the future by thinking about upcoming events, tasks, hypothetical scenarios, and even impossible missions (Kvavilashvili & Rummel, 2020). People always think about the future when planning their personal and professional things (e.g., travel, leisure). The future is a place, where we will spend the rest of our lives, so people plan a lot in the present time (Thom et al., 2013).

Thinking about the future is an integral aspect of human cognition, underpinning the ability to anticipate opportunities to plan and control the relationship with the environment and other aspects in advance (Suddendorf & Corballis, 2007). The desire to understand how people think about the future has led to the emergence of a new field of research based on the discoveries of neuroscience and psychology, which is becoming a popular topic in the study of developmental psychology (Szpunar, 2010). Exploring people's future thinking and decision making

provides insight into many important real-world phenomena (Thom et al., 202ę). Meanwhile the relevance of this topic is growing in the face of a pandemic, when thinking about the future's possible new challenges, crises, and sustainable development.

Scientists have identified several taxonomies for future thinking. Szpunar with colleagues (2014) distinguish four forms of future thinking: *simulation* (construction of a detailed mental representation of the future), *prediction* (estimation of the likelihood of and/or one's reaction to a particular future outcome), *intention* (the mental act of setting a goal), and *planning* (the identification and organization of steps toward achieving a goal state). Kvavilashvili & Rummel (2020) mention these future thinking techniques: episodic future thinking, episodic simulation, episodic foresight, and autobiographical planning, among several others. The content of the representation of the idea distinguishes between episodic (specific autobiographical experiences that may occur in the future, such as a trip with friends or participation in a competition that will take place next week) and semantic (focused on community or world values) thinking. Episodic thinking research is most conducted in scientific practice (Schacter et al., 2017). Neuroscience research suggests that stimulation of future ideas activates different areas of the brain depending on the content of future events (e.g., interactions with familiar *people* (social scenarios) or *objects* (non-social scenarios) in personally familiar *locations*) (Szpunar et al., 2014). However, the hippocampus responds to entirely new events whose elements (i.e., individuals, location, and scenarios) were not simulated (Van Mulukom et al., 2013).

We are constantly imagining what will happen in the future, from the big decisions of life to everyday things. For example, when planning a holiday trip, we choose the direction of the trip, the hotel, we book tickets, we plan our leisure time. Later, already preparing for the trip, we plan in detail. This attempt to paint a picture of the future is called episodic thinking about the future (Atance & O'Neill, 2001). Episodic future thinking refers to the capacity to imagine or simulate experiences that might occur in one's personal future (Schacter et al., 2017). Engaging in episodic future thinking (projecting the self into the future to pre-experience future events) may facilitate the perception of future events as psychologically close, thereby increasing the perceived risk associated with those events.

In the field of physical activity and sports, short-term and long-term goals are constantly set, plans and strategies are developed, and in the field of health, people set goals related to weight management or strengthening physical or mental health. This makes it possible to

anticipate the future very clearly and it can become a habit of thinking about the future. It should be noted that future thinking and mental construction of the future by linking the future to the current situation (reality) can be used as a self-regulatory strategy to promote energy, depending on people's expectations to achieve the desired future (Lee et al., 2020). And from a sustainability perspective, competence for future thinking is not just about planning one's own future and regulating one's own activities. As each person's decisions and actions change the relationship with others and reality, thinking about the future is especially relevant when thinking about sustainable development. Conscious physical activity practices that shape self-regulatory skills and future thinking competencies can be a significant precondition for sustainable development.

Discussion

The COVID-19 pandemic rapidly modified the socio-ecological systems of the earth in many ways (Morse et al., 2020), instantly caused transformations in the social world and exposed social vulnerabilities in all areas of life (health, well-being, employment, ecology, economics, human rights, etc.), highlighted phenomena not visible under normal conditions (Leach et al., 2021). It was the restriction of people's movement, self-isolation that led to changes in the daily lives of most of the world's people (less physical activity, social distance, changes in work and communication cultures) and negative consequences (stress, physical, emotional, and mental health) and many people's life thoughts (past, present and future).

In emergencies, it is not possible to act effectively and successfully in the usual way. The resolution of critical situations involves changes in people's behaviour. Many of the consequences of a pandemic are precisely the change in the movement of people and the regime of physical activity and the adoption of new decisions. The ability to critically evaluate a situation and change behaviour is determined by people's ability to self-regulate and their perception of the importance of changes in personal behaviour.

A key determinant of behavioural change is a conscious practice. Therefore, physical activity is one of the best ways to form and develop self-regulatory skills. Participation in physical activity activities promotes adaptation to ever-changing conditions, critical assessment of the situation, recognition of challenges and decision-making. During physical activity all human senses are activated, a pleasure is experienced and thus an involvement in physical activities is considered a value.

Perceptions of personal progress strengthen a person's confidence in his efforts and ability to change his behaviour that is to set new goals and challenges. Experiencing pleasure in sport and perception of value encourages the development of self-regulation, future forecasting, and planning skills. The development of physical activity scenarios is an important tool for developing future thinking skills.

Conclusion

Systematic and planned physical activity is not only a significant measure of a person's physical and mental health, but a sign of health and physical literacy competencies. Health and physical literacy competencies are closely linked to the development of self-regulatory capacity and are manifested in responsible, well-being and sustainable development-oriented behaviour. Conscious physical activity develops a person's ability to self-regulate and plan for their future and can therefore be a meaningful means of shaping future thinking skills.

CRedit authorship contribution statement

S. Sabaliauskas: Conceptualization, Data collection, Systematization, Analysis, Writing - original draft, Writing - review & editing. T. Kaukėnas: Conceptualization, Supervision, Validation, Writing - review & editing. N. Žilinskienė: Supervision, Validation, Writing - review & editing. D. Gražulis: Supervision, Validation, Writing - review & editing.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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