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LITERATURE REVIEW: ANALYSIS OF PHYSICAL ACTIVITY IN PHYSICAL EDUCATION LEARNING ON OPTIMIZING STUDENTS' NEUROMUSCULAR SYSTEM

Prima Suci Ibar Wati Ningrum[a,1,*], Sugiharto[a,2], Sapto Adi[a,3]
[a] Sport Education-Postgraduate, Universitas Negeri Malang, Jl. Semarang No.5 Malang, Malang 65145, Indonesia
[1] primasuci31@gmail.com; [2] sugiharto@um.ac.id; [3] sapto.adi.fik@um.ac.id*
*Corresponding author

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ABSTRACT

Abstract: This literature review aims to analyze the optimization of physical activity in neuromuscular students. Of the 4 data bases (googlescholar, sciencedirect, hindawi, and PubMed with a span of the last 10 years (2011-2021)) searched using the appropriate keywords. The keywords used to analyze the appropriate article are physical education, physical activity, neuromuscular, neurotransmitters, acetylcholine, dopamine, motor function, student. Data extraction and analysis using PRISMA flowcharts. The results of an analysis of 30 articles showed that physical education learning has an effect on the optimization of acetylcholine, dopamine optimization, and neuromuscular optimization in performing the speed of extraction. Based on the results of the analysis it can be concluded that physical activity plays an important role in the optimization of the neuromuscular system of students.

INTRODUCTION

Physical education is suggested for all ages of children and can serve as a springboard to physical activity (Redawati & Asnaldi, 2017:11). Physical education, sports, and health are incorporated in the curriculum of both elementary and secondary schools. Applications for physical education must make curriculum references and stress learning in the areas of physical health, movement skills, emotional stability, reasoning, and moral action (Sebtika, 2017:3). This activity will deliver a pleasant, structured, fascinating, and enjoyable movement experience (De et al., 2018: 6), hence promoting lifetime physical activity (Khodaverdi et al., 2016: 6). Physical education will promote an active lifestyle (Burns & FU, 2018: 8), not just to improve physical and mental health, but also to strengthen motor skills (Nicholls et al., 2016: 4). (Noorafshan et al., 2013: 25). All children will acquire the knowledge, abilities, attitudes, and motivation necessary to develop motor skills and maintain a lifelong commitment to physical exercise through positive play, game, and other physical activity experiences in physical education (Rullestad et al. al., 2018:13). Participation in sports has a substantial effect on the cognitive and motor skills of students (Anisah et al, 2020:4). Physical education learning as a sequence of physical activities has not, however, provided children with a positive and joyful movement experience that improves their neuromuscular development (Canli, 2019).

In schools, the practice of altering the objectives of physical education is used, and the emphasis of physical education is on achieving sporting accomplishments and completing curriculum requirements. Children are robbed of opportunities to develop and learn the fundamental skills required for a physically active lifestyle due to the de-emphasis of physical education in schools. The World Health Organization recommends that children and adolescents engage in moderate to vigorous physical activity (PA) for a total of 60 minutes each day in order to reap the health advantages of PA (WHO, 2020:77). Physical education has been neglected in school curricula and is seen as having a lower priority than core topics. This poses a significant risk to the growth and development of children, their future health, and the fall in physical activity participation rates. Inactivity is associated with many risk factors and low aerobic fitness. Lack of physical exercise is directly associated to a reduction in physical fitness and a rise in non-communicable diseases, metabolic disorders, and metabolic syndrome, posing a future threat (Milanovic et al., 2013:14). Sedentarism significantly impacts not just physical health but also cognitive health, as demonstrated by neuroscientific data. Physical activity is vital for brain health because people are built to move and engage with their environment through movement (Doherty & Miravalles, 2019:7).

Physical education must be able to strengthen the connectivity of new nerves, neuromuscular, and neurohormonal cells for intellectual development to be promoted in addition to physical development (Sindic et al, 2021:15). Physical education can aid in the development of motor abilities and lay the groundwork for overall health, including cardiovascular fitness, metabolic function, and muscular fitness. Due to the fact that neuromuscular coordination is a movement that occurs in the correct time and sequence, the

movement contains energy resulting from muscle contractions, and muscles contract in response to nervous system commands, neuromuscular coordination has a significant impact on the working system of motor skills (Schmidt, 1988:265). Neuromuscular optimization seeks to improve neuromuscular control, hence increasing functional joint stability, which may act as a type of damage protection. Combining components of strengthening, stretching, plyometrics, and balance is how neuromuscular optimization is achieved (Griffin et al., 2018:141).

Neuromuscular systems are vital to daily life, particularly in sports. The muscle's ability to contract or shorten. The nervous system stimulates the muscle during shortening so that the muscle's strength, precision, and power can be managed. This is because the higher the will, the stronger and more fast the contractions, making it difficult for the muscles to function properly without the contribution of the nerves (Emery et al, 2015:12). The concentration of the neurotransmitter acetylcholine regulates the speed and strength of muscular contractions, and the enzyme acetylcholinesterase is present in the synapse to activate acetylcholine so that muscle contractions do not continue indefinitely. The interaction between the neurotransmitter acetylcholine and its receptors, as well as the presence of acetylcholinesterase and inhibitory stimulation by other neurotransmitters (GABA), are essential for the creation of proper muscular contractions (Sheffler et al., 2019:30). In addition, the hormone dopamine has a function in the control of movement, learning, memory, emotion, pleasure, sleep, and cognition by the central nervous system. Dopamine is essential for the regulation of our motor actions and the establishment of a balanced posture. Dopamine is a significant neurotransmitter that conveys impulses through D1–D5 transmembrane receptors (Sheffler et al., 2019:39).

Due to the complexity of the response and adaptation of physical activity to body functions, involving the cellular, tissue organ, and molecular levels, this meta-analysis highlights the significance of studying the effects of physical education learning on motor function and neuromuscular optimization. This study aims to identify, synthesize, and interpret the best current information concerning the lowest and optimal levels of physical exercise required to develop motor skills and neuromuscular optimization in kids. Therefore, researchers will conduct research utilizing a review paper named "Physical Activity in Physical Education Learning and the Optimization of Students' Neuromuscular System." The factors of nerve cell function responsible for motor function are employed to investigate motor function in this study.

METHOD

This literature review utilized secondary data from multiple published research articles as its informational sources. To identify existing novelties, the authors restrict their search to articles published between 2011 and 2021 within the last decade. The secondary data utilized was the result of an article review. The collection of article data uses four databases: Google Scholar, Science Direct, Hindawi, and PubMed. The number of international articles collected and used by researchers as secondary data was thirty. Physical education, physical activity, neuromuscular, neurotransmitter, acetylcholine, dopamine, motor function, and student were keywords used to identify articles with relevant titles. Table 1 displays the inclusion criteria for the articles analyzed.

Table 1. Data Inclusion Criteria

Type	Inclusion
Article type	*Research Article*
Published year	2011-2021
Origin	International articles
standard d	Scopus-indexed journals *qurtile* 1, *qurtile* 2, *quartile* 3
sample le	15-18 year old students
method _	Experiment _
Physical Activity Measurement	Measures of physical activity (sports session)
Neuromuscular Measurement	Elisa, *Enzymatic Meter* , *Randomized Controlled Trials* (RCTs), *Onco-move Ontrack, Cross Sectional*

In the data extraction phase, researchers searched for articles using the previously mentioned keywords on access. A total of 116 articles were selected for screening, which consists of four stages: identification, screening, feasibility, and the inclusion of as many as 30 articles in the systematic and meta-analysis. Figure 1 depicts the data extraction of the PRISMA flowchart.

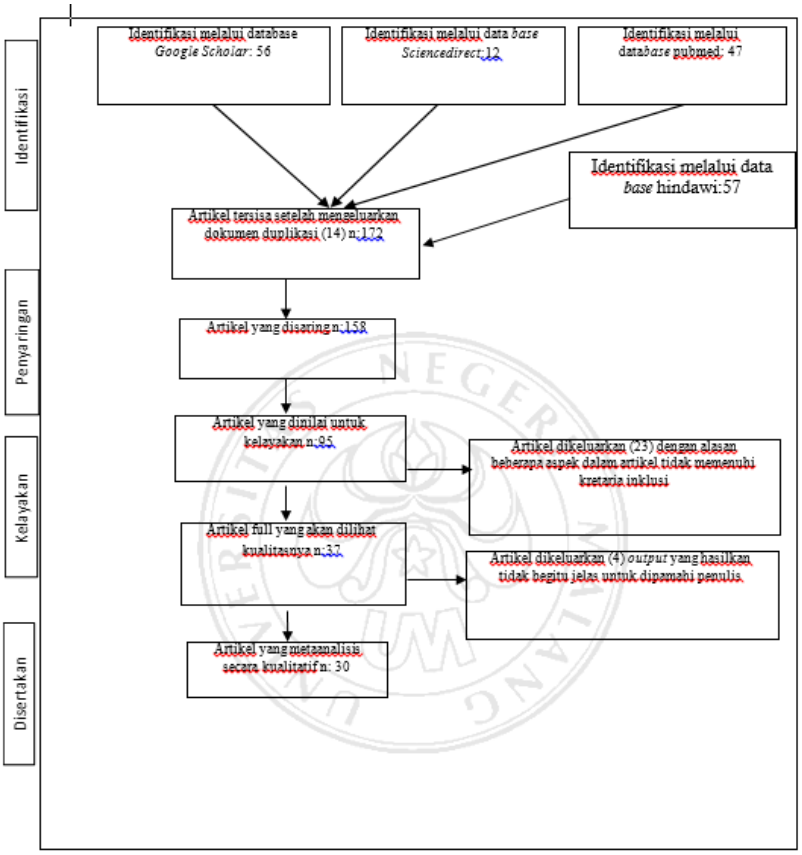

Figure 1. Prisma-Source Flowchart: Adapted from (Moher et al. 2009)

RESULTS

In this section, the authors explain that the results of an analysis of 30 journal articles demonstrate that physical education learning affects the optimization of acetylcholine, the optimization of dopamine, and the optimization of neuromuscular in terms of contraction speed. The descriptions of the collected articles are provided in Table 2.

Table 2. Analysis Results of 30 International Articles

No	Authors and Years	Purpose	Research Design	Data Collection	Subject	Findings
1	Connaughton J., et al. (2013)	To determine the relationship between physical activity, fatigue, sleep quality and pain.	Experiment	Elisa	The research sample is 4 teenagers aged 6-17 years	Physical exercise for 14 days has been shown to increase acetylcholine
2	Semplonius T., et.al. (2018)	To determine the long-term relationship between physical activity and sleep quality	Experiment	Enzymatic meter	The research sample was 827 teenagers aged 12-16 years	Regular physical activity can increase dopamine
3	Lopez, FE, et al. (2020)	To determine the effectiveness of exercise on	Experiment	Randomized controlled trials (RCTs)	The research sample was 108 people aged 6-17 years	Regular exercise can increase the

No	Authors and Years	Purpose	Research Design	Data Collection	Subject	Findings
		fatigue and sleep quality				neuromuscular in the speed of contraction
4	Herring., et al. (2018)	To find out the relationship between physical activity and a feeling of energy moderated by sleep quality	Experiment	Elisa	The research sample was 481 (men = 281 and women = 200) who were 15 years old	Physical activity can avoid fatigue and get more good and positive energy so that it can increase acetylcholine.
5	Donath, Let al. (2014)	To find out the effects of Zumba training on cardiovascular and neuromuscular function	Experiment	Randomized controlled trial	The research sample was 15 women aged 18 year	Instructed Zumba training for eight weeks can improve neuromuscular contraction speed
6	Chan., et al. (2014).	To find out the relationship of qigong practice to body fitness	Experiment	Enzymatic meter	The research sample was 105 people with an average age of 19 years	The effectiveness of Baduanjin Qigong physical exercise for three months can increase dopamine
7	Yanga, C., & Chenb, C. (2018)	To determine the effectiveness of aerobic exercise on stress, fatigue, and sleep	Experiment	Elisa	The research sample was 140 women aged 17 years	Aerobic exercise carried out for 12 weeks can make acetylcholine work optimally
8	Faigenbaum. , et al. (2014)	To find out the relationship of integrative neuromuscular training to body fitness	Experiment	Elisa	The research sample was 40 teenagers (16 boys and 24 girls) aged 17 years	Integrative neuromuscular training (INT) for 15 minutes daily has been shown to increase acetylcholine,
9	Verret1, C., et al. (2012)	To find out whether a physical activity program can improve behavior and cognitive function	Experiment	Randomized controlled trial	The research sample was 21 adolescents with ages 12 to 17 years	Physical activity programs benefit those with motor skills, optimization of muscle movement, and can increase neuromuscular optimization in the speed of contraction.
10	Yilmaz. CK, et al (2013)	To know the effect of progressive relaxation exercise on fatigue and sleep quality	Experiment	Enzymatic meter	The research sample was 56 Swiss vocational youth (29 boys and 17 girls)	Physical activity can increase dopamine.

No	Authors and Years	Purpose	Research Design	Data Collection	Subject	Findings
11	Van Waart, H., et al. (2018)	To determine the effect of low physical activity intensity and moderate to high physical activity	Experiment	Onco-move, ontrack	The research sample was 110 women aged 15-17 years	Pilates exercises have a dopamine-boosting effect
12	Feng, Q., et al. (2014)	To find out the role of physical activity on mental health	Experiment	Elisa	The research sample was 1106 (471 women and 635 men) aged 18 years	Physical activity can increase acetylcholine, reduce anxiety because the muscles work well
13	Ma, C., at al. (2020)	To determine the effect of pilates training on sleep quality, anxiety, depression and fatigue	Experiment	Enzymatic meter	The research sample was 5,233 students aged 18 years	Twelve weeks of physical activity can increase dopamine in physiological, psychological, and social health.
14	Juriena, D., at al. (2016)	To determine the effect of physical activity with depression, anxiety, and sleep quality	Experiment	Cross-sectional	The research sample was 48 teenagers aged 12-16 years	Exercise routine, can increase the neuromuscular in the speed of contraction and reduce muscle fatigue,
15	Chaddock, L., et al. (2011)	To determine the effect of physical activity on health and sleep quality	Experiment	Enzymatic meter	The research sample was 21 children (10 boys and 11 girls) aged 12-16 years	Physical education learning can be a starting point for children to be physically active, causing muscles and nerves to work optimally and increasing dopamine
16	Stroth, S., et al. (2019)	To find out the relationship between exercise as an intervention to reduce fatigue	Experiment	Randomized controlled trial	The research sample is 35 who are aged 14-17 years	Physical activity for 6 weeks is directly proportional to the increase in physical fitness, the increase in neuromuscular in the speed of contraction
17	Ishihara, T., et al. (2018)	To find out that physical activity can increase the risk of mental health problems and poor sleep quality	Experiment	Enzymatic meter	The research sample was 325 adolescents (boys 172 and girls 153) aged 15-17 years old	The motion experience gained during physical activity will encourage an active living culture not only to develop motor skills, but also to increase dopamine
18	Hwang, J., at al. (2017)	In order to investigate the neuroimaging	Experiment	Elisa	The research sample is 98 teenagers aged 18 years	Physical activity is able to make healthy brain function and increase

No	Authors and Years	Purpose	Research Design	Data Collection	Subject	Findings
		investigation of the relationship between aerobic fitness, hippocampal volume, and memory performance				the optimization of acetylcholine.
19	Pesce, C., et al. (2013)	To find out the relationship between physical fitness and healthy living	Experiment	Cross-sectional	The research sample was 250 (127 males and 123 females) aged 17 years	Physical activity can increase neuromuscular in the speed of contraction, help the development of motor skills
20	Chang, S., at al. (2016)	To find out the relationship between achievement motivation and physical fitness with academic performance	Experiment	Elisa	The research sample was 1230 teenagers aged 18 years,	Adolescents who regularly exercise have a better quality of life because acetylcholine works more optimally.
21	Ezati, M., et al. (2020)	To find out the positive cognitive impact of aerobic fitness was associated with peripheral inflammation and neurotrophic	Experiment	Randomized controlled trial	The research sample was 67 teenagers aged 18 years	Intensive aerobic exercise for 8 weeks can and does increase neuromuscular contraction speed
22	Rodríguez-Ruiz, D., et al. (2013)	To search for cognitively optimal challenge points in physical activity for typical and atypical motor development	Experiment	Enzymatic meter	The research sample is 84 who are 18 years old	With increasing age, the response speed of the vastus lateralis muscle will decrease, but routine physical activity can increase dopamine in the body
23	Ashrafinia, F., et al. (2013)	To find out the relationship between training and quality sleep and life in between student in taiwan	Experiment	Enzymatic meter	The research sample was 80 women aged 15-18 years	Pilates training can improve the quality of the body's work and relax to sleep because the dopamine system works more optimally.
24	Walker, S., et al. (2012)	To determine the effect of regular aerobic exercise on sleep quality and fatigue in women	Experiment	Randomized controlled trial	The research sample was 13 youths aged 18 years	Resistance training can optimize the performance of muscles, nerves and reduce fatigue due to the increase in

No	Authors and Years	Purpose	Research Design	Data Collection	Subject	Findings
						neuromuscular contraction speed.
25	Buzescu, R., et al. (2021)	To find out about health promotion related to physical activity competence in physical education	Experiment	Enzymatic meter	The research sample was 51 teenagers (26 boys and 25 girls) aged 14-16 years	the children who practicing systematic and continuous physical activity can improve the ability of a child's brain and dopamine system
26	Badicu, G. (2018)	To determine the effect of age and physical activity on the response speed of the knee flexor and extensors muscles	Experiment	Elisa	The research sample was 394 teenagers (255 boys and 139 girls) aged 18 years	Physical activity can benefit the body, relax, increase acetylcholine
27	Zhai, X., et al. (2020)	To determine the effect of Pilates exercise on sleep quality in postpartum women	Experiment	Elisa	The research sample was 3,864 teenagers with the age of 17 years	Continuous physical activity and reducing the use of smartphones can increase the optimization of neural performance so that the acetylcholine system can work optimally.
28	Lang, C., at al. (2013)	To find out the self-reported and objectively assessed increase in physical activity predicting sleep quality among adolescents	Experiment	Enzymatic meter	The research sample was 56 (28 males and 28 females) aged 17 years	Physical activity seems not only beneficial physical and mental health, but also increased dopamine
29	Pooranfar, S., et al. (2014)	To determine the effect of exercise on the quality and quantity sleep	Experiment	Randomized controlled trial	The study sample was 56 patients aged 17 years	10 weeks of exercise activity increased neuromuscular in the speed of contraction
30	Shiguemitsu, F., et al. (2015)	To know	Experiment	Randomized controlled trial	The research sample was 40 teenagers aged 17 years	Physical activity can optimize the neuromuscular response, thereby reducing the occurrence of physical fatigue and increasing

No	Authors and Years	Purpose	Research Design	Data Collection	Subject	Findings
						the speed of contraction.

DISCUSSION

Physical education is fundamentally the same as executing motions that have an effect not only on the quality of movement, but also on neuromuscular development. Physical education can contribute in the development of motor skills and the construction of a firm foundation for overall health, including cardiovascular fitness, metabolic function, and muscular fitness. Our findings imply that physical exertion in physical education promotes neuromuscular function, consequently speeding muscle contraction. According to the findings of a survey of 35 scientific publications, physical education learning activities enhance the secretion of acetylcholine and dopamine. Dopamine is a neurotransmitter involved in motor regulation, as well as anti-depression, motivation, and the reward system of the body (Ishihara, 2018:13). (Ishihara, 2018:13). The enzyme acetylcholine is secreted by neurons in multiple regions of the brain and is specific for pyramidal cells or the motor cortex, from certain neurons according to the basal ganglia, but also motor neurons innervating skeletal muscles, pre-ganglionic neurons of the vegetative nervous system, and post-ganglionic nerves ganglion neurons of the sympathetic and parasympathetic nervous systems (Campbell, 1998:67). (Campbell, 1998:67). In this instance, the enzyme acetylcholine has an excitatory impact, but at specific levels of peripheral parasympathetic termination (eg, cardiac suppression by the vagus nerve), it works as an inhibitor (Emery et al, 2015: 19). (Emery et al, 2015: 19). At the neuromuscular junction and numerous synapses in the central and vegetative nervous systems, acetylcholine is released. Activity of acetylcholine is reliant on the postsynaptic membrane potential (Yanga et al, 2018:13). (Yanga et al, 2018:13). Acetylcholine can cause muscle contraction by increasing sodium and potassium permeability at the neuromuscular junction receptor level (Kiranadi, 2012:91). (Kiranadi, 2012:91). At the receptor level of the excitoconducting system, by increasing the membrane's permeability to sodium alone, it produces hyperpolarization and a drop in impulse rate, resulting in a decrease in heart rate. Acetylcholine is a neurotransmitter for the parasympathetic and postganglionic sympathetic levels of all vegetative ganglia (Kiranadi, 2012: 86). (Kiranadi, 2012: 86).

Physical activity can alter the dopaminergic, noradrenergic, and serotonergic systems in the brain. An increase in the neurotransmitter dopamine, which is responsible for muscular movement behavior, was also identified in prior investigations involving experimental animals and swimming. Lang's 2013:17 study indicated a much larger increase in dopamine and its metabolites in the hippocampus, prefrontal cortex, striatum, midbrain, and pons-medulla following an acute episode. After beginning exercise, acetylcholine levels in the brain rise, particularly in the hippocampus and cortex (Zhai, 2020:11). (Zhai, 2020:11). Increased acetylcholine enhances theta production in the hippocampus, whose role is to enhance synaptic plasticity and memory formation. Students can increase neuromuscularity in terms of neurotransmitters in the acetylcholine enzyme if well-packaged physical education activities have an influence on cognition, in addition to playing a part in developing motor abilities. In order for acetylcholine to stimulate or activate depolarization of smooth muscle and activation of Ca2+ channels via the G protein pathway. Ca2+ ions will enter the cell, and the actin-myosin mechanism will cause muscle contraction. Moreover, the stimulation will encourage the breakdown of the phospholipid membrane, resulting in the generation of IP3. The intracellular presence of IP3 will induce the release of Ca2+ ions from the SR. Both internal and external Ca2+ ions will affect the contraction of smooth muscle.

Students involved in physical education can obtain neuromuscular optimization and muscle contraction through their physical activities. In terms of the neurotransmitter in the acetylcholine enzyme, physical activity can increase neuromuscular function. Yanga et al. (2008:5) claimed that aerobic exercise physical education learning that reduces stress, weariness, and increases sleep quality promotes cholinergic function. Physical activity can relieve depression and anxiety because well-functioning muscles can enhance acetylcholine levels (Zhai et al, 2020: 6). (Zhai et al, 2020: 6). In addition, physical activity influences the production of the hormone dopamine. According to Chaddock et al. (2011:6), physical education can be a beginning point for youngsters to become physically active, and the ensuing rise in dopamine causes muscles and nerves to operate optimally. Students who engage in systematic and continuous physical activity can increase their cognitive capacities and dopamine system, allowing them to accomplish tasks with better precision than those who do not engage in physical activity (Buzescu et al, 2021:10). (Buzescu et al, 2021:10). Physical exercise in physical education learning will affect the child's involvement and ability to follow the activity if the teacher makes learning fun. Properly executed physical activity can enhance acetylcholine and dopamine, which affect student muscle contraction.

CONCLUSION

Based on the results of the study, it can be concluded that physical activity during physical learning increases the secretion of acetylcholine and dopamine, thus it can optimize neuromuscular function to increase the speed of muscle contraction.

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