



## Review Article

# The Effect of Physical Activity on Academic Performance and Mental Health: Systematic Review

Getu Teferi

Department of Sports Science, Debremarkos University, Debremarkos, Ethiopia

### Email address:

[eferigetu36@gmail.com](mailto:eferigetu36@gmail.com)

### To cite this article:

Getu Teferi: The Effect of Physical Activity on Academic Performance and Mental Health: Systematic Review. *American Journal of Science, Engineering and Technology*. Vol. 5, No. 3, 2020, pp. 131-136. doi: 10.11648/j.ajset.20200503.12

**Received:** August 26, 2020; **Accepted:** September 9, 2020; **Published:** November 4, 2020

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**Abstract:** Examining the association between participation in physical activities and academic achievement is important for many reasons. Understanding the relationship between participation in sport activities, academic achievement and cognitive development is very important for teachers, school psychologists and other stakeholders. The relationship among physical activity, academic achievement and mental health has long been theorized to be of profound importance in understanding human behavior and development. This review article aims specifically to highlight the state of existing research pertaining to the relationship between physical activity and the state of mental health. Different studies, summarized here, have found that healthy levels of physical activity generally correlate with mental health and academic achievement. This review result has showed that there was a significant relationship between physical fitness level and academic achievement and higher academic achievement was associated with higher levels of physical fitness. Increased physical activity levels and fitness can improve bone and musculoskeletal function and help alleviate or relieve depression, anxiety and stress. Generally, the previous research findings from large-scale observational studies indicate that participation in physical activity has a small to moderate effect in prevention and management of the risk of depression and anxiety which in turn have effect on academic achievement and mental health. Physical activity is a relatively cheap and non-harmful lifestyle intervention that can easily be implemented into school settings.

**Keywords:** Academic Achievement, Cognitive Development, Mental Health, Physical Activity, Sports Participation and Students

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## 1. Introduction

The association between Physical activity and academic performance has various theoretical concepts. On an informal stage, there are numerous people who claim to have finished diverse successes associated with educational achievement due to formative sports stories. From the output of research, there is considerable evidence that sports participation positively relates to academic achievement among students [1-3]. The sports participation is an important setting in the lives of students. Over 47 million students participate in organized sports [4]. Since sports area meaningful context in which many young people participate, youth sports team's may be a viable way in which to promote better development in academic performance. Research results suggesting the value of consciously designed sports programs for positive student academic performance development [5]. Positive

youngsters' development refers to the purchase of capabilities and competencies needed for best teenagers' improvement that maintains into adult hood. These contributions include cognitive, social, emotional, and intellectual competencies, such as confidence, character, or perseverance. Participation in team sports provide various importance for student academic performance and cognitive development, including a high level of enjoyment and challenge, ample opportunities to develop positive relationships, and fulfilling a need to belong [6]. The association between sports participation and academic achievement may be a byproduct of this phenomenon.

Examining the association between participation in physical activities and academic achievement is important for many reasons. Understanding the relationship between participation in sport activities, academic achievement and cognitive development is very important for teachers, school

psychologists and other stakeholders. If student's participation in sport activities has association with academic achievement and cognitive development, the student athletes should have been courage and supported to continue sports participation rather than viewed as being distracted from their participation. The current study contributes to the literature by examining the effect of sports participation on academic achievement, and mental health of students (cognitive development). The purpose of this study is to examine the association of student's participation in sports activities with academic achievement and mental health (cognitive development).

## 2. Physical Activity and Related Concepts

Physical activity and exercise are often used interchangeably, but these terms aren't similar. Physical activity is characterized as any real development created by the compression of skeletal muscles that bring about a considerable increment over resting vitality consumption. Physical activity, exercise and related terms have been defined somewhat inconsistency over the last decade [7-10]. It is therefore important to differentiate between a numbers of related terms which have different meaning. PA can be classified in various ways, including type, intensity, and purpose. With regard to classification by "purpose," physical activity is frequently categorized by the context in which it is performed. Commonly used physical activity classifications include occupational, leisure time or recreational, household, self-care, and transportation physical activities [10].

Health enhancing physical activity (HEPA) is a term used particularly among the European health promotion community, and is defined as "any form of PA that benefits health and functional capacity without tiredness". Another term encountered in the literature is leisure-time physical activity [10-13] which has been defined as activities performed by a person that is not required as essential activities of daily living and are performed at the interest of the person. The term lifestyle activities describe the activities that a person perform in the course of daily life that can contribute to expend energy, e.g., taking the stairs instead of using the elevator, walking instead of driving, parking further away than usual to walk to a destination [10, 14] The terms exercise and physical activity are often used interchangeably. However, exercise could even be a subcategory of physical activity and has been defined as "planned, structured, and repetitive and purposive within the sense that the event or maintenance of 1 or more components of fitness is that the objective", and in some studies sports participation is assessed and analyzed separately from other leisure - time activities [7, 10].

## 3. The Association Between Physical Activity and Academic Achievement

Different scholars suggest that there is a positive correlation between physical fitness levels and academic achievement

levels of students. As schools explore all avenues to improve student academic success, researchers believe that participation in different physical activity has positive impact on students' academic achievement, so every stakeholder should understand it. According to [15-16] studies suggested that students participating in 5 hours of vigorous physical activity a week had stronger academic performances in math, English, and science than do students who participate in just 2 hours of fitness activity every week. She also argued that sport skills teach students about prepositions, adverbs, and communication skills and those students are more likely to retain their learning by being active. Another crucial element being considered by researchers and part of the theoretical framework of the study was the association between physical fitness levels and academic achievement. Students are being asked to increase their academic performance in the classroom and teachers are seeking ways to help them achieve as well.

With information being obtained about the poor physical fitness levels of many students there is ample reasons for concern on the part of educators about this growing epidemic in our world. The prevalence of obesity in today's children is detrimental to the student's health and is purported to have a negative impact on student learning and achievement. Research has shown that physical movement and physical activity assists children in learning more effectively. Epidemiological findings indicated that children are less active and more obese than ever before despite initiatives to combat this [17]. According to brain research by [18], a child's earliest learning is based on motor development. He found that there is a connection between the cerebellum (motor control part of brain) and such cognitive functions as memory, spatial orientation, attention, language, and decision making. In addition, Jensen has further confirmed that most of the brain is activated during physical activity and that sitting for more than ten minutes at a time results in reduced concentration. Jensen (2010) further showed that exercise is highly correlated with neurogenesis, the production of brain cells that is correlated with improved learning and memory. Students cannot sit still for long periods of time before the flow of blood and oxygen to their brain slows down considerably which inhibits the learning process [19]. Time spent being physically active did not detract from education achievement and in some instances were associated with improved scholastic performance [20]. The study of also found a positive association of physical activity with academic achievement [21].

In general, different findings have showed that there was a significant relationship between physical fitness level and academic achievement and higher achievement was associated with higher levels of physical fitness. Those studies also found that children who are more physically fit tend to perform better in the classroom and have better school attendance and fewer discipline problems. Here, given more time for physical education did not hurt academic performance and that students tended to perform better in the classroom [22-30].

#### 4. The Association Between PA and Students' Mental Development

Studies on children: The associations of physical activity and fitness with cognitive function are relatively few in number but generally show a positive association between physical activity and cognitive function of students. Involvement in regular exercise and on more aerobic fitness are related to greater brain volume, improved neurophysiological responses to stimuli as measured by EEG (electroencephalography), and better levels of growth factors that promote growth of brain tissue, neurogenesis, and angiogenesis [31]. Another study also suggested from their finding that physical fitness levels of students were strongly and significantly related to academic achievement regardless of other socio-demographic and physical fitness variables and seems to high in late middle to early high school. They recommended that policymakers should consider physical education subject in middle and high schools and that physical education allotted times should be increased with an emphasis on more cardiovascular fitness [32]. Also conclude that from their study aerobic fitness was a significant predictor of academic performance [26, 33].

According to [18] finding on brain research shows a positive and significant correlation between physical activity levels and cognitive (brain) development. [20] Also indicated that time allotted to being physically active did not reduce academic achievement of students and in most cases, was shown to be more beneficial. [34] reported that student's regular participation in different sports activities showed improved attributes such as increased brain function and nourishment, higher energy/concentration levels, changes in body build affecting self-esteem, increased self-esteem and better behavior which may all support cognitive function. [35, 36] also indicated that consistent physical activity led to increased cerebral blood flow, changes in hormone levels, enhanced nutrient intake and greater arousal in brain functioning. Additionally, [37] found that specific regions of the basal ganglia of the brain, which support cognitive control, are enlarged in physically fit children. Furthermore, physically fit children displayed superior performance in behavioral activities that required complicated skills and control. Another studies by [37, 38] revealed that physically fit children performed better on associational memory tasks and also found that physically fit children displayed faster cognitive processing speed that indicated that these children had greater attentional ability and faster processing of the stimulus being presented. [39] Completed a study that demonstrated that children who were physically active showed improvement on fluid intelligence tests (measures ability to reason quickly and to think critically). Different findings showed clearly, movement and physical activity can positively affect the overall development of a child.

The study looked at the relationship from both a behavioral and neuro-electric perspective, which is the subject's ability to recognize, respond to, and discriminate between different visual stimuli. When the researchers measured brain activity, they found that fit children allocated more resources towards

identifying the stimuli and were also able to process the stimuli faster. Behaviorally, the children made fewer errors than their less fit peers [40-42].

Improving component of fitness (aerobic, muscular, and body composition) has the most influence on improving cognitive functioning. Currently this determination has not been established [41, 43]. Different scholars caution regarding absolutely linking physical fitness levels and improved academic achievement, cognitive functioning, reduced depression and social/cognitive stimulation, which resulted in improved cognitive functioning [44-46].

#### 5. Physical Activity and Mental Health

Obesity and overweight rates among all groups in society, regardless of age, sex, race, socioeconomic status, educational level, or geographic region have noticeably increased within the last twenty years [47]. Obesity and overweight are not just a personal matter; it is also public health epidemics that affects education achievement outcomes, economic productivity, state budgets and in turn affect students' academic achievement [48-49]. In addition to disease prevention, studies suggest that physical activity directly benefits cognition and academic achievement. In one study, in which children jogged for thirty minutes two to four times per week, researchers measured an increase in activity in the prefrontal cortex, suggesting greater cognitive function. However, the cognitive gains were only sustained while children maintained the jogging regimen [50-51]. If an individual follows a physically active lifestyle, it has been found to be an effective way of improving fitness and overall health [52]. In other way, the absence of a physically active life-style can adversely affect fitness and properly-being, increasing the risk of somatic health problems such as cardiovascular diseases, hypertension, diabetes mellitus, osteoporosis, and some types of cancer [53]. In addition, regular PA is known to have a positive impact on mental health [54]. A number of meta-analyses of intervention studies of the effect of exercise training have revealed that exercise may have a significant moderate to high anti-depressive effect [55-57]. In other way if students have poor physical fitness different problems are appearing in addition to academic achievement problems such as sleep apnea, which has been linked to problems with learning and memory, liver problems, orthopedic problems and asthma. If there is Sleep apnea problem in children, it can to impair a child's ability to concentrate and stay alert during the day, which could have a negative impact on academic performance [58] also reported, based on their study results, being physically fit reduces the risk of cardiovascular disease, colon cancer, diabetes, dying prematurely, and obesity. Increased physical activity levels and fitness can improve bone and musculoskeletal function and help alleviate or relieve depression, anxiety and stress (mental health) [58].

Generally the previous research findings from large-scale observational studies indicate that participation in physical

activity has a small to moderate effect in prevention and management of the risk of depression and anxiety which in turn have effect on academic achievement and mental health [59-67].

## 6. Conclusion

### 6.1. The Effect of Participation in Physical Activity on Academic Achievement

In general, different findings have showed that there was a significant relationship between physical fitness level and academic achievement and higher achievement was associated with higher levels of physical fitness. Those studies also found that children who are more physically fit tend to perform better in the classroom and have better school attendance and fewer discipline problems. Here, given more time for physical education did not hurt academic performance and that students tended to perform better in the classroom.

### 6.2. The Effect of Participation in Physical Activity on Mental Health

The absence of a physically active lifestyle of students can adversely affect their health and total well-being, increasing the risk of chronic diseases/non-communicable diseases such as cardiovascular diseases, hypertension, diabetes mellitus, osteoporosis, and some types of cancer. In other way if students have poor physical fitness, different problems are appearing in addition to academic achievement problems such as sleep apnea, which has been linked to impair a child's ability to concentrate and stay alert during the day, which could have a negative impact on academic performance. Increased physical activity levels and fitness can improve bone and musculoskeletal function and help alleviate or relieve depression, anxiety and stress. Generally, the previous research findings from large-scale observational studies indicate that participation in physical activity has a small to moderate effect in prevention and management of the risk of depression and anxiety which in turn have effect on academic achievement and mental health.

## 7. Recommendations

The future generations not enjoying a better quality of life or shorter life expectancy than their parents are a frightening outlook. Steps are should be taken by government and concerned body to fight this problem.

In addition, the decreased levels of cognitive functions will have a negative impact on the people's productivity and creativity. Parents and educators must work together to prevent students from overweight and/or obese and from non-communicable diseases.

If the matter is ignored, future generations can pay the worth. Policy makers should give longer for education to form students more active and each stakeholder should use increased participation in sports activities as a technique to

enhance students' academic performance and psychological state.

## Conflict of Interest

The author does not have any possible conflicts of interest.

## References

- [1] Gerber, 1996; Gerber, S. B. (1996). Extracurricular activities and academic achievement. *Journal of Research & Developmental Education*, 30, 42-50.
- [2] Stegman & Stephens, L. J., (2000). Athletics and academics: Are they compatible? *The High School Magazine*, 7, 36-39.
- [3] Stephens, L. J., & Schaban, L. A. (2002). The effect of inter-scholastic sports participation on academic achievement of middle school students, *NASSP Bulletin*, 86, 34-31.
- [4] Ewing, M. E., & Seefeldt, V. (2002). Patterns of participation in American agency- sponsored youth sports. In F. L. Smoll & R. E. Smith (Eds.), *Children and youth in sport: A bio-psychological perspective*, 2nd edition (pp. 39-60). Dubuque, Iowa: Kendall/Hunt Publishing.
- [5] Fraser-Thomas, J. L., Côté, J., & Deakin, J. (2005). Youth sport programs: An avenue to foster positive youth development. *Physical Education and Sport Pedagogy*, 10, 19-40. doi: 10.1080/1740898042000334890.
- [6] Heilman, C.(2012). A mixed methods approach examining alpine ski racing as a context for positive youth development. *Dissertation Abstracts International*, 72, Retrieved August 9, 2012 from: Psyc INFO, Ipswich, MA.
- [7] ACSM. (2009). Position statement on the recommended quantity and quality of exercise for developing and maintaining fitness in healthy adults, *Med Sci Sports*, 10 (3).
- [8] WHO (2010a). *Global Status Report on Non-communicable Diseases*. Geneva; Switzerland: WHO.
- [9] US Department of Health and Human Service (1996). *Physical Activity and Health: A report of the Surgeon General*. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion: Atlanta, GA.
- [10] Physical Activity Guidelines Advisory Committee. (2008). *Physical Activity Guidelines Advisory Committee Report 2008*. Washington, DC: U.S: Department of Health and Human Services.
- [11] Hagströmer, M., (2007). Assessment of health-enhancing physical activity at population level. (Thesis, Department of Biosciences and Nutrition Unit for Prevention Nutrition, Karolinska Institute: Stockholm).
- [12] Caspersen, C. J., K. E. Powell, and G. M. Christenson (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Rep*, 100 (2): 126-31.
- [13] Cavill, N., et al. (2006). An evidence-based approach to physical activity promotion and policy development in Europe: contrasting case studies. *Promot Educ*; 13 (2): 104-11.

- [14] Riddoch C. (2005). *Physical activity, in Key topics in public health – essential briefings on prevention and health promotion*, L. Ewels, Editor. London: Churchill Livingstone.
- [15] Pica, R. (2004a). More movement, smarter kids. Retrieved from <http://www.movingandlearning.com>.
- [16] Grissom, J. B. (February 2005). Physical fitness and academic achievement. *Journal of Exercise Physiology*, vol. 8, Retrieved from <http://www.asep.org/jeponline/issue/Doc/Feb2005/Grissom.pdf>.
- [17] Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2012). Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2000. *Journal of the American Medical Association*, 307 (5), 483-490.
- [18] Jensen, E. (2001). Moving with the brain in mind. *Educational Leadership*, (3), pg. 34-37. Jensen, E. (2010, April 19). Physical Education Is Supported by Brain Research. *Physical Education Is Supported by Brain Research | Brain Based Learning | Brain Based Teaching | Articles from Jensen Learning*. Retrieved from <http://www.jensenlearning.com/news/physical-education-is-supported-by-brain-research-or-brain-based-learning>.
- [19] Gilbert, A. G. (2002). Movement is the key to learning. Retrieved from <http://www.newhorizons.org>.
- [20] Donnelly, J. E., Greene, J. L., Gibson, C. A., Smith, B. K., Washburn, R. A., Sullivan, D. K., (2009). Physical activity across the curriculum (PAAC): A randomized controlled trial to promote physical activity and diminish overweight and obesity in elementary school children. *Preventive Medicine*, 49 (4), 336-34.
- [21] Chomitz, V. R., Slining, M. M., McGowan, R. T., Mitchell, S. E., Dawson, G. F., & Hacker, (2009). Is there a relationship between physical fitness and academic achievement? Positive results from public school children in Northeastern United States. *Journal of School Health*, 79, 30-37.
- [22] California Department of Education (2005). State study proves physically fit kids perform better. Retrieved from <http://www.health.ocde.us/physed.asp> (CDE, 2005).
- [23] Trost, (2009). Active education: physical education, physical activity and academic performance. A research brief. *Active Living Research*, a National Program of the Robert Wood Johnson Foundation, (Summer).
- [24] Holler, D., Messiah, S. E., Lopez-Mitnik, G., Holler, L. T., Almon, M., & Agatston, A. S., (2010). Effect of a two-year obesity prevention intervention on percentile changes in body mass index and academic performance in low-income elementary school children. *American Journal of Public Health*, 100 (4), 646-653.
- [25] American Heart Association's 2010 American Heart Association. (2010). Students' physical fitness associated with academic achievement; organized physical activity.
- [26] Wittberg, R., Northrup, K., & Cottrell, L. (2009). Children's physical fitness and academic achievement. *American Journal of Health Education*, Jan-Feb (40), 1, 30-36.
- [27] Michigan State University. (2006). Research Finds Vigorous Exercise Equals Better Academics. *Science Daily*. Retrieved from <http://www.sciencedaily.com/releases/2006/08/060803181914.htm>.
- [28] Bausch, C. E. (2011). Physical activity and the achievement gap among urban minority youth. *Journal of School Health*, 81 (10), 626-634.
- [29] Coe, D. P., Pivarnik, J. M., Womack, C. J., Reeves, M. J., & Malina, R. M. (2012). Health-related fitness and academic achievement in middle school students. *Journal of Sports Medicine and Physical Fitness*, 52 (6), 654-660.
- [30] Castelli, D., Hillman, C. H., Buck, S. M., & Erwin, H. E. (2007). Physical fitness and academic achievement in third and fifth grade students. *Journal of Sport and Exercise Psychology*, 29, 239-252.
- [31] Zoeller, R. F. (2010). Can working out train the brain too? *American Journal of Lifestyle Medicine*, vol. 4. (no. 5), 397-409.
- [32] Van Dusen, D. P., Kelder, S. S., Kohl, H. W., 3rd, Ranjit, N., & Perry, C. L. (2011). "Associations of physical fitness and academic performance among school children." *Journal of School Health*, 81 (12), 733-40.
- [33] Rauner, R. R., Walters, R. W., Avery, M., & Wanser, T. J. (2013). Evidence that aerobic fitness is more salient than weight status in predicting standardized math and reading scores in fourth through eighth grade students. *Journal of Pediatrics*, Aug (163), 2, 344-348.
- [34] Cocke, A (2002). Brain may also pump up from workout. Retrieved from <http://www.neurosurgery.medsch.ucla.edu>.
- [35] Shepherd, R. J. (1997). Curricular physical activity and academic performance. *Pediatric Exercise Science*. 9, 113-125.
- [36] Hillman, C. H., Buck, S. M., Themanson, J. R., Pontifex, M. B., & Castelli, D. M. (2009). Aerobic fitness and cognitive development: Event-related brain potential and task performance indices of executive control in preadolescent children. *Development Psychology*, 45 (1), 114-129.
- [37] Chaddock, L., Erickson, K. L., Prakash, R. S., Van Patter, M., Voss, M. W., Pontifex, M. B., Kramer, A. F. (2010). Basal ganglia volume is associated with aerobic fitness in preadolescent children. *Developmental Neuroscience*, 32 (3), 249-256.
- [38] Pontifex, M. B., Raine, L. B., Johnson, C. R., Chaddock, L., Voss, M. W., Cohen, N. J., et al. (2011). Cardiorespiratory fitness and the flexible modulation of cognitive control in preadolescent children. *Journal of Cognitive Neuroscience*, 23 (6), 1332-1345.
- [39] Reed, J. A., Einstein, G., Hahn, E., Hooker, S. P., Gross, V. P., & Kravtitz, J. (2010). Examining the impact of integrating physical activity on fluid intelligence and academic performance in an elementary school setting: A preliminary investigation. *Journal of Physical Activity and Health*, 7 (3), 343-351.
- [40] Dwyer, T., Sallis, J. F., Blizzard, L., Lazarus, R., & Dean, K. (2001). Relation of academic performance to physical activity and fitness in children. *Pediatric Exercise Science*, 13, 225-238.
- [41] Centers for Disease Control and Prevention (2010). The association between school based physical activity, including physical education, and academic performance.
- [42] McCracken, B. (2002). Creating an environment for learning. *The State Education Standard*, p 46-51.

- [43] Datar, A. & Sturm, R. (2006). Childhood overweight and elementary school outcomes. *International Journal of Obesity*, 30, 1449-1460.
- [44] Miller, D., Taler, V., Davidson, P. S., & Messier, C. (2012). Measuring the impact of exercise on cognitive aging: methodological issues. *Neurobiology of Aging*, 33 (3), 29-43.
- [45] Duncan, S. C., Duncan, T. E., Strycker, L. A., & Chaumeton, N. R., (2002). Neighborhood physical activity opportunity: a multilevel contextual mode. *Research Quarterly for Exercise and Sport*, 73, 457-463.
- [46] Mezzacappa, E. (2004). Alerting, orienting, and executive attention: developmental Properties and sociodemographic correlates in an epidemiological sample of young, urban children. *Child Development*, 75, 1373-1386.
- [47] (Centers for Disease Control, 2009). Centers for Disease Control and Prevention. (2009). Obesity - Halting the epidemic by making health easier. Atlanta, GA: Centers for Disease Control and Prevention. Retrieved from <http://www.cdc.gov/chronicdisease/index.htm>.
- [48] Cline, K. P., Spradlin, T. E., & Plucker, J. P. (2005). Child obesity in Indiana: A growing public policy concern. Bloomington, IN: Center for Evaluation & Education Policy.
- [49] Summerbell CD, Waters E, Edmunds L, Kelly SAM, Brown T, & Campbell KJ. (2005). Interventions for preventing obesity in children. *Cochrane Database of Systematic Reviews*, Issue 3. Art. No.: CD001871. DOI: 10.1002/14651858.CD001871.pub2.
- [50] Harada, T., Okagawa, S., & Kubota, K. (2004). Jogging improved performance of a behavioral branching task: implications for prefrontal activation. *Neuroscience Research*, 49 (3), 325-337. doi: 10.1016/j.neures.2004.03.011.
- [51] Sibley, B. A., & Etnier, J. L. (2003). The relationship between physical activity and cognition in children: a meta-analysis. *Pediatric Exercise Science*, 15, 243-256.
- [52] Haskell, W. L., I-Min Lee, F., Pate, R. R., Powell, K. E., Blair, S. N., Franklin, B. A., et al. (2007). Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation*, 116 (9), 1081-1093.
- [53] US Department of Health. (1997). Physical Activity and Health: A Report of the Surgeon General. Atlanta: National Center for Chronic Disease Prevention and Health Promotion. (Biddle & Mutrie, 2008; Ströhle, 2009).
- [54] Biddle, S. J. H., & Mutrie, N. (2008). *Psychology of Physical Activity: Determinants, Wellbeing and Interventions*. (2nd ed.). New York: Routledge.
- [55] Lawlor & Hopker, 2001; Lawlor, D. A., & Hopker, S. W. (2001). The effectiveness of exercise as an intervention in the management of depression: Systematic review and meta-regression analysis of randomised controlled trials. *British Medical Journal*, 322 (7289), 763.
- [56] McDonald & Hodgdon, 1991; McDonald, D. G., & Hodgdon, J. A. (1991). *The Psychological Effects of Aerobic Fitness Training Research and Theory*. New York: Springer Verlag.
- [57] North, McCullagh, & Tran, 1990). North, T. C., McCullagh, P., & Tran, Z. V. (1990). Effect of exercise on depression. *Exercise and Sport Sciences Reviews*, 18 (1), 379-416.
- [58] Eveland-Sayers, B. M., Farley, R. S., Fuller, D. K., Morgan, D. W., & Caputo, J. L. (2009). Physical fitness and academic achievement in elementary school children. *Journal of Physical Activity and Health*, 6, 99-104.
- [59] (Augestad, Slettemoen, & Flanders, 2008; Augestad, L. B., Slettemoen, R. P., & Flanders, W. D. (2008). Physical activity and depressive symptoms among Norwegian adults aged 20-50. *Public Health Nursing*, 25 (6), 536-545.
- [60] De Moor, Beem, Stubbe, Boomsma, & De Geus, 2006; De Moor, M. H. M., Beem, A. L., Stubbe, J. H., Boomsma, D. I., & De Geus, E. J. C. (2006). Regular exercise, anxiety, depression and personality: A population-based study. *Preventive Medicine*, 42 (4), 273-279. doi: 10.1016/j.ypmed.2005.12.002.
- [61] De Moor, Boomsma, Stubbe, Willemsen, & de Geus, 2008; De Moor, M. H. M., Boomsma, D. I., Stubbe, J. H., Willemsen, G., & de Geus, E. J. C. (2008). Testing causality in the association between regular exercise and symptoms of anxiety and depression. *Archives of General Psychiatry*, 65 (8), 897-905.
- [62] Goodwin, 2003; Goodwin, R. D. (2003). Association between physical activity and mental disorders among adults in the United States. *Preventive Medicine*, 36 (6), 698-703. doi: 10.1016/S0091-7435(03)00042-2.
- [63] Mutrie & Hannah, 2007; Mutrie, N., & Hannah, M. K. (2007). The importance of both setting and intensity of physical activity in relation to non-clinical anxiety and depression. *International Journal of Health Promotion and Education*, 45 (1), 24-32.
- [64] Harvey, Hotopf, Overland, & Mykletun, 2010; Harvey, S. B., Hotopf, M., Overland, S., & Mykletun, A. (2010). Physical activity and common mental disorders. *The British Journal of Psychiatry*, 197 (5), 357-364.
- [65] Mikkelsen et al., 2010; Mikkelsen, S. S., Tolstrup, J. S., Flachs, E. M., Mortensen, E. L., Schnohr, P., & Flensborg Madsen, T. (2010). A cohort study of leisure time physical activity and depression. *Preventive Medicine*, 51 (6), 471-475. doi: 10.1016/j.ypmed.2010.09.008.
- [66] Teychenne, Ball, & Salmon, 2008; Teychenne, M., Ball, K., & Salmon, J. (2008). Physical activity and likelihood of depression in adults: A review. [doi: DOI: 10.1016/j.ypmed.2008.01.009]. *Preventive Medicine*, 46 (5), 397-411.
- [67] Thorsen, L., Nystad, W., Stigum, H., Dahl, O., Klepp, O., Bremnes, R. M., et al. (2005). The association between self-reported physical activity and prevalence of depression and anxiety disorder in long-term survivors of testicular cancer and men in a general population sample. *Supportive Care in Cancer*, 13 (8), 637-646.