



## Interrelationship between Exercise and Diseases in young people: Review study

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### Abstract

**Introduction:** Regular physical activity is associated with physical, and mental benefits, whilst insufficient physical activity (PA) is associated with number of negative health outcomes (e.g. metabolic syndrome, brain health, cognitive functions, insulin resistance, prediabetes, type 2 diabetes, sarcopenia, coronary heart disease etc.). In our systematic overview, we look into relationship between participation on regular PA and health of young people. **Material and methods:** Electronic databases were searched for articles related to connection between PA and correlated diseases in young man. **Results:** The search resulted in 137 identified records of which 54 records articles were included in the presented review. **Conclusions:** Based on our findings, we recognize that human body rapidly maladapt to insufficient PA, and if extended for a longer period of time, it will result in substantial decline of health. Altogether, conclusive evidence exists that physical inactivity is one of the most important cause of most chronic diseases. In addition, PA especially in younger age can primarily prevents, or delays chronic diseases, assuming that chronic diseases may not be an inevitable outcome throughout life. Our review suggests that PA exert substantial positive effect on health of young men, however, to reach a true consensus, the mechanism behind these observations must be further elucidated.

**Keywords:** physical activity, quality of life, mental health, fitness, young people

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## INTRODUCTION

Presented overview revealed large differences between studies on PA in youth used widely varying objective and subjective PA assessment methods, different definitions of intensity of PA, and various outcome variables. Conclusive and overwhelming scientific evidence, largely ignored and prioritized as low, exists for physical inactivity as a primary and actual cause of most chronic diseases. The comprehensive evidence herein clearly establishes that lack of PA affects almost every cell, organ, and system in the body, regardless of the age, causing sedentary dysfunction and accelerated death. An underappreciated primary cause of most chronic conditions is the lack of sufficient daily PA. Overwhelming evidence proves the notion that reduction in daily PA are primary cause of chronic diseases – conditions and that physical activity – exercise is rehabilitative treatment “therapy” from the inactivity caused dysfunction. The aim of our paper is to bring insight into the observation that a lack of PA initiate number of pathological and clinical conditions that can be observe at even young age. Firstly, we have to identify what is (health, health enhancing physical activity, physical activity, physical inactivity and exercise).

*Health* – a human condition with physical social and psychological dimensions, each characterized on a continuum with positive and negative poles, (Centers for Disease Control and Prevention) [1]. *Health enhancing physical activity* – activity that, when added to baseline activity, produces health benefits. Brisk walking, jumping rope, dancing, playing tennis or soccer, lifting weights, climbing on playground equipment, and doing yoga are all examples of health-enhancing physical activity [1]. *Physical activity* – any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above a base level. Physical activity generally refers to the subset of physical activity that enhances health [1]. *Physical inactivity* – physical activity levels less than those require for optimal health and prevention of premature death [1]. *Exercise* – subcategory of physical activity that is planned, structured, repetitive, and purposive in the sense that improvement of maintenance of one or more components of physical fitness is the objective [1].

## MATERIAL AND METHODS

This review was performed on five databases (EMBASE, PubMed, Google, FreeFullPDF, OpenGrey). We did keywords search, using word/phrases that describe our topic. Supplemental forward and backward tracking was done and authors’ and experts’ electronic databases were searched to identify relevant articles. Journal articles or reports that reported level of physical activity in the general population of youth from across the world studies were included. Data were reviewed, extracted and assessed by two researchers. The presented cross-sectional studies examine physical exertion and the magnitude of association between PA and selected lifestyle determinants of young people (i.e. selected civilization diseases, psychological factors and sleep variables).

## RESULTS

### *Physical inactivity and its consequences at young age*

According to [2,3] between 58% and 92% aged 6-11 and 12-19 years old, respectively, do not meet the recommended 60 min of daily physical activity. Dustan et al [4] in his study compare dose – response relationship between physical activity sitting time and prediction of premature death, he found that each 1- our increase in TV viewing time was associated with 11% and 18% increased risks of all-causes and, further cardiovascular disease (CVD) mortality increased 46% and 80% respectively for TV viewing time >4hr/day as compare <2hrs/day, which were independent of smoking, blood pressure, cholesterol, diet, waist circumference and leisure-time exercise. Further, between 1960 and 1980 adolescent obesity ranged between 5-6%. About 25 years later 1980's to 2010 (>95% BMI percentile for adolescents in the 1960's) in adolescents rose 3-fold from 5-6% in between 1960-1980 to 18% in 2008-2010 [5,6]. Higher BMI during childhood is associated with an increased risk of coronary heart disease (CHD) in adulthood [7]. If we look on adult onset diabetes in our adolescents

we can find that once considered a disease of adult's type two diabetes (T2D) is becoming increasingly common among adolescents [8]. Foster et al. [9] in his study claim that children in whom T2D develops at early age, are at risk for complications as adults from the disease, that includes retinopathy, neuropathy, and cardiovascular and renal disease, that may require decades of treatment. Nerayan et al. [10] estimated that if diagnosed with T2D at age 20 years that person would die 17 years before average, with a reduction of 27 quality life adjusted years. Children and adolescents with BMI and waist circumference values greater than normal values are at increased risk for the adult metabolic syndrome [11]. Gilmore and his colleagues indicate that the extent of coronary lesions in adolescents is associated with risk factors including lipids, smoking, blood pressure, obesity, hyperglycemia and inactivity as a risk factor. Reversibility of childhood metabolic syndrome (MetS) is rare, thus leading to high risk of adulthood cardiovascular disease (CVD) [12,13]. Moreover, non-alcoholic fatty liver disease (NAFLD) in children and adolescents is about 3-10% among normal weight children but rising up to 40-70% among obese children and adolescents [14].

Less weight bearing activity by children and adolescents results in earlier osteoporosis. Rizzori et al. [15] claim, that less load bearing activity by children during skeletal growth is associated with smaller bone mass than in load bearing children. Author further assert that childhood and adolescence is a key determinant of bone health and future fracture risk during adulthood. The positive effect of mechanical loading on bone growth is greatest pre- and early puberty in girls and pre-puberty in boys [16]. Also, less weight bearing activity by children and adolescents results in earlier sarcopenia. This means that inactivity accelerates loss of functional capacities with chronological aging leading to premature death. Physically inactive individuals reached skeletal muscle frailty about 24 years younger in age than masters' weight lifters [17].

Looking at the physiological functional capacity (PFC) less endurance type of play in children and inactivity in young age accelerates loss of functional capacities with chronological aging leading to premature death [18]. At last we can conclude that physical inactivity is an actual cause of chronic diseases in children and adolescents. (Figure 1). Documented health benefits of physical activity in young age include increased physical fitness, CRF and muscular strength, reduce body fatness, is factor in favorable cardiovascular and metabolic disease risk profiles, enhanced bone health [19].

### *Physical activity and mental health*

Additionally, growing evidence also documents the importance of PA for brain health (table 1) with numerous studies indicating regular engagement in PA may be protective against cognitive decline and dementia later in life. Aerobic exercise and physical activity improve cognitive health across the lifespan [20] (table 2). According to Dik et al. [21] man how is physically active at a young age, 15-25 years old, had less of a decline in informational processing capabilities vs. individuals physically inactive early in life. Seems to, that out of the all age groups, teenage physical activity appeared to be most strongly related to better cognitive function and lower prevalence of cognitive impairment in old age [22]. Investigation of Aberg et al. [23] showed that between the ages 15 and 18 year of age those with top 10% of improvement in cardiovascular fitness scores had highest enhancement of global intelligence, logical, verbal, visuospatial and technical scores, while those subjects with declines in cardiovascular fitness had less than mean intelligence scores. Further, an association between better cardiovascular fitness at age 18 year, a higher socioeconomical status, and educational attainment in life existed.

There is growing evidence that regular engagement in PA during childhood can influence gray and white matter integrity, and this may have implications for cognitive development [24]. Using cardiovascular fitness as a proxy measure for PA, shown that compared to unfit children, those who are fitter have increased volume of the dorsal striatum, a region important for attention regulation [25]. Similarly, bilateral hippocampal volumes have been shown to be markedly increased in fitter, compared to less fit children [26].

In sum, greater cardiovascular fitness may be associated with greater white matter integrity and myelination to more efficient neural transmission between brain regions critical to cognitive functioning.

Table 1. Physical health and physical activity.

Authors and Reference	Participants	Measures	Major Results
Troiano et al. [2] Cameron et al. [3]	6-19 yr. and adults (20+ yr.)	Physical activity	Between 58-92% do not meet daily physical activity recommendations.
Dunstan et al. [4]	>25 yr.	Television viewing time	Prolonged television viewing is associated with increased risk of all-cause and CVD mortality.
Ogden et al. [5,6] Sun [11] Baker et al. [7] Washington [13]	2-19 yr. 13 yr. 7-13 yr. 13- yr.	BMI	Incrementation of BMI between 1970-2009 from 5% to 18%. Risk for development of adult metabolic syndrome.
Marcovecchio et al. [8] Foster et al. [9] Nerayan et al. [10] Gillman [12]	4-19 yr.	Diabetes mellitus	T2DM accounts for 8-45% of all diabetes. Physical activity reduces the risk of T2DM and early death
Jonathan et al. [14]	11-19 yr.	Non-Alcoholic Fatty Liver Disease (NAFLD)	NAFLD account for 40-70% among obese children and adolescents.
Olmedillas et al. [15] Ducher [16] Hunter [17]	15-20 yr. 12-16 yr.	Bone health	Physical activity enhances peak bone mass (PBM) in young age.
Tanaka [18] Physical Activity Guidelines Report [19]	15-20 yr.	Physical functional capacity (PFC)	Physical activity enhances functional capacity and demonstrate much lower prevalence of many chronic degenerative diseases.

The benefit of PA across childhood and adolescence are not limited to cognitive performance and academic achievement. The evidence also points to a number of psychological benefits of PA including the reduction of depression [27,28] and anxiety [29,30] symptomatology, and improvements in self-esteem [31]. Furthermore, a number of studies have demonstrated significant relationships between increased PA and reductions in attention-deficit hyperactivity disorder (ADHD) symptomatology [32]. Longitudinal data suggest that regular PA between the ages of 15 and 25 years is associated with better cognitive processing speed in 62-85-year-old men [21]. However, of all time points, the strongest protective factor was found to be PA during the teenage years [33].

Giving the increasingly recognized benefits of PA in childhood and adolescence for healthy cognitive and brain development, the emerging evidence indicating that early life PA may improve cognitive performance many decades later, therefor PA should be encouraged at this stage of life [34,35].

Table 2. Physical activity and mental health.

Authors and Reference	Participants	Measures	Major Results
Hillman et al. [20] Dik et al. [21] Middleton et al. [22] Aberg et al. [23] Carson et al. [24] Chaddock et al. [25] Chaddock et al. [26] Gäbler et al. [33] Pullmannová [34] Pullmannová [35]	6-15 yr. 15-25 yr. 15-18 yr. 15-18 yr. 5-13 yr. 9-10 yr. 9-10 yr. 6-18 yr. 10-16 yr. 6-15 yr.	Cognitive function and physiological capacity	Appropriate physical and cardiovascular fitness, delay cognitive impairment, enhance mental health and structure and function of the brain later in life
Larun et al. [27] North et al. [28] Yang et al. [29] Petruzzello et al. [30]	11-19 yr. <18 yr. 5-15 yr. <20 yr.	Psychological benefits	Physical activity appears to have effect in reducing depression and anxiety scores.
Ekeland et al. [31]	3-20 yr.		Exercise has positive effect on self-esteem in children and youth
Song et al. [32]	<18 yr.		Positive association between physical activity and Attention - deficit hyperactivity disorder (ADHD).

Table 3. Physical activity and sleep.

Authors and Reference	Participants	Measures	Major Results
Mendelson et al. [39] Lang et al. [40] Dalene et al. [45]	15 yr. 15-19 yr. <15 yr.	Sleep duration and sleep quality	Exercise training improves sleep duration, sleep quality and physical activity
Fatima et al. [42] Harp [47]	6-20 yr. 15-20 yr.	Sleep duration and body composition	Insufficient sleep duration is associating with overweight/obesity
Dutil et al. [43] Dorenbos et al [44]	5-19 yr. 15 yr.	Sleep duration and glucose homeostasis	Lack of sleep is associated with insulin resistance

### *Sleep and physical activity*

Although a substantial body of literature has explored the relationship between sleep and exercise, definite conclusions about the impact of exercise interventions on sleep are lacking (table 3). Physiologically, sleep is an internally and externally controlled process structured by an interaction of the circadian clock and homeostatic mechanisms [36]. Chronic sleep deprivation has been shown to increase the risk for a host of physical and mental illnesses. It is estimated that two-thirds of high-school students, who are advised to sleep eight to ten hours, receive less than eight on school nights [37]. Lack of sleep has been found to impair cognitive performance, mood, glucose metabolism, appetite regulation and immune function [38]. One study demonstrated that 12 weeks of exercise training increased sleep duration and variables of sleep quality in adolescents [39]. These investigators found exercise training to decrease Nonrapid eye movement (NREM) stage N1 (very light sleep) while increasing Rapid eye movement (REM) sleep continuity, and sleep efficiency when using polysomnography [39].

Another study found associations between sleep duration, PA and dietary behaviors. Sleep duration < 8 hours associated with higher likelihood of fruit, vegetable, consumption. Moderate PA, muscular-strengthening physical activity, and with a lower likelihood of cigarette, alcohol use also, sweets intake, Western fast food intake, and breakfast skipping [40].

There is observed relationship between sleep duration, physical activity and body mass index (BMI) in youth. Study results showing unique (inverse) association among age groups 5-24 years, the estimated impact of replacing 60 min/day sedentary behavior (SB) with the same amount of moderate to vigorous physical activity (MVPA). In young people (age group 20-24), the impact of replacing 30 min/day of SB with MVPA resulted to in an estimated - 1 BMI units decrease [41,42, 44]. Also, increased sleep disturbances are often seen with a diagnosis of obesity or T2D [43].

Moreover, results of some studies pointing to the conclusion, that exercise promotes increased sleep efficiency and duration regardless of the mode and intensity of activity, especially in population suffering from diseases. Despite the magnitude of sleep problems in contemporary society, the physiological function of sleep in regulating normal hormonal and metabolic processes is not fully recognized. However, based on numerous studies sleep and exercise exert substantial positive effects on one another. Despite on all this, we have mounting evidence that PA is an effective intervention for those who do not experience adequate sleep quantity or quality [37].

Changes in PA corresponding with changes in sleep disturbance. A negative bidirectional relationship between sleep disturbance and PA over time was also found. These results suggest that increasing PA may be an effective strategy for improving the quality of sleep in youth. [45]. Further authors observed, that the relationship between a sleep disorder and PA is bidirectional [45,46]. What may start as a sleep disorder results in greater fatigue throughout the day and thus lowers the likelihood of exercising [45].

However, some studies of young adults, primarily from college campuses, reveal mixed effects of exercise on sleep. Variations in the methods of these investigations make it difficult to compare the findings across studies. Harp found that age, gender, and body composition are significantly related to sleep quality [47]. This may explain why young may see benefits to sleep duration while middle-aged adults may not. Nevertheless, it is worth discussing the differences as they may allude to further understanding of the sleep-exercise relationship [40].

Despite different views on relationship between sleep and PA there is a mounting evidence that PA is an effective intervention for those who do not experience adequate sleep quantity or quality. However, further research needs to explore the biological, psychological and social mechanism that modulate the dynamic interplay between these two aspects of human lifestyle.

## DISCUSSION

Taken together, data evidence provides conclusive evidence that lack of PA alone is sufficient to increase chronic diseases and death. Such data, therefore, empowers health care and healthy lifestyle providers to prescribe PA activity as primary preventive measure.

Physical inactivity is a cause of chronic disease in any segment of the population. Furthermore, documented health benefits by prevention of physical inactivity in youth [48] include increased physical fitness (both cardiorespiratory system and muscle strength), reduced body fatness, favorable cardiovascular and metabolic disease risk factors, enhanced bone health, and reduced symptoms of depression and anxiety. Studies indicates [49,50] that PA diminishes mortality by 30% alternatively, physical inactivity increases mortality by 30% later on. Taking into consideration that in most economically developed countries 58%-90% of youth aged 6-19 years old, respectively, do not meet the recommended 60 min of daily PA [51,52].

Modern humans have been able to engineer most PA out of daily life. Now we have a choice not to be physical active. Conclusive and overwhelming scientific evidence, largely ignored and prioritized as low, exists for physical inactivity as a primary and actual cause of most chronic diseases. Thus, longer-term health was also engineered out with the successful removal of PA as a necessity for immediate survival. The comprehensive evidence clearly establishes that lack of PA affects almost every, organ, and system in the body causing sedentary dysfunction and accelerated death. The

massive multifactorial nature of dysfunction caused by sedentarism means that just as food and reproduction remain as requirements for long-term continued human existence, PA is also a requirement to maximize health span and lifespan. The only valid scientific therapeutic approach to completely counter sedentary dysfunction is primary prevention PA itself [56].

We have to be aware that mechanisms of physical inactivity and activity differ, they are not merely mirror images of each other as is commonly considered. For example, inactivity results in immediate negative remodeling of the blood vessel, while activity required 4-6 weeks to positively remodel the blood vessel [53].

Considering that Booth et al [54] describe exercise as the primary prevention against 35 chronic health conditions especially CVD and related disorders, this drastic reduction in leisure time PA may contribute to the substantial prevalence of lifestyle diseases throughout our society. Literature on subject, indicate, that optimal functioning improvement considering the individual context of each patient (or others) is a common objective of the interdisciplinary therapeutic interaction [57-58].

Taken together, above mentioned data provide conclusive evidence that physical inactivity alone is sufficient to increase chronic disease and death. Such data, therefore, empowers health professionals, trainers and other competent to prescribe PA as primary preventative measure.

## CONCLUSIONS

Our findings draw attention to the relationship between PA and selected lifestyle determinants of young people. Despite the above assertion, we have only limited amount of data available as regards the interaction of these variables in their conditionality, influence and intrinsic coupling of such complex variables. Following the facts presented, our ambition is to educate young people to gain awareness of their own behavior as a precursor towards the overall balance of an individual's inner environment.

It is needful to carry out further research in order to highlight the importance of PA in the context of a healthy lifestyle. At a certain level, it concerns the synthesis of biological, psychological and social aspects and their causality in reality. All things considered, a healthy lifestyle is not merely beneficial for the individual himself, but also for his near and distant surroundings, i.e. the society as a whole.

On the very end we can utter, that the scientific and technical expertise to appreciate the complexity of exercise-inactivity and chronic diseases is limited within the scientific community. Thus, policy makers must be careful in their selection of scientists to enable public policy related to physical activity, quality of life and lifestyle.

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